Cisco Secure Workload User Guide SaaS, Release 3.8

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CHAPTER 1

Get Started

Cisco Secure Workload Overview

Today’s networks include applications running in a hybrid multicloud environment that uses bare-metal, virtualization, and cloud-based and container-based workloads. The key challenge in such an environment is improving application and data security without compromising on agility. Cisco Secure Workload provides comprehensive workload protection by bringing security closer to applications and tailoring the security posture that is based on the application behavior. Secure Workload achieves this tailoring by using advanced machine learning and behavior analysis techniques. It provides a ready-to-use solution to support the following security use cases:

- Implement a zero-trust model with microsegmentation policies that allow only traffic required for business purposes.
- Identify anomalies on the workloads using behavioral baselining and analysis.
- Detect Common Vulnerabilities and Exposures in the software packages that are installed on the servers.
- Recommend quarantining of servers if vulnerabilities persist after enforcing policies and blocking communication.

About Workloads

In Cisco Secure Workload, a workload is an IP address; hosts that have software agents installed are called workloads and hosts that do not have an agent installed on them are called IP addresses.

Quick Start Wizard

An optional wizard can guide you through creating the first branch of your scope tree, which is a first step toward generating and enforcing policies for an application you choose. The wizard introduces the concepts and benefits of labels and scopes.

The following user roles can access the wizard:

- Site administrator
- Technical support
- Root scope owner

To access the wizard, do any one of the following:

- Sign in to Cisco Secure Workload.
- Click the link in the blue banner. The blue banner appears at the top of all pages.
- Choose **Overview** from the main menu.

Note You cannot access the wizard if scopes are already defined in **Organize** > **Scopes and Inventory**. Delete the existing scopes to access the wizard.

Get Started with Segmentation and Microsegmentation

Use the high-level procedures given here to set up segmentation and microsegmentation policies using Cisco Secure Workload.

General Process for Implementing Microsegmentation

The intent of segmentation and microsegmentation is to allow only the traffic that is required for business purposes and to block all other traffic.

Procedure

Step 1 Ensure that Secure Workload supports the platforms and versions that your workloads are running on, and the systems that provide essential information to your policies. See Secure Workload Compatibility Matrix.

Step 2 Install agents on workloads.

Agents gather flow data and other information that is requiredthat is for Secure Workload to group workloads and determine appropriate policies. The agents also enforce approved policies. For more information, including links to lists of supported platforms and requirements, see Deploying Software Agents.

Step 3 Gather or upload labels that describe your workloads.

Labels let you easily understand the purpose of each workload and provide other key information about each workload.

You need this information to group workloads, apply appropriate policies, and understand the policies that Secure Workload suggests. Labels are the foundation of selfmaintaining groups that simplify policy management. For more information, see Workload Labels and Importing Custom Labels, on page 346.

Step 4 Create a scope tree based on your workload labels.

The logical groups of workloads that labels help you create are called scopes, and a well-chosen set of labels helps you create a hierarchical map of your network called a scope tree. This hierarchical view of the workloads on your network is key to efficiently creating and maintaining policies. The hierarchical view enables you to create a policy once and apply it automatically to every workload on that branch of the tree. The view also lets you delegate responsibility for certain applications (or parts of your network) to people who have the expertise needed to determine the correct policies for those workloads.

You can query workloads and group them into scopes based on their labels. For example, you can create a scope called Email-app that includes all of the workloads that have the labels Application = Email-app and Environment = Production. You can create a parent scope for the Application = Email-app scope by using the query Environment = Production. The Production scope includes the production Email-app and all other workloads labeled with Environment = Production.

For more information, see Scopes and Inventory.

If you have not yet created any scopes, you can use the Quick Start wizard to create a scope tree. For more information, see Quick Start Wizard, on page 1.

Step 5 Create a workspace for each scope for which you want to create policies.

The workspace is where you manage policies for the workloads in that scope. For more information, see Use Workspaces to Manage Policies.

Step 6 Manually create policies that apply across your network.

For example, you might want to allow access from all internal workloads to your NTP server, and deny all external traffic, or deny access from all non-internal hosts unless explicitly permitted. Policies can be absolute, meaning that they cannot be overridden by more specific policies, or default, where they can be overridden by more specific policies.

For more information, see Manually Create Policies, on page 424.

Secure Workload has policy templates that make policy creation easier. For more information, see Policy Templates, on page 428.

You can enforce manually created policies without waiting for the policies to be discovered. For more information, see Enforce Policies, on page 534.

Step 7 Automatically discover policies based on existing traffic patterns.

Secure Workload analyzes traffic between workloads, groups workloads based on their behavior, and suggests a set of policies that are intended to allow the traffic that your organization needs, so you can block all other traffic.

Analysis of more data flow over a longer time period leads to more accurate policy suggestions.

You can discover policies iteratively. (There is more information about this later in this procedure.)

a. Discover policies for a branch of your scope tree.

If you are just getting started, you can have temporary set of policies in place and provide protection against future threats.

b. Discover policies for single scopes.

Typically, you will do this for scopes at or near the bottom of your scope tree. These scopes usually include workloads for a single application.

For more information, see Discover Policies Automatically and Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435.

Step 8 Review and analyze your policies.

Examine your policies carefully to ensure that they have the effects you expect and that there are no unintended side effects.

Work with subject-matter experts and application owners in your organization to understand the needs of the organization and the appropriateness of suggested policies.

a) Review the policies and clusters that Secure Workload has suggested.

(Clusters are groups of workloads within a scope that are closely related and may warrant policies that are more tailored than policies targeted at the entire scope. For more information, see Grouping Workloads: Clusters and Inventory Filters, on page 483.)

For more information, see Review Automatically Discovered Policies, on page 516.

b) Analyze your policies to see how they affect actual traffic on your network.

Use policy analysis and other tools in Secure Workload to confirm that your policies allow the traffic your organization needs in order to conduct business. For more information, see Live Policy Analysis and Policy Visual Representation, on page 519.

As you analyze the results of your policies, keep the following points in mind:

- Policies in workspaces for higher scopes of a branch might affect the workloads of lower scopes of the branch. For more information, see Policy Inheritance and the Scope Tree, on page 422.
- Microsegmentation creates a miniature firewall around each workload. In order for a connection to be successful, both consumer and provider of the transaction must have policies allowing the traffic. If both workloads are not in the same scope, creating these policies may require extra steps. For more information, see When Consumer and Provider Are In Different Scopes: Policy Options, on page 500.

Step 9 Iteratively discover policies as needed.

More traffic flow produces more accurate policy suggestions. For example, for a monthly report even three weeks worth of data may not capture all essential traffic. Continue to discover policies and review and analyze new policy suggestions. Each discovery run suggests policies based on the current traffic flows.

You can also iteratively discover polices to capture changes in policy discovery settings and approved clusters. For more information, see Iteratively Revise Policies, on page 460.

Before you re-run automatic policy discovery, ensure that you approve policies and clusters that you want to retain.

Each time you re-discover policies, you must review and analyze them.

Step 10 When you are ready, enforce policies.

After you have determined that the policies associated with a workspace (and hence, the associated scope) are appropriate and will block unwanted traffic while not interrupting essential services, you can enforce those policies.

You can iteratively enforce policies; for example, you might initially enforce just the manually created policies in scopes near the top of your tree, then over time, enforce discovered policies in scopes lower in the tree.

For more information, see Enforce Policies, on page 534.

Set Up Microsegmentation for Workloads Running on Bare Metal or Virtual Machines

Procedure

Step 1 Gather the IP addresses of workloads on your network.

For each workload, you will also want the application name, application owner, environment (production or non-production), and other information such as geographical region that will determine the policies to be applied..

If you do not have a Configuration Management Database (CMDB), you can collect this information in a spreadsheet.

To get started, choose a single application that you can focus on.

Step 2 Install agents on supported bare-metal-based or virtual workloads.

For more information, see Deploying Software Agents.

Step 3 Upload labels that describe these workloads.

For more information, see Workload Labels and Importing Custom Labels, on page 346.

Optionally, you can run the quick start wizard to create labels and the first branch of your scope tree. For more information about the wizard, see Quick Start Wizard.

Step 4 If needed, create or update your scope tree based on your labels.

For more information, see Scopes and Inventory.

Step 5 Create a workspace for each scope for which you want to apply policies.

For more information, see Use Workspaces to Manage Policies.

Step 6 Create manual policies that apply across your network.

For more information, see Manually Create Policies, on page 424.

Step 7 For more information on platform-specific policies, see Platform-Specific Policies, on page 468.

Step 8 Automatically discover policies in workspaces associated with lower-level scopes.

For more information, see Discover Policies Automatically and subtopics.

Step 9 Review and analyze the suggested policies.

For more information, see Review and Analyze Policies, on page 516 and subtopics.

Step 10 Iteratively discover policies as needed.

For more information, see Iteratively Revise Policies, on page 460 and subtopics.

Step 11 When you are ready, enforce the policies.

You can enforce policies when you are satisfied with the behavior of the policies in each workspace.

You must enforce policies both in the workspace and in the agent configuration.

For more information, see Enforce Policies, on page 534.

Set Up Microsegmentation for Cloud-Based Workloads

Procedure

Step 1 Install agents on your cloud-based workloads, if required.

Cloud connectors provide VPC/VNet level granularity in policy discovery and enforcement. Install agents on supported platforms if you require policy discovery and enforcement at a more granular level.

Install agents based on the operating system on which your cloud service is running. For more information, see Deploying Software Agents.

Step 2 Set up cloud connectors to gather labels and flow data.

For more information, see:

- AWS Connector.
- Azure Connector.
- GCP Connector

Step 3 Create workspaces for the scopes created by the connector.

For more information, see Use Workspaces to Manage Policies.

Step 4 Automatically discover policies.

Discover policies for each VPC/VNet-defined scope, and if applicable, for more granular scopes.

For more information, see Discover Policies Automatically.

Step 5 Review and analyze the suggested policies.

See Review and Analyze Policies, on page 516 and subtopics.

Step 6 Iteratively discover policies as needed.

See Iteratively Revise Policies, on page 460 and subtopics.

Step 7 Approve and enforce policies for each scope.

You must enable enforcement in the applicable workspace and in the connector for each VPC or VNet, and for any agents installed on individual workloads.

- For more information, see Enforce Policies, on page 534 and subtopics.
- For more information on:

- AWS-based workloads, see Best Practices When Enforcing Segmentation Policy for AWS Inventory.
- Azure-based workloads, see Best Practices When Enforcing Segmentation Policy for Azure Inventory.
- GCP-based workloads, see Best Practices When Enforcing Segmentation Policy for GCP Inventory.

Set Up Microsegmentation for Kubernetes-Based Workloads

Procedure

Step 1 Install agents on Kubernetes-based workloads. Ensure that you check the requirements and prerequisites.

For more information, see Installing Kubernetes or OpenShift Agents for Deep Visibility and Enforcement.

Agents are automatically installed on all future workloads managed by the applicable Kubernetes service.

Step 2 Gather labels for your Kubernetes-based workloads.

For more information on:

- Plain-vanilla Kubernetes and OpenSource workloads, see External Orchestrators, on page 131 and Kubernetes/OpenShift, on page 148.
- Elastic Kubernetes Services (EKS) Running on Amazon Web Services (AWS), see AWS Connector, on page 239 and Managed Kubernetes Services Running on AWS (EKS), on page 250.
- Azure Kubernetes Services (AKS), see Azure Connector, on page 252 and Managed Kubernetes Services Running on Azure (AKS), on page 259
- Google Kubernetes Engine (GKE) running on Google Cloud Platform (GCP), see Managed Kubernetes Services Running on GCP (GKE), on page 268.

Step 3 Create or update your scope tree based on your labels.

For more information, see Scopes and Inventory.

Step 4 Create a workspace for each scope for which you want to apply policies.

For more information, see Use Workspaces to Manage Policies.

Step 5 Automatically discover policies for each low-level scope.

For more information, see Discover Policies Automatically.

Step 6 For more information on applicable additional options, see Platform-Specific Policies, on page 468.

Step 7 Review and analyze the suggested policies.

For more information, see Review and Analyze Policies, on page 516.

Step 8 Iteratively discover, review, and analyze policies as needed.

For more information, see Iteratively Revise Policies, on page 460.

Step 9 When you are ready, approve and enforce policies for each scope.

You must enable policy enforcement in the workspace and for the agents.

For more information, see Enforce Policies, on page 534 and Enforcement on Containers, on page 542.

Deploying Software Agents

Related Topics

Workload Labels
Scopes and Inventory
Deploying Software Agents
Secure Workload Quick Start Guide
Segmentation

CHAPTER 2

Software Agents

A Secure Workload software agent is a lightweight piece of software that you install on your workloads. Its purpose is to:

- Collect host information such as network interfaces and active processes running in the system.
- Monitor and collect network flow information.
- (When enabled) Enforce security policies by setting firewall rules on the installed hosts.

Agents automatically update your Secure Workload inventory when interface addresses change.

You do not need to install agents on end-user (employee) computers.

Deploying Software Agents

Note Installer scripts downloaded from LDAP or AD accounts with automatic role mapping fail once you are logged out. To give the installer scripts uninterrupted access to the cluster, enable Use Local Authentication.

On deployment, the agent is assigned a unique identity by the Secure Workload cluster, based on a set of parameters specific to the host where the agent is running. If the host name and the BIOS UUID are a part of the set of parameters, you may encounter the following issues:

1. Registration failure when cloning a virtual machine and retaining the BIOS UUID and host name, and when instant cloning a VDI. The registration failure happens because Secure Workload already has a registered software agent using the same parameters set. You can delete the registered agent using OpenAPI. In some cases, a duplicate BIOS UUID configured during startup is changed by VMware after a certain period of time. Agent registration recovers once the Cisco Secure Workload services are restarted.

2. A new identity is generated for the agent if the host name is changed and the host rebooted. The redundant or the old agent is marked as inactive after a certain period of time. For more information, see Troubleshooting Software Agents, on page 104.

Supported Platforms and Requirements

For information on supported platforms and additional requirements for software agents, see:

- The release notes for your release, see Release Notes.
- The agent install wizard in the Secure Workload web portal: In the navigation menu, click **Manage** > **Workloads** > **Agents**, then click the **Installer** tab. Choose an installation method, a platform, and if applicable, an agent type to see supported platform versions.
- Support Matrix for additional dependencies.
- The following sections for details on additional requirements for each platform and agent type.

Installing Linux Agents for Deep Visibility and Enforcement

Requirements and Prerequisites to Install Linux Agents

- See Supported Platforms and Requirements.
- Root privileges to install and execute the services.
- 1-GB storage space for agent and log file.
- Security exclusions are configured on the security applications that are monitoring the host to prevent these applications from blocking agent installation or agent activity. For more information, see Security Exclusions.
- A special user, **tet-sensor**, is created in the host where the agent is installed. If PAM or SELinux is configured on the host, tet-sensor user must be granted appropriate privileges for executing the tet-sensor process and making connections to collectors. If an alternative install directory is provided and SELinux is configured, ensure that execution is allowed for that location.
- You must be able to use the unzip command, if the agent is installed using the AutoInstall (installer script) method.

Supported Methods to Install Linux Agents

Methods to install a Linux agent for deep visibility and enforcement:

- Install Linux Agent Using the Agent Script Installer Method, on page 11
- Install Linux Agent using the Agent Image Installer Method, on page 13

Install Linux Agent Using the Agent Script Installer Method

We recommend the installer script method to deploy Linux agents for deep visibility and enforcement.

Note

- The installed Linux agent supports both deep visibility and enforcement.
- By default, enforcement is disabled. To enable enforcement, see Create an Agent Configuration Profile, on page 66.

To install a Linux agent using the script installer method:

Procedure

Step 1 Navigate to Agent Installation methods:

- If you are a first-time user, launch the **Quick Start Wizard** and click **Install Agents**.
- In the left pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Script Installer**.

Step 3 From the **Select Platform** drop-down list, choose **Linux**.

To view the supported Linux platforms, click **Show Supported Platforms**.

Step 4 Choose the tenant to install the agents.

Note Secure Workload SaaS clusters do not require selecting a tenant.

Step 5 If you want to assign labels to the workload, choose the label keys and enter label values.

When the installed agent reports IP addresses on the host, the installer CMDB labels selected here, along with other uploaded CMDB labels that have been assigned to IPs reported by this host, would be automatically assigned to the new IP address. If there are conflicts between uploaded CMDB labels and installer CMDB labels:

- Labels assigned to an exact IP address take precedence over labels assigned to the subnet.
- Existing labels assigned to an exact IP address take precedence over installer CMDB labels.

Step 6 If an HTTP proxy is required to communicate with Secure Workload, choose **Yes**, and then enter a valid proxy URL.

Step 7 In the **Installer expiration** section, select an option:

- No expiration: The installer script can be used multiple times.
- One time: The installer script can be used only once.
- Time bound: You can set the number of days for which the installer script can be used.

- Number of deployments: You can set the number of times the installer script can be used.

Step 8 Click **Download** and save the file to the local disk.

Step 9 Copy the installer shell script on Linux hosts and run the following command to grant execute permission to the script: `chmod u+x tetration_installer_default_sensor_linux.sh`

Note The script name may differ depending on the selected agent type and scope.

Step 10 To install the agent, run the following command with root privileges:

```
./tetration_installer_default_sensor_linux.sh
```

Note If an agent is already installed on the tenant, you cannot proceed with the installation.

We recommend running the precheck, as specified in the script usage details.

Linux installer script usage details:

```
bash tetration_linux_installer.sh [--pre-check] [--skip-pre-check=<option>] [--no-install]
 [--logfile=<filename>] [--proxy=<proxy_string>] [--no-proxy] [--help] [--version]
[--sensor-version=<version_info>] [--ls] [--file=<filename>] [--save=<filename>] [--new]
[--reinstall] [--unpriv-user] [--force-upgrade] [--upgrade-local]
[--upgrade-by-uuid=<filename>] [--basedir=<basedir>] [--logbasedir=<logbdir>]
[--tmpdir=<tmp_dir>] [--visibility] [--golden-image]
  --pre-check: run pre-check only
  --skip-pre-check=<option>: skip pre-installation check by given option; Valid options
include 'all', 'ipv6' and 'enforcement'; e.g.: '--skip-pre-check=all' will skip all
pre-installation checks; All pre-checks will be performed by default
  --no-install: will not download and install sensor package onto the system
  --logfile=<filename>: write the log to the file specified by <filename>
  --proxy=<proxy_string>: set the value of CL_HTTPS_PROXY, the string should be formatted
as http://<proxy>:<port>
  --no-proxy: bypass system wide proxy; this flag will be ignored if --proxy flag was
provided
  --help: print this usage
  --version: print current script's version
  --sensor-version=<version_info>: select sensor's version; e.g.: '--sensor-version=3.4.1.0';
 will download the latest version by default if this flag was not provided
  --ls: list all available sensor versions for your system (will not list pre-3.1 packages);
 will not download any package
  --file=<filename>: provide local zip file to install sensor instead of downloading it
from cluster
  --save=<filename>: download and save zip file as <filename>
  --new: remove any previous installed sensor; previous sensor identity has to be removed
from cluster in order for the new registration to succeed
  --reinstall: reinstall sensor and retain the same identity with cluster; this flag has
higher priority than --new
  --unpriv-user=<username>: use <username> for unpriv processes instead of tet-sensor
  --force-upgrade: force sensor upgrade to version given by --sensor-version flag; e.g.:
'--sensor-version=3.4.1.0 --force-upgrade'; apply the latest version by default if
--sensor-version flag was not provided
  --upgrade-local: trigger local sensor upgrade to version given by --sensor-version flag:
 e.g.: '--sensor-version=3.4.1.0 --upgrade-local'; apply the latest version by default if
--sensor-version flag was not provided
  --upgrade-by-uuid=<filename>: trigger sensor whose uuid is listed in <filename> upgrade
to version given by --sensor-version flag; e.g.: '--sensor-version=3.4.1.0
--upgrade-by-uuid=/usr/local/tet/sensor_id'; apply the latest version by default if
--sensor-version flag was not provided
  --basedir=<base_dir>: instead of using /usr/local use <base_dir> to install agent. The
full path will be <base_dir>/tetration
```

```
  --logbasedir=<log_base_dir>: instead of logging to /usr/local/tet/log use <log_base_dir>.
 The full path will be <log_base_dir>/tetration
  --tmpdir=<tmp_dir>: instead of using /tmp use <tmp_dir> as temp directory
  --visibility: install deep visibility agent only; --reinstall would overwrite this flag
if previous installed agent type was enforcer
  --golden-image: install Cisco Secure Workload Agent but do not start the Cisco Secure
Workload Services; use to install Cisco Secure Workload Agent on Golden Images in VDI
environment or Template VM. On VDI/VM instance created from golden image with different
host name, Cisco Secure Workload Services will work normally
```

Note

- Ubuntu uses the native .deb package, and new installations and reinstallations switch to this package type. Upgrades from previous versions continue with the .rpm package.
- Ubuntu .deb package is installed under `/opt/cisco/tetration`.
- There is no relocation support for the .deb package and so the –basedir option is not supported for Ubuntu.

Install Linux Agent using the Agent Image Installer Method

We recommend the automated installer script method for installing Linux agents. Use the image installer method if you have a specific reason for using this manual method.

Prerequisite:

Configure the ACTIVATION_KEY and HTTPS_PROXY in the user.cfg file for SaaS clusters and when you are installing the agent on a non-default tenant of on-premises clusters with multiple tenants. For more information, see (Manual Installations Only) Update the User Configuration File.

To install a Linux agent using the agent image method:

Procedure

Step 1 Navigate to Agent Installation Methods:

- If you are a first-time user, launch the Quick Start wizard and click **Install Agents**.
- In the navigation pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Image Installer**.

Step 3 In the **Platform** field, enter Linux.

Step 4 Enter the required agent type and the version of the agent, and then from the results, download the required version of the agent.

Step 5 Copy the RPM package to all the Linux hosts for deployment.

Note If the agent is already installed on the host, do not reinstall the agent. To upgrade the agent, see Upgrading Software Agents section.

Step 6 Based on your platform, run the RPM commands with root privileges.

- For RHEL/CentOS/Oracle platforms, run command: `rpm -ivh <rpm_filename>`
- For Ubuntu platform:

- To retrieve the dependency list and ensure all dependencies are met, run the command: `rpm -qpR <rpm_filename>`
- Install the agent with "–nodeps" option by running the command: `rpm -ivh \\--nodeps <rpm filename>`

Verify Linux Agent Installation

Procedure

Run command `sudo rpm -q tet-sensor`.
Verify that you have a single entry as the output, which confirms that a Linux agent is installed on the host.

Sample output: `tet-sensor-3.1.1.50-1.el6.x86_64`

The specific output may differ depending on the platform and architecture.

Installing Windows Agents for Deep Visibility and Enforcement

Requirements and Prerequisites for Installing Windows Agent

- See Supported Platforms and Requirements
- Administrator privileges are required for install and service execution.
- Npcap must be installed on workloads running Windows 2008 R2 or when the installed agent version is prior to version 3.8. If the Npcap driver is not already installed, the recommended Npcap version will be installed silently by the agent after the service starts. See Npcap version information.
- Storage requirement for agent and log files: 1 GB.
- Required Windows services: If your Windows hosts have been security that is hardened or have deviated from the default configuration as shipped from Microsoft, you may have some Windows services disabled that are required for successful agent installation. See Required Windows Services.
- Prevent other security applications from blocking agent installation or agent activity by configuring security exclusions on the security applications that are monitoring the host. See Security Exclusions.

Supported Methods to Install Windows Agents

There are two methods to install an agent on Windows platforms for deep visibility or enforcement:

- Install Windows Agent using the Agent Script Installer Method, on page 15
- Install Windows Agent using the Agent Image Installer Method, on page 17

You can also install using a golden image. See Deploying Agents on a VDI Instance or VM Template (Windows).

Install Windows Agent using the Agent Script Installer Method

The installer script is the recommended method to deploy agents on Windows platforms for deep visibility or enforcement.

Note

- The installed Windows agent supports both deep visibility and enforcement.
- By default, enforcement is disabled. To enable enforcement, see Create an Agent Configuration Profile, on page 66.

To install a Windows agent using the script installer method:

Procedure

Step 1 To navigate to the agent installation methods:

- For a first-time user, launch the Quick Start wizard and click **Install Agents**.
- In the left pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Script Installer**.

Step 3 From the **Select Platform** drop-down menu, choose **Windows**.

To view the supported Windows platforms, click **Show Supported Platforms**.

Step 4 Choose the tenant to install the agents.

Note Selecting a tenant is not required in Secure Workload SaaS clusters.

Step 5 (Optional) To assign labels to the workload, choose the label keys and enter label values.

When the installed agent reports IP addresses on the host, the installer CMDB labels selected here, along with other uploaded CMDB labels that have been assigned to IPs reported by this host, would be assigned to the new IP address automatically. If there are conflicts between uploaded CMDB labels and installer CMDB labels:

- Labels assigned to exact IP address take precedence over labels assigned to the subnet.
- Existing labels assigned to exact IP address take precedence over installer CMDB labels.

Step 6 If HTTP proxy is required to communicate with Secure Workload, choose **Yes**, and then enter a valid proxy URL.

Step 7 Under the **Installer expiration** section, select one from the available options:

- No expiration: The installer script can be used multiple times.
- One time: The installer script can be used only once.
- Time bounded: You can set the number of days the installer script can be used.
- Number of deployments: You can set the number of times the installer script can be used.

Step 8 Click **Download** and save the file to local disk.

Step 9 Copy the installer PowerShell script to all the Windows hosts for deployment and run the script with administrative privileges.

Note

- Depending on the system settings, the command `Unblock-File` may need to be run before other commands.
- The script does not run if the agent is already installed on the tenant.

We recommend running the pre-check, as specified in the script usage details.

Windows installer script usage details:

```
# powershell -ExecutionPolicy Bypass -File tetration_windows_installer.ps1 [-preCheck]
[-skipPreCheck <Option>] [-noInstall] [-logFile <FileName>] [-proxy <ProxyString>] [-noProxy]
 [-help] [-version] [-sensorVersion <VersionInfo>] [-ls] [-file <FileName>] [-save <FileName>]
 [-new] [-reinstall] [
-npcap] [-forceUpgrade] [-upgradeLocal] [-upgradeByUUID <FileName>] [-visibility]
[-goldenImage] [-installFolder <Installation Path>]
  -preCheck: run pre-check only
  -skipPreCheck <Option>: skip pre-installation check by given option; Valid options include
 'all', 'ipv6' and 'enforcement'; e.g.: '-skipPreCheck all' will skip all pre-installation
 checks; All pre-checks will be performed by default
  -noInstall: will not download and install sensor package onto the system
  -logFile <FileName>: write the log to the file specified by <FileName>
  -proxy <ProxyString>: set the value of HTTPS_PROXY, the string should be formatted as
http://<proxy>:<port>
  -noProxy: bypass system wide proxy; this flag will be ignored if -proxy flag was provided

  -help: print this usage
  -version: print current script's version
  -sensorVersion <VersionInfo>: select sensor's version; e.g.: '-sensorVersion 3.4.1.0.win64';
 will download the latest version by default if this flag was not provided
  -ls: list all available sensor versions for your system (will not list pre-3.1 packages);
 will not download any package
  -file <FileName>: provide local zip file to install sensor instead of downloading it from
 cluster
  -save <FileName>: downloaded and save zip file as <FileName>
  -new: remove any previous installed sensor; previous sensor identity has to be removed
from cluster in order for the new registration to succeed
  -reinstall: reinstall sensor and retain the same identity with cluster; this flag has
higher priority than -new
  -npcap: overwrite existing npcap
  -forceUpgrade: force sensor upgrade to version given by -sensorVersion flag; e.g.:
'-sensorVersion 3.4.1.0.win64 -forceUpgrade'; apply the latest version by default if
-sensorVersion flag was not provided
  -upgradeLocal: trigger local sensor upgrade to version given by -sensorVersion flag; e.g.:
 '-sensorVersion 3.4.1.0.win64 -upgradeLocal'; apply the latest version by default if
-sensorVersion flag was not provided
  -upgradeByUUID <FileName>: trigger sensor whose uuid is listed in <FileName> upgrade to
version given by -sensorVersion flag; e.g.: '-sensorVersion 3.4.1.0.win64 -upgradeByUUID
"C:\\Program Files\\Cisco Tetration\\sensor_id"'; apply the latest version by default if
-sensorVersion flag was not provided
  -visibility: install deep visibility agent only; -reinstall would overwrite this flag if
 previous installed agent type was enforcer
  -goldenImage: install Cisco Secure Workload Agent but do not start the Cisco Secure
Workload Services; use to install Cisco Secure Workload Agent on Golden Images in VDI
environment or Template VM. On VDI/VM instance created from golden image with different
host name, Cisco Secure Workload Services will work normally
  -installFolder: install Cisco Secure Workload Agent in a custom folder specified by
```

```
-installFolder e.g.: '-installFolder "c:\\custom sensor path"'; default path is "C:\Program
 Files\Cisco Tetration"
```

Install Windows Agent using the Agent Image Installer Method

We recommend that the installer script method (automated) is used to install the Windows agents, unless you have a specific reason to install the agent manually using the Agent Image method.

Note Do not manually deploy an older MSI agent version when an existing agent is already running on the host.

Site-related files in the package:

- **ca.cert**—Mandatory—CA certificate for sensor communications.
- **enforcer.cfg**—Mandatory only when installing enforcement sensor—Contains configuration of enforcement endpoints.
- **sensor_config**—Mandatory—Configuration for deep visibility sensor.
- **sensor_type**—Type of the sensor (enforcement or deep visibility).
- **site.cfg**—Mandatory—Global site endpoint configuration.
- **user.cfg**—Mandatory for SaaS—Sensor activation key and proxy configuration.

Prerequisite:

For SaaS clusters and when you are not installing under the default tenant on on-premises clusters with multiple tenants, you must configure the ACTIVATION_KEY and HTTPS_PROXY in the user.cfg file. For more information, see (Manual Installations Only) Update the User Configuration File.

To install a Windows agent using the agent image method:

Procedure

Step 1 To navigate to the agent installation methods:

- For a first-time user, launch the Quick Start wizard and click **Install Agents**.
- In the left pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Image Installer**.

Step 3 In the **Platform** field, enter Windows.

Step 4 Enter the required agent type and the version of the agent, and then from the results, download the required version of the agent.

Step 5 Copy the *tet-win-sensor<version>.win64-<clustername>.zip* file to all the Windows hosts for deployment.

Step 6 With administrative privileges, extract the ZIP file.

Step 7 In the extracted folder, run the following command to install the agent: `msiexec.exe /i TetrationAgentInstaller.msi`

Additionally, the following options are available for MSI installer.

Table 1: Available Options for MSI Installer

Options	Description
agenttype=<AgentType>	*AgentType* should either be *sensor* or *enforcer*, depending on whether enforcement is required. By default, content of sensor_type file is checked by the installer in same folder and overwrites the passed parameter. However, if agent is installed in */quiet* mode, this option is required.
overwritenpcap=yes	For Windows 2008 R2, by default, the agent will not attempt to upgrade Npcap if Npcap already exists. Pass this parameter to upgrade the existing Npcap. If this option is used, subsequent agent auto-upgrades will also upgrade Npcap to newer supported versions.
nostart=yes	You must pass this parameter when installing the agent on a golden image in a VDI environment or VM template to prevent agent services (tetsensor and tetenforcer) from starting automatically. On VDI/VM instances created from the golden image with a different host name, these services will start automatically, as expected.
installfolder=<FullPathCustomFolder>	Use the parameter at the end of the install command to install agent in a custom folder.
serviceuser=<Service UserName>	Use the parameter at the end of the install command to configure service user. Default service user is “LocalSystem”. For local user, serviceuser=.\<Service UserName> For domain user, serviceuser=<domain_name>\<samaccount name> Service user must have local administrative privileges.
servicepassword=<Service UserPassword>	Use the parameter at the end of the install command to configure password for the service user. The password must be in plain-text format.
proxy=”<proxy_address>”	Use the parameter to set HTTPS proxy to access the Secure Workload cluster.
activationkey=<activation Key>	Use the parameter to specify tenant if agent is not installed under the default tenant.

Note

- If activation key and proxy options are used during manual installation, you do not need to manually configure *user.cfg*.
- For Windows OS other than Windows 2008 R2, when you upgrade to version 3.8, the installed Npcap is automatically uninstalled by the Windows agent.
- If the agent is already installed on the host, do not reinstall the agent. To upgrade the agent, see Upgrading Software Agents section.

Verify Windows Agent Installation

Procedure

Step 1 Verify that the folder `C:\\Program Files\\Cisco Tetration` (or the custom folder) exists.

Step 2 Verify that the service—*TetSensor*, for deep visibility, exists and is in the running state. Run command `cmd.exe` with administrative privileges.

Run command `sc query tetsensor`

Check state **Running**

Run command `sc qc tetsensor`

Check DISPLAY-NAME **Cisco Secure Workload Deep Visibility**

OR

Run command **services.msc**

Find name **Cisco Secure Workload Deep Visibility**

Check status **Running**

Step 3 Verify that the service—*TetEnforcer*, for enforcement, exist and is in the running state.

Run command `cmd.exe` with **Admin** privileges

Run command `sc query tetenforcer`

Check state **Running**

Run command `sc qc tetenforcer`

Check DISPLAY-NAME **Cisco Secure Workload Enforcement**

OR

Run command `services.msc`

Find name **Cisco Secure Workload Enforcement**

Check status **Running**

Verify Windows Agent in the Configured Service User Context

1. Verify that the service TetSensor (for deep visibility) and TetEnforcer (for enforcement) running in the config- ured service user context. TetSensor and TetEnforcer run in the same service user context.

   Run command `cmd.exe` with **Admin** privileges

   Run command `sc qc tetsensor`

   Check SERVICE_START_NAME **<configured service user>**

   Run command `sc qc tetenforcer`

   Check SERVICE_START_NAME **<configured service user>**

   OR

   Run command `services.msc`

   Find name **Cisco Secure Workload Deep Visibility**

   Check **Log On As** for the <configured service user>

   Find name **Cisco Secure Workload Enforcement**

   Check **Log On As** for the <configured service user>

   OR

   Run command `tasklist /v | find /i “tet”`

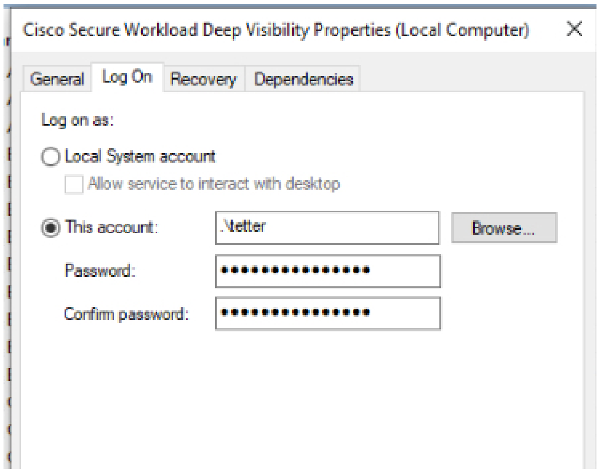
   Check the user context for the running processes (5th column)

Modify Service Account

To modify the service account after installing Windows Agents, use one of the following methods to modify the existing Deep Visibility and Enforcement services.

- Use **services.msc**.

  Figure 1: Modify Service Account based on services.msc Account

  Cisco Secure Workload Deep Visibility Properties (Local Computer)

  Log on as:

  ○ Local System account

  □ Allow service to interact with desktop

  ● This account: .\tetter

  Password: ••••••••••••••••

  Confirm password: ••••••••••••••••

- Use any third party application to configure the services.

- Use the following commands:
  1. Run cmd as an administrator.
  2. Modify the services using service account name by running the following commands:
     a. `sc config tetsensor obj= <service user name> password= <password>`
     b. `sc config tetenforcer obj= <service user name> password= <password>`
  3. Verify service configurations by running the following commands:
     a. `sc qc tetsensor`
     b. `sc qc tetenforcer`
  4. Restart the tetsensor and tetenforcer services by running the following commands:
     a. `sc stop tetsensor / tetenforcer`
     b. `sc start tetsensor / tetenforcer`

Deploying Agents on a VDI Instance or VM Template (Windows)

By default, agent services start automatically after agents are installed. When installing on a golden image, you must use installer flags to prevent these services from starting. When instances are cloned from the golden image, agent services will start automatically as expected.

Agent will not install Npcap on golden VMs, but will be automatically installed if needed on VM instances cloned from a golden image. For more information, see Windows Agent Installer and Npcap—For Windows 2008 R2.

Install the agent on a golden image in a VDI environment or VM template

Procedure

Step 1 Install the agent on a golden image in a VDI environment or VM template using an MSI installer or PowerShell installer script:

Using MSI installer with **nostart=yes**

- For more information, see Install Windows Agent using the Agent Image Installer Method, on page 17.
- msiexec.exe /<MSI installer> nostart=”yes” /quiet /norestart /l*v <installer_log_file> OR

OR

Using PowerShell installer with the **-goldenImage** flag.

- For more information, see Install Windows Agent using the Agent Script Installer Method, on page 15.

Step 2 Verify that the folder `C:\\Program Files\\Cisco Tetration` (or the custom folder) exists.

Step 3 Verify that the service TetSensor (for deep visibility) exists and is stopped:

Run command `cmd.exe` with **Admin** privileges

Run command `sc query tetsensor`

Check STATE **Stopped**

Step 4 Verify that the service TetEnforcer (for enforcement) exists and is stopped:

Run command **sc query tetenforcer**

Check STATE Stopped

Step 5 The VM template is now configured.

Step 6 Shut down the VM template.

Create a new VDI instance VM

Procedure

Step 1 Create a new VDI instance VM by cloning the VM template.

Step 2 Reboot the VDI instance VM.

Step 3 After rebooting the VDI instance VM, verify that the services – TetSensor (for deep visibility) and TetEnforcer (for enforcement) – are running in the configured service context. See Verify Windows Agent Installation.

Step 4 On the VDI instance VM, verify that the NPCAP driver is installed and running:

Run command `cmd.exe` with Admin privileges

Run command `sc query npcap`

Check STATE **Running**

Step 5 On the VDI instance VM, verify that the agent is registered using a valid sensor_id:

- Check the sensor_id file in installation folder.
- If the sensor_id starts with “uuid”, it is not a valid sensor_id.
- If the agent fails to register but the Secure Workload web interface shows that the agent is registered:
- Delete the agent using OpenAPI. For more information, see Deploying Software Agents.

Note

- Do not change the host name of the golden image or VM template.
- If the golden image or VM template is rebooted after installing the agent, Secure Workload services will start running after reboot.
- If the VDI instance VM fails to report network flows, see VDI instance VM does not report network flows

.

Windows Agent Installer and Npcap—For Windows 2008 R2

1. For supported Npcap versions, see the Support Matrix at https://www.cisco.com/go/secure-workload/requirements/agents.
2. Installation:

   If Npcap is not installed, the agent will install the supported version ten seconds after the service starts. If User has Npcap installed but is older than supported version, Npcap will not be upgraded. Upgrade/uninstall Npcap yourself, run the agent installer with option **overwritenpcap=yes**, or run installer script with **-npcap** to get the supported Npcap version. If Npcap driver is in use by any application, the agent will try to upgrade Npcap at a later time.
3. Upgrade:

   If Npcap is installed by Windows Agent and the version is older than the supported version, Npcap will be upgraded to the supported version ten seconds after the service starts. If Npcap driver is in use by any application, the agent will try to upgrade Npcap at a later time. If Npcap is not installed by Windows Agent, Npcap will not be upgraded.
4. Uninstall:

   If Npcap is installed by Windows Agent, it will uninstall Npcap. If Npcap is installed by user, but upgraded by the agent installer with **overwritenpcap=yes**, it will not be uninstalled. If Npcap driver is in use by any application, the agent will not uninstall Npcap.

Windows Agent Flow Captures—For all Windows OS excluding Windows 2008 R2

From the latest version of Windows agent, the agent uses ndiscap.sys (Microsoft in-built) driver and Events Tracing using Windows (ETW) framework to capture the network flows.

During the upgrade to the latest version:

- Agent switches to ndiscap.sys from npcap.sys.
- Agent installer will uninstall Npcap if:
  - Npcap is installed by the agent
  - Npcap is not in use
  - OS version is not Windows 2008 R2

After the agent services are started, the agent creates ETW sessions, CSW_MonNet, and CSW_MonDns (for DNS data), and initiates the capture of network flows.

Note On Windows 2012, network packets are parsed for DNS data.

Installing AIX Agents for Deep Visibility and Enforcement

Note Process tree, Package (CVE), and Forensic Event reporting features are not available on AIX. Additionally, some aspects of those features may not be available on specific minor releases of otherwise supported platforms due to OS limitations.

Requirements and Prerequisites for Installing AIX Agents

- See Supported Platforms and Requirements.
- Additional requirements for deep visibility:
    - Root privileges are required to install and execute the services.
    - Storage requirement for agent and log files: 500 MB.
    - Prevent other security applications from blocking agent installation or agent activity by configuring security exclusions on any security applications that are monitoring the host. See Security Exclusions.
    - AIX only supports flow capture of 20 net devices (6 net devices if version is AIX 7.1 TL3 SP4 or earlier). The deep visibility agent captures from a maximum of 16 network devices, leaving the other 4 capture sessions available for exclusive generic system usage (For example, tcpdump).
    - The deep visibilty agent does the following to ensure this behaviour:
        - The agent creates 16 bpf device nodes under the agents directory (/opt/cisco/tetration/chroot/dev/bpf0 - /opt/cisco/tetration/chroot/dev/bpf15)
        - tcpdump and other system tools using bpf will scan through the system device nodes (/dev/bpf0-/dev/bpf19) until they find an unused node (!EBUSY)
        - The agent created bpf nodes and system bpf nodes will share the same major/minor, with each major/minor only be opened by one instance (either tcpdump or agent)
        - The agent will not access the system device nodes, and not create them as tcpdump does (tcpdump-D will create /dev/bpf0. . . /dev/bpf19 if they do not exist).
    - Running iptrace on system will prevent in certain scenarios flow capture from tcpdump and deep visibilty agent. This is a known design issue and needs to be checked with IBM.
        - To check if this scenarios exists before installing the agent, run tcpdump. If error message is like **tcpdump: BIOCSETIF: en0: File exists** iptrace is blocking flow capture. Stopping iptrace will resolve the issue.
    - Not every deep visibility functionality is supported on AIX. Package and process accounting are among the ones not supported.
- Additional requirements for policy enforcement:
    - If IP Security Filter is enabled (i.e. smitty ipsec4), agent installation fails in pre-check. We recommend to disable IP Security Filter before installing agent.

- When IP security is enabled, while Secure Workload enforcer agent is running, it will be reported as an error and enforcement agent will stop enforcing. To disable IP Security Filter when enforcement agent is active, contact a customer service representative.

Install AIX Agent using the Agent Script Installer Method

Deep visibility or enforcement AIX agents can only be installed using the Agent Script Installation method.

Note

- The installed AIX agent supports both deep visibility and enforcement.
- By default, enforcement is disabled. To enable enforcement, see Create an Agent Configuration Profile, on page 66.

To install an AIX agent:

Procedure

Step 1 To navigate to the agent installation methods:

- For a first-time user, launch the Quick Start wizard and click **Install Agents**.
- In the left pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Script Installer**.

Step 3 From the **Select Platform** drop-down menu, choose **AIX**.

To view the supported AIX platforms, click **Show Supported Platforms**.

Step 4 Choose the tenant to install the agents.

Note Selecting a tenant is not required in Secure Workload SaaS clusters.

Step 5 (Optional) To assign labels to the workload, choose the label keys and enter label values.

When the installed agent reports IP addresses on the host, the installer CMDB labels selected here, along with other uploaded CMDB labels that have been assigned to IPs reported by this host, would be assigned to the new IP address automatically. If there are conflicts between uploaded CMDB labels and installer CMDB labels:

- Labels assigned to exact IP address take precedence over labels assigned to the subnet.
- Existing labels assigned to exact IP address take precedence over installer CMDB labels.

Step 6 If HTTP proxy is required to communicate with Secure Workload, choose **Yes**, and then enter a valid proxy URL.

Step 7 Under the **Installer expiration** section, select one from the available options:

- No expiration: The installer script can be used multiple times.
- One time: The installer script can be used only once.

- Time bounded: You can set the number of days the installer script can be used.
- Number of deployments: You can set the number of times the installer script can be used.

Step 8 Click **Download** and save the file to local disk.

Step 9 Copy the installer shell script to all the AIX hosts for deployment.

Step 10 To grant execute permission to the script, run command: `chmod u+x tetration_installer_default_sensor_aix.sh`

Note The script name may differ depending on agent type and scope.

Step 11 To install the agent, run the following command with root privileges:

```
./tetration_installer_default_sensor_aix.sh
```

Note If an agent is already installed on the host, you cannot proceed with the installation.

We recommend running the pre-check, as specified in the script usage details.

AIX installer script usage details:

```
ksh tetration_installer_default_enforcer_aix.sh [--pre-check] [--pre-check-user]
[--skip-pre-check=<option>] [--no-install] [--logfile=<filename>] [--proxy=<proxy_string>]
 [--no-proxy] [--help] [--version] [--sensor-version=<version_info>] [--ls]
[--file=<filename>] [--osversion=<osversion>] [--save=<filename>] [--new] [--reinstall]
[--unpriv-user] [--libs=<libs.zip|tar.Z>] [--force-upgrade] [--upgrade-local]
[--upgrade-by-uuid=<filename>] [--logbasedir=<logbdir>] [--tmpdir=<tmp_dir>] [--visibility]
 [--golden-image]
  --pre-check: run pre-check only
  --pre-check-user: provide alternative to nobody user for pre-check su support
  --skip-pre-check=<option>: skip pre-installation check by given option; Valid options
include 'all', 'ipv6' and 'enforcement'; e.g.: '--skip-pre-check=all' will skip all
pre-installation checks; All pre-checks will be performed by default
  --no-install: will not download and install sensor package onto the system
  --logfile=<filename>: write the log to the file specified by <filename>
  --proxy=<proxy_string>: set the value of HTTPS_PROXY, the string should be formatted as
http://<proxy>:<port>
  --no-proxy: bypass system wide proxy; this flag will be ignored if --proxy flag was
provided
  --help: print this usage
  --version: print current script's version
  --sensor-version=<version_info>: select sensor's version; e.g.: '--sensor-version=3.4.1.0';
 will download the latest version by default if this flag was not provided
  --ls: list all available sensor versions for your system (will not list pre-3.3 packages);
 will not download any package
  --file=<filename>: provide local zip file to install sensor instead of downloading it
from cluster
  --osversion=<osversion>: specify osversion for --save flag;
  --save=<filename>: download and save zip file as <filename>; will download package for
osversion given by --osversion flag; e.g.: '--save=myimage.aix72.tar.Z --osversion=7.2'
  --new: remove any previous installed sensor; previous sensor identity has to be removed
from cluster in order for the new registration to succeed
  --reinstall: reinstall sensor and retain the same identity with cluster; this flag has
higher priority than --new
  --unpriv-user=<username>: use <username> for unpriv processes instead of tet-snsr
  --libs=<libs.zip|tar.Z>: install provided libs to be used by agents
  --force-upgrade: force sensor upgrade to version given by --sensor-version flag; e.g.:
'--sensor-version=3.4.1.0 --force-upgrade'; apply the latest version by default if
--sensor-version flag was not provided
```

```
  --upgrade-local: trigger local sensor upgrade to version given by --sensor-version flag:
 e.g.: '--sensor-version=3.4.1.0 --upgrade-local'; apply the latest version by default if
--sensor-version flag was not provided
  --upgrade-by-uuid=<filename>: trigger sensor whose uuid is listed in <filename> upgrade
to version given by --sensor-version flag; e.g.: '--sensor-version=3.4.1.0
--upgrade-by-uuid=/usr/local/tet/sensor_id'; apply the latest version by default if
--sensor-version flag was not provided
  --logbasedir=<log_base_dir>: instead of logging to /opt/cisco/tetration/log use
<log_base_dir>. The full path will be <log_base_dir>/tetration
  --tmpdir=<tmp_dir>: instead of using /tmp use <tmp_dir> as temp directory
  --visibility: install deep visibility agent only; --reinstall would overwrite this flag
if previous installed agent type was enforcer
  --golden-image: install Cisco Secure Workload Agent but do not start the Cisco Secure
Workload Services; use to install Cisco Secure Workload Agent on Golden Images in VDI
environment or Template VM. On VDI/VM instance created from golden image with different
host name, Cisco Secure Workload Services will work normally
```

Verify AIX Agent Installation

Procedure

Run command `lslpp -c -l tet-sensor.rte`, confirm that there is one entry as follows.

Note The specific output may differ depending on the version

`$ sudo lslpp -c -l tet-sensor.rte` /usr/lib/objrepos:tet-sensor.rte:3.4.1.19::COMMITTED:I:TET tet sensor package:

`$ sudo lssrc -s tet-sensor`

Subsystem Group PID Status tet-sensor 1234567 active

`$ sudo lssrc -s tet-enforcer`

Subsystem Group PID Status tet-enforcer 7654321 active

Installing Kubernetes or OpenShift Agents for Deep Visibility and Enforcement

Requirements and Prerequisites

Operating system support information is available at Agent OS support matrix.

Requirements

- The install script requires Kubernetes or OpenShift administrator credentials to start privileged agent pods on the cluster nodes.
- Secure Workload entities are created in the **tetration** namespace.
- The node or pod security policies must permit privileged mode pods.
- busybox:1.33 images must either be preinstalled or downloadable from Docker Hub.

- For containerd run time, if the config_path is not set, modify your config.toml (default location: /etc/containerd/config.toml) as follows:

  ~~~~
  ```
      [plugins."io.containerd.grpc.v1.cri".registry]
      config_path = "/etc/containerd/certs.d"
   ```
  ~~~~

  Restart the containerd daemon.

- In order to run on Kubernetes or OpenShift control plane nodes, the *–toleration* flag can be used to pass in a toleration for the Secure Workload pods. This usually is the NoSchedule toleration that normally prevents pods from running on control plane nodes.

- For Windows worker nodes:

  - Supported Windows worker node container runtime: ContainerD.

  - ContainerD config: Configure the following containerd change.

    ~~~~
    ```
        [plugins."io.containerd.grpc.v1.cri".registry]
        config_path = "/etc/containerd/certs.d"
     ```
    ~~~~

    Remove configurations under **registry.mirrors**. The default configuration file location is `C:\Program Files\containerd\config.toml`.

    Restart the containerd daemon after the configuration changes.

  - The image **mcr.microsoft.com/oss/kubernetes/windows-host-process-containers-base-image:v1.0.0** must either be preinstallated or downloadable on the Windows worker node.

  - The existing Kubernetes agent which is upgrading to the newer version includes the Windows DaemonSet agent automatically. However, the previous script does not uninstall the Windows DaemonSet agent. Download the latest installer script to uninstall the Windows DaemonSet agent.

  - Supported on:

    - Microsoft Windows Server 2022

    - Windows Server 2019

    - Kubernetes 1.27 and later

Requirements for Policy Enforcement

IPVS-based kube-proxy mode is not supported for OpenShift.

These agents should be configured with the Preserve Rules option that is enabled. See Create an Agent Configuration Profile.

For enforcement to function properly, any installed CNI plug-in must:

- Provide flat address space (IP network) between all nodes and pods. Network plug-ins which masquerade the source pod IP for intracluster communication are not supported.

- Not interfere with Linux iptables rules or marks that are used by the Secure Workload Enforcement Agent (mark bits 21 and 20 are used to allow and deny traffic for NodePort services)

The following CNI plug-ins are tested to meet the requirements above:

- Calico (3.13) with the following Felix configurations: *(ChainInsertMode: Append, IptablesRefreshInterval: 0)* or *(ChainInsertMode: Insert, IptablesFilterAllowAction: Return, IptablesMangleAllowAction: Return, IptablesRefreshInterval: 0)*. All other options use their default values.

See the Felix configuration reference for more information on setting these options.

Install Kubernetes or OpenShift Agent using the Agent Script Installer Method

Note The agent script installer method automatically installs agents on nodes included later.

Procedure

Step 1 To navigate to the agent installation methods:

- For a first-time user, launch the Quick Start wizard and click **Install Agents**.
- In the left pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Script Installer**.

Step 3 From the **Select Platform** drop-down menu, choose **Kubernetes**.

To view the supported Kubernetes or OpenShift platforms, click **Show Supported Platforms**.

Step 4 Choose the tenant to install the agents.

Note Selecting a tenant is not required in Secure Workload SaaS clusters.

Step 5 If HTTP proxy is required to communicate with Secure Workload, choose **Yes**, and then enter a valid proxy URL.

Step 6 Click **Download** and save the file to local disk.

Step 7 Run the installer script on a Linux machine which has access to the Kubernetes API server and a kubectl configuration file with administrative privileges as the default context/cluster/user.

The installer will attempt to read the file from its default location (~/.kube/config). However, it be specified explicitly with the --kubeconfig command line option.

The installation script will provide instructions to verify the Secure Workload Agent Daemonset and Pods that were installed.

Note The HTTP Proxy configured on the agent installer page prior to download only controls how Secure Workload agents connect to the Secure Workload cluster. This setting does not affect how Docker images are fetched by Kubernetes or OpenShift nodes, since the container runtime on those nodes uses its own proxy configuration. If the Docker images are unable to be pulled from the Secure Workload cluster, debugging the container runtime's image pulling process will be necessary and adding a suitable HTTP proxy might be necessary.

Installing Solaris Agents for Deep Visibility

Requirements and Prerequisites for Installing Solaris Agents

- See Supported Platforms and Requirements.
- Root privileges are required to install and execute the services.
- Storage requirement for agent and log files: 1 GB.
- Prevent other security applications from blocking agent installation or agent activity by configuring security exclusions on the security applications that are monitoring the host. See Security Exclusions.

Install Solaris Agent using the Agent Script Installer Method

The installed Solaris agent supports both deep visibility and process/ package visibility.

Procedure

Step 1 To navigate to the agent installation methods:

- For a first-time user, launch the Quick Start wizard and click **Install Agents**.
- In the left pane, click **Manage** > **Agents**, and select the **Installer** tab.

Step 2 Click **Agent Script Installer**.

Step 3 From the **Select Platform** drop-down menu, choose **Solaris**.

To view the supported Solaris platforms, click **Show Supported Platforms**.

Step 4 Choose the tenant to install the agents.

Note Selecting a tenant is not required in Secure Workload SaaS clusters.

Step 5 (Optional) To assign labels to the workload, choose the label keys and enter label values.

When the installed agent reports IP addresses on the host, the installer CMDB labels selected here, along with other uploaded CMDB labels that have been assigned to IPs reported by this host, would be assigned to the new IP address automatically. If there are conflicts between uploaded CMDB labels and installer CMDB labels:

- Labels assigned to exact IP address take precedence over labels assigned to the subnet.
- Existing labels assigned to exact IP address take precedence over installer CMDB labels.

Step 6 If HTTP proxy is required to communicate with Secure Workload, choose **Yes**, and then enter a valid proxy URL.

Step 7 Under the **Installer expiration** section, select one from the available options:

- No expiration: The installer script can be used multiple times.
- One time: The installer script can be used only once.
- Time bounded: You can set the number of days the installer script can be used.
- Number of deployments: You can set the number of times the installer script can be used.

Step 8 Click **Download** and save the file to local disk.

Step 9 Copy the installer shell script on Solaris hosts and run the following command to grant execute permission to the script: `chmod u+x tetration_installer_default_sensor_solaris.sh`

Note The script name may differ depending on the selected agent type and scope.

Step 10 To install the agent, run the following command with root privileges:

```
./tetration_installer_default_sensor_solaris.sh
```

Note If an agent is already installed on the tenant, you cannot proceed with the installation.

We recommend running the pre-check, as specified in the script usage details.

Solaris installer script usage details:

```
tetration_installer_default_sensor_solaris.sh [--pre-check] [--skip-pre-check=<option>]
[--no-install] [--logfile=<filename>] [--proxy=<proxy_string>] [--no-proxy] [--help]
[--version] [--sensor-version=<version_info>] [--ls] [--file=<filename>] [--save=<filename>]
 [--new] [--reinstall] [--unpriv-user] [--force-upgrade] [--upgrade-local]
[--upgrade-by-uuid=<filename>] [--basedir=<basedir>] [--logbasedir=<logbdir>]
[--tmpdir=<tmp_dir>] [--visibility] [--golden-image]
  --pre-check: run pre-check only
  --skip-pre-check=<option>: skip pre-installation check by given option; Valid options
include 'all', 'ipv6' and 'enforcement'; e.g.: '--skip-pre-check=all' will skip all
pre-installation checks; All pre-checks will be performed by default
  --no-install: will not download and install sensor package onto the system
  --logfile=<filename>: write the log to the file specified by <filename>
  --proxy=<proxy_string>: set the value of CL_HTTPS_PROXY, the string should be formatted
as http://<proxy>:<port>
  --no-proxy: bypass system wide proxy; this flag will be ignored if --proxy flag was
provided
  --help: print this usage
  --version: print current script's version
 --sensor-version=<version_info>: select sensor's version; e.g.: '--sensor-version=3.4.1.0';
 will download the latest version by default if this flag was not provided
 --ls: list all available sensor versions for your system (will not list pre-3.1 packages);
 will not download any package
  --file=<filename>: provide local zip file to install sensor instead of downloading it
from cluster
  --save=<filename>: download and save zip file as <filename>
  --new: remove any previous installed sensor; previous sensor identity has to be removed
from cluster in order for the new registration to succeed
  --reinstall: reinstall sensor and retain the same identity with cluster; this flag has
higher priority than --new
  --unpriv-user=<username>: use <username> for unpriv processes instead of nobody
  --force-upgrade: force sensor upgrade to version given by --sensor-version flag; e.g.:
```

```
'--sensor-version=3.4.1.0 --force-upgrade'; apply the latest version by default if
--sensor-version flag was not provided
  --upgrade-local: trigger local sensor upgrade to version given by --sensor-version flag:
 e.g.: '--sensor-version=3.4.1.0 --upgrade-local'; apply the latest version by default if
--sensor-version flag was not provided
  --upgrade-by-uuid=<filename>: trigger sensor whose uuid is listed in <filename> upgrade
to version given by --sensor-version flag; e.g.: '--sensor-version=3.4.1.0
--upgrade-by-uuid=/usr/local/tet/sensor_id'; apply the latest version by default if
--sensor-version flag was not provided
  --logbasedir=<log_base_dir>: instead of logging to /opt/cisco/secure-workload/log use
<log_base_dir>. The full path will be <log_base_dir>/secure-workload
  --tmpdir=<tmp_dir>: instead of using /tmp use <tmp_dir> as temp directory
  --visibility: install deep visibility agent only; --reinstall would overwrite this flag
if previous installed agent type was enforcer
  --golden-image: install Cisco Secure Workload Agent but do not start the Cisco Secure
Workload Services; use to install Cisco Secure Workload Agent on Golden Images in VDI
environment or Template VM. On VDI/VM instance created from golden image with different
host name, Cisco Secure Workload Services will work normally
```

Verify Solaris Agent Installation

Procedure

Step 1 Run command: `sudo pkg list tet-sensor`

Step 2 Verify that you have a single entry as the output, which confirms that a Solaris agent is installed on the host. Sample output:

NAME (PUBLISHER)	VERSION	IFO
tet-sensor (cisco)	3.8.1.1	i--

Note The specific output may differ depending on the platform and architecture.

(Manual Installations Only) Update the User Configuration File

The following procedure is required only for installations involving *all* of the following:

- Secure Workload SaaS, or on-premises clusters with multiple tenants (on-premises clusters that use only the default tenant do NOT need this procedure)
- Manual installation
- Linux or Windows platform

In order for agents to register to the Secure Workload cluster, they require a cluster activation key. Additionally, if agents require an HTTPS proxy to reach the cluster, you must specify the proxy.

Note In Windows Environment, there is no need to configure user.cfg manually if activationkey and proxy options are used during manual installation.

Before installation, configure the required variables in the user configuration file:

Procedure

Step 1 Retrieve your activation key: Go to **Manage** > **Agents**, click the “Installer” tab, click “Manual Install using classic packaged installers”, then click “Agent Activation Key”.

Step 2 Open the `user.cfg` file in the Secure Workload Agent installation folder for editing. (Example: `/usr/local/tet` on Linux or `C:\\Program Files\\Cisco Tetration` on Windows). The file contains a list of variables in the form of “key=value”, one on each line.

Step 3 Add the activation key to the **ACTIVATION_KEY** variable. Example:

```
ACTIVATION_KEY=7752163c635ef62e6568e9e852d07bd21bfd60d0
```

Step 4 If the agent requires an HTTPS proxy, add the **http** protocol proxy server and port using the **HTTPS_PROXY** variable. Example: `HTTPS_PROXY=http://proxy.my-company.com:80`

Other Agent-Like Tools

AnyConnect agents

Platforms supported by Cisco AnyConnect Secure Mobility agent with Network Visibility Module (NVM). No additional Secure Workload agent is required. AnyConnect connector registers these agents and exports flow observations, inventories, and labels to Secure Workload. For more information, see AnyConnect Connector.

For Windows, Mac, or Linux platforms, see Cisco AnyConnect Secure Mobility Client Data Sheet.

ISE agents

Endpoints registered with Cisco Identity Services Engine (ISE). No Secure Workload agent on the endpoint is required. ISE connector collects metadata about endpoints from ISE through pxGrid service on ISE appliance. It registers the endpoints as ISE agents on Secure Workload and pushes labels for the inventories on these endpoints. For more information, see ISE Connector.

SPAN agents

SPAN agents work with the ERSPAN connector. For information, see ERSPAN Connector.

Integration with third-party and additional Cisco products

- Integrations using external orchestrators configured in Secure Workload.

  See External Orchestrators, on page 131.

- Integrations using connectors configured in Secure Workload.

  See What are Connectors.

Connectivity Information

In general, when the agent is installed onto the workload, it starts making several network connections to the back-end services hosted on the Secure Workload cluster. Depending on the agent type and its functionality, the number of connections look different.

The following table captures various permanent connections that are made by various agent types.

Table 2: Agent Connectivity

Agent type	Config server	Collectors	Enforcement backend
visibility (on-premises)	CFG-SERVER-IP:443	COLLECTOR-IP:5640	N/A
visibility (SaaS)	CFG-SERVER-IP:443	COLLECTOR-IP:443	N/A
enforcement (on-premises)	CFG-SERVER-IP:443	COLLECTOR-IP:5640	ENFORCER-IP:5660
enforcement (SaaS)	CFG-SERVER-IP:443	COLLECTOR-IP:443	ENFORCER-IP:443
docker images	CFG-SERVER-IP:443	N/A	N/A

Legends:

- CFG-SERVER-IP represents the IP address of the config server.
- COLLECTOR-IP represents the IP address of the collector. Deep visibility and enforcement agents connect to all available collectors.
- ENFORCER-IP represents the IP address of the enforcement endpoint. The enforcement agent connects to only one of the available endpoints.
- For Kubernetes/Openshift agent deployments, the installation script does not contain the agent software - Docker images containing the agent software will be pulled from the Secure Workload cluster by every Kubernetes/Openshift node. These connections will be established by the container run time image fetch component and directed at CFG-SERVER-IP:443.

Navigate to **Platform** > **Cluster Configuration** to know the config server IP and collector IP.

- **Sensor VIP** is for the config server IP: The IP address that has been set up for the config server in this cluster.
- **External IPs** are for collectors IPs and enforcer: If this is populated, when assigning external cluster IP addresses, the selection process is restricted to only IP addresses defined in this list, that are part of the external network.

Note

- Secure Workload agent always acts as a client to initiate the connections to the services hosted within the cluster, it will never open a connection as a server.
- In addition to the above permanent connections, for the given agent type that upgrade is supported, agent will periodically perform https requests (port 443) to the cluster sensor VIP to query the available packages.
- Agent is allowed to be located behind a NAT server.

It is important to note that if the workload is behind a firewall or the host firewall service is enabled, then the connections to the cluster might be denied. It is necessary for the administrators to allow such connections by creating appropriate firewall policies.

Security Exclusions

Software agents continuously interact with the host’s operating system during their normal operations. This may cause other security applications installed on the host, such as antivirus, security agents, and others, to raise alarms or block the actions of Secure Workload agents. Therefore, to ensure that agents are installed successfully and are functioning, you must configure the necessary security exclusions on the security applications that are monitoring the host.

Table 3: Security exclusions for agent directories

Host OS	Directories
AIX	/opt/cisco/tetration
Linux	/usr/local/tet or /opt/cisco/tetration or <user chosen inst dir>
	/var/opt/cisco/secure-workload
Windows	C:\Program Files\Cisco Tetration
	C:\ProgramData\Cisco Tetration
Solaris	/opt/cisco/secure-workload

Table 4: Security exclusions for agent processes

Host OS	Processes
AIX	csw-agent
	tet-sensor
	tet-enforcer
	tet-main

Host OS	Processes
Linux	csw-agent
	tet-sensor
	tet-enforcer
	tet-main
	enforcer
Windows	TetSenEngine.exe
	TetSen.exe
	TetEnfEgine.exe
	TetEnfC.exe
	TetEnf.exe
	TetUpdate.exe
	tet-main.exe
Solaris	csw-agent
	tet-sensor
	tet-main

Table 5: Security exclusions for agent actions

Host OS	Actions
AIX	Access /dev/bpf*, /dev/ipl, /dev/kmem
	Invokes cfg_ipf, curl, ipf, ippool, ipfstat lslpp, lsfilt, prtconf
	Scan /proc
Linux	Invokes curl, ip[6]tables-save, ip[6]tables-restore, rpm/dpkg
	Scan /proc, open netlink sockets
Windows	Access registry
	Register to firewall events
	Invokes c:\windows\system32\netsh.exe

Host OS	Actions
Solaris	Invokes curl, lspp, pkg, smbios
	Scan /proc

Table 6: Security exclusions for agents scripts or binaries executions

Host OS	Invoked scripts/binaries
AIX	-
Linux	-
Windows	dmidecode.exe
	npcap-installer.exe
	sensortools.exe
	signtool.exe
Solaris	-

Service Management of Agents

Software agents are deployed as a service in all supported platforms. This section describes methods to manage the services for various functions and platforms.

Note Unless specified otherwise, all the commands in this section require root privileges on Linux or Unix, or administrative privileges on Windows to run.

Service Management for RHEL, CentOS, OracleLinux-6.x, and Ubuntu-14

Run the following commands for:

- **Starting a service**: `start csw-agent`
- **Stopping a service**: `stop csw-agent`
- **Restarting a service**: `restart csw-agent`
- **Checking service status**: `status csw-agent`

Service Management for RHEL, CentOS, OracleLinux-7.x and Later

The commands are also applicable to:

- AlmaLinux, Rocky Linux- 8.x and later

- Amazon Linux 2 and later
- Debian 8 and later
- SLES-12SPx and later
- Ubuntu-16.04 and later

Run the following commands for:

- **Starting a service**: `systemctl start csw-agent`
- **Stopping a service**: `systemctl stop csw-agent`
- **Restarting a service**: `systemctl restart csw-agent`
- **Checking service status**: `systemctl status csw-agent`

Service Management for Windows Server or Windows VDI

Run the following commands for:

- **Starting a service**: `net start <service-name>`

  Example: **net start tetsensor** for deep visibility service - **net start tetenforcer** for enforcement service
- **Stopping a service**: `net stop <service-name>`

  Example: **net stop tetsensor** for deep visibility service - **net stop tetenforcer** for enforcement service
- **Restarting a service**:
  1. `net stop <service-name>`
  2. `net start <service-name>`
- **Checking service status**: `sc query <service-name>`

  Example: **sc query tetsensor** for deep visibility service - **sc query tetenforcer** for enforcement service

Service Management for AIX

Run the following commands for:

- **Starting a service**: `startsrc -s csw-agent`
- **Stopping a service**: `stopsrc -s csw-agent`
- **Restarting a service**:
  1. `stopsrc -s csw-agent`
  2. `startsrc -s csw-agent`
- **Checking service status**: `lssrc -s csw-agent`

Service Management for Kubernetes Agent Installations

- **Starting or stopping a service**: It is not possible to start or stop the agents on a specific node because they are not installed as individual services but rather as a clusterwide daemon set.
- **Restarting an agent on a node**: Locate the Secure Workload agent pod on the node and run the appropriate Kubernetes command to kill it. The pod is automatically restarted.
- **Checking the status of pods**: `kubectl get pod -n tetration` or `oc get pod -n tetration` (for OpenShift) lists the status of all Secure Workload agent pods in the Kubernetes cluster.

Service Management for Solaris

Run the following commands for:

- **Starting a service**: `svcadm enable csw-agent`
- **Stopping a service**: `svcadm disable csw-agent`
- **Restarting a service**: `svcadm restart csw-agent`
- **Checking service status**: `svcs -l csw-agent`

Policy Enforcement with Agents

By default, agents that are installed on your workloads have the capability to enforce policy, but enforcement is disabled. When you are ready, you can enable these agents to enforce policy on selected hosts that are based on the configured intent.

When an agent enforces a policy, it applies an ordered set of rules that specify whether the firewall should ALLOW or DROP specific network traffic that is based on parameters such as the source, destination, port, protocol, and direction. For more information on policies, see Policies, on page 413.

Enforcement using agents

- Agents receive policies over a secured TCP or SSL channel.
- Agents run in a privileged domain. On Linux machines, the agent runs as root; on Windows machines, the agent runs as SYSTEM.
- Depending on the platform, when policy enforcement is enabled, agents can completely control the firewall or work with existing configured rules.
- For details about enforcement options and to enable and configure agents to enforce policies, see Create an Agent Configuration Profile, on page 66.

Advanced details

When you enable enforcement, golden rules are formulated to allow the agent to connect to the controller. Agents communicate with the Enforcement Front End (EFE) of the controller through a bidirectional and secure channel using the TLS or SSL protocol. Messages from the controller are signed by the policy generator and verified by the agent.

The agent receives policies in a platform-independent schema from the controller. The agent converts these platform-independent policies into platform-specific policies and programs the firewall on the endpoint.

The agent actively monitors the firewall state. If the agent detects any deviation in the enforced policies, it enforces the cached policies into the firewall again. The agent also monitors its own consumption of system resources such as CPU and memory.

The agent periodically sends a status and stats report to the controller using EFE. The status report includes the status of the latest programmed policies such as success, failure, or error, if any. The stats report includes the policy stats such as allowed and dropped packets, and byte count depending on the platform.

Agent Enforcement on the Linux Platform

On the Linux platform, the agent uses the iptables, ip6tables, or ipset to enforce network policies. After the agent is enabled on the host, by default, it controls, and programs iptables. If the IPv6 network stack is enabled, then the agent controls the IPv6 firewall using ip6tables.

Linux iptables or ip6tables

The Linux kernel has iptables and ip6tables that are used to set up, maintain, and inspect the tables of IPv4 and IPv6 packet filter rules. The iptables and ip6tables consist of many predefined tables. Each table contains predefined chains and can also contain user-defined chains. These chains contain sets of rules and each of these rules specifies the match criteria for a packet. Predefined tables include raw, mangle, filter, and NAT. Predefined chains include INPUT, OUTPUT, FORWARD, PREROUTING, and POSTROUTING.

The Secure Workload agent programs a filter table that contains rules to allow or drop packets. The filter table consists of the predefined chains INPUT, OUTPUT, and FORWARD. Along with these, the agent adds custom TA chains to categorize and manage the policies from the controller. These TA chains contain Secure Workload rules that are derived from the policies along with rules that are generated by the agent. When the agent receives platform-independent rules, it parses and converts them into iptable, ip6table, or ipset rules and inserts these rules into TA defined chains in the filter table. After programming the firewall, the agent monitors the firewall for any rule or policy deviation and if so, reprograms the firewall. It keeps track of the policies that are programmed in the firewall and reports their stats periodically to the controller.

Here is an example to depict this behavior:

A typical policy in a platform-independent network policy message consists of:

```
source set id: “test-set-1”
destination set id: “test-set-2”
source ports: 20-30
destination ports: 40-50
ip protocol: TCP
action: ALLOW
. . .
set_id: “test-set-1”
     ip_addr: 1.2.0.0
     prefix_length: 16
     address_family: IPv4
set_id: “test-set-2”
     ip_addr: 3.4.0.0
     prefix_length: 16
     address_family: IPv4
```

Along with other information, the agent processes this policy and converts it into platform-specific ipset and iptables rule:

```
ipset rule:
Name: ta_f7b05c30ffa338fc063081060bf3
Type: hash:net
Header: family inet hashsize 1024 maxelem 65536
Size in memory: 16784
References: 1
Members:
1.2.0.0/16
Name: ta_1b97bc50b3374829e11a3e020859
Type: hash:net
Header: family inet hashsize 1024 maxelem 65536
Size in memory: 16784
References: 1
Members:
3.4.0.0/16
iptables rule:
TA_INPUT -p tcp -m set --match-set ta_f7b05c30ffa338fc063081060bf3 src -m set --match-
↪→set ta_1b97bc50b3374829e11a3e020859 dst -m multiport --sports 20:30 -m multiport --
↪→dports 40:50 -j ACCEPT
```

Caveats

ipset Kernel Module

When enforcement is enabled and preserve rules is disabled in the Agent Config profile, the agents running on Linux hosts ensures that the ipset kernel module has a sufficiently large *max_sets* configuration. In case a change is needed, the agent reloads the ipset kernel module with a new *max_sets* value. If Preserve Rules is enabled, the agents check the current ipset module *max_sets* value, but does not make any change. The current configured *max_sets* value can be found in `cat /sys/module/ip_set/parameters/max_sets`.

Host Firewall Backup

The first time that enforcement is enabled in the Agent Config profile, the agents running on Linux hosts, store the current content of ipset and ip[6]tables in `/opt/cisco/tetration/backup` before taking control of the host firewall.

Successive disable or enable transitions of enforcement configuration do not generate backups. The directory is not removed after agent uninstallation.

Agent Enforcement on the Windows Platform in WAF mode

On the Windows platform, the Secure Workload agent uses the Windows Firewall to enforce network policies.

Windows Firewall with Advanced Security

A native component on Windows, the Windows Firewall with Advanced Security, regulates network traffic that is based on the following types of settings:

- Rules that regulate inbound network traffic.
- Rules that regulate outbound network traffic.
- Override rules that is based on the authentication status of the source and destination of the network traffic.
- Rules that apply to IPsec traffic and to Windows services.

The Secure Workload Network Policy is programmed using inbound and outbound firewall rules.

Secure Workload Rules and the Windows Firewall

On the Windows platform, the Secure Workload Network Policy is enforced as follows:

1. The platform-independent firewall rules from the Secure Workload Network policy are translated into Windows Firewall rules.
2. The rules are programmed in Windows Firewall.
3. The Windows Firewall enforces the rules.
4. The Windows Firewall and its ruleset are monitored. If a change is detected, the deviation is reported and the Secure Workload Network policy is reset in the Windows Firewall.

Security Profiles

Windows Firewall groups the rules based on the network that the host is connected to. These rule groups are called Profiles and there are three such profiles:

- Domain Profile
- Private Profile
- Public Profile

The Secure Workload rules are programmed into all the profiles, but only rules in active profiles are continuously monitored.

Effective Setting and Mixed-List Policies

The set of rules in the Windows Firewall is not ordered based on the precedence. When multiple rules match a packet, the most restrictive of those rules take effect meaning that DENY rules take precedence over ALLOW rules. For more information, see the article on Microsoft TechNet.

Consider the mixed-list, both allow and deny, policy example from the Enforcement Agent section:

```
1. ALLOW 1.2.3.30 tcp port 80
2. ALLOW 1.2.3.40 udp port 53
3. BLOCK 1.2.3.0/24 ip
4. ALLOW 1.2.0.0/16 ip
5. Catch-all: DROP ingress, ALLOW egress
```

When a packet headed for the host 1.2.3.30 TCP port 80 reaches the firewall, it matches all the rules above, but the most restrictive of them all, Rule number 3, is the one that will be enforced and the packet will be dropped. This behavior is contrary to the expectation that the rules will be evaluated in order, Rule 1 will be the rule that is enforced, and that the packet will be allowed.

This difference in behavior is expected in the Windows platform owing to the design of the Windows Firewall described above. This behavior can be observed in mixed-list policies with overlapping rules that have different rule actions.

For example,

```
1. ALLOW 1.2.3.30 tcp
2. BLOCK 1.2.3.0/24 tcp
```

Interference from Other Firewalls or Policies

We recommend that you grant the agent full and exclusive control of the Windows Firewall to enforce the Secure Workload Network Policy as intended. Agents cannot reliably enforce the policy if:

- A third-party firewall is present. (The Windows Firewall is required to be the active firewall product on the host.)
- The Firewall is disabled for the current profiles.
- Conflicting firewall settings are deployed using Group Policy. Some of the conflicting settings are:
  - Firewall rules.
  - Default inbound or outbound actions in the current profiles that differ from the catch-all rules of the policy.
  - Firewall disabled for the current profiles.

Stateful Enforcement

Windows Advanced Firewall is considered as a **stateful** firewall, that is for certain protocols such as TCP, the firewall maintains internal state tracking to detect if a new packet hitting the firewall belongs to a known connection. Packets belonging to a known connection are allowed without the firewall rules having to be examined. A stateful firewall enables bidirectional communication without rules having to be established in the INBOUND and OUTBOUND tables.

For example, consider the following rule for a web server: **Accept all TCP connections to port 443**

The intention is to accept all TCP connections on port 443 to the server, and allow the server to communicate back to the clients. In this case, only one rule is inserted in the INBOUND table, allowing TCP connections on port 443. No rule is required to be inserted in the OUTBOUND table. Inserting a rule in the OUTBOUND table is implicitly done by the Windows Advanced Firewall.

Note Stateful tracking applies only to protocols that establish and maintain explicit connections. For other protocols, both INBOUND and OUTBOUND rules must be programmed to enable bidirectional communication.

When enforcement is enabled, a given concrete rule is programmed as **stateful** when the protocol is TCP (the agent decides, based on the context, whether the rule is to be inserted in the INBOUND table or the OUTBOUND table). For other protocols (including **ANY**), both INBOUND and OUTBOUND rules are programmed.

Caveats

Host firewall backup

When enforcement is enabled for the first time in the Agent Config profile, the agents running on Windows hosts, before taking control of the host firewall, export the current Windows Advanced Firewall content to `ProgramData\Cisco\Tetration\backup`. Successive disable or enable transitions of Enforcement configuration do not generate backups. The directory is not removed upon agent uninstallation.

Agent Enforcement on the Windows Platform in WFP Mode

On the Windows platform, the agent enforces the network policies by programming Windows Filtering Platform (WFP) filters. Windows Advanced Firewall is not used to configure the network policy.

Windows Filtering Platform

Windows Filtering Platform (WFP) is a set of APIs provided by Microsoft to configure filters for processing network traffic. Network traffic processing filters are configured using kernel-level APIs and user level APIs. WFP filters can be configured at various layers, Network Layer, Transport Layer, Application Layer Enforcement (ALE). Secure Workload WFP filters are configured at the ALE layer, similar to Windows firewall rules. Each layer has several sublayers, ordered by weight, from highest to lowest. Within each sublayer, filters are ordered by weight, from highest to lowest. A network packet traverses through all the sublayers. At each sublayer, the network packet traverses through the matching filters that are based on weight, from highest to lowest and returns the action: Permit or Block. After passing through all the sublayers, the packet is processed based on the rule that Block action overrides Permit.

Advantages of WFP over WAF

- Avoids Windows Firewall configuration dependencies.
- Overcomes GPO restrictions.
- Ensures ease of migration and policy reversion.
- Allows you to control policy ordering.
- Avoids strict block-first policy order of Windows Firewall.
- Reduces CPU overhead on policy update.
- Creates an efficient 1:1 policy rule filter.
- Ensures a faster single-step update.

Agent Support for WFP

When enforcement is configured to use WFP, Secure Workload filters override Windows Firewall rules.

In WFP mode, the agent configures the following WFP objects:

- Provider has a GUID and name, is used for filter management, and does not affect packet filtering
- Sublayer has a GUID, name, and weight. The Secure Workload sublayer is configured with higher weight than the Windows Advanced Firewall sublayer.
- Filter has name, GUID, ID, weight, layer ID, sublayer key, action (PERMIT/ BLOCK), and conditions. WFP filters are configured for Golder rules, Self Rules, and Policy Rules. The agent also configures the port scanning prevention filters. Secure Workload filters are configured with the FWPM_FILTER_FLAG_CLEAR_ACTION_RIGHT flag. This flag ensures that Secure Workload filters are not overridden by Microsoft Firewall rules. For each Secure Workload Network policy rule, one or more WFP filters are configured based on the direction (inbound or outbound) and protocol.

For TCP inbound policy,

```
id: 14 , TCP Allow 10.195.210.184 Dir=In localport=3389
```

The WFP filters configured are:

```
Filter Name:                  Secure Workload Rule 14
------------------------------------------------------
EffectiveWeight:                       18446744073709551589
LayerKey:                              FWPM_LAYER_ALE_AUTH_LISTEN_V4
Action:                                Permit
Local Port:                            3389
Filter Name:                           Secure Workload Rule 14
------------------------------------------------------
EffectiveWeight:                       18446744073709551589
LayerKey:                              FWPM_LAYER_ALE_AUTH_RECV_ACCEPT_V4
Action:                                Permit
RemoteIP:                              10.195.210.184-10.195.210.184
```

Secure Workload agent configures **Secure Workload Default Inbound** and **Secure Workload Default Outbound** filters for inbound and outbound CATCH-ALL policy respectively.

Agent WFP support and Windows Firewall

- The agent **does not monitor** WAF rules or WAF profiles.
- The agent **does not monitor** firewall states.
- The agent **does not require** firewall state to be enabled.
- The agent **does not conflict** with GPO policies.

Effective Setting and Mixed-List Policies

Agent enforcement in WFP mode supports mixed-list or grey list policies.

Consider the mixed-list (both allow and deny) policy example from the Enforcement Agent section:

```
1. ALLOW 1.2.3.30 tcp port 80-            wt1000
2. BLOCK 1.2.3.0/24 ip-                   wt998
3. ALLOW 1.2.0.0/16 ip-                   wt997
4. Catch-all: DROP ingress, ALLOWegress - wt996
```

When a packet headed for the host 1.2.3.30 tcp port 80 reaches the firewall, it matches filter 1 and is allowed. However, a packet that is headed for the host 1.2.3.10 is blocked because of filter 2. A packet that is headed for host 1.2.2.10 is allowed by filter 3.

Stateful Enforcement

Secure Workload WFP filters are configured at the ALE layer. Network traffic is filtered for socket connect(), listen(), and accept() operations. Network packets related to a L4 connection are not filtered after the connection is established.

Visibility of Configured WFP Filters

You can view the configured Secure Workload WFP filters using `c:\program files\tetration\tetenf.exe`. Supported options:

- With administrative privileges, run `cmd.exe`.
- Run `c:\program files\tetration\tetenf.exe -l -f <-verbose> <-output=outfile.txt>`.

OR

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- View the **filters.xml** file for configured Secure Workload filters.

Disable Stealth Mode Filters in WFP Mode

To disable stealth mode filters (port scanning filters):

Procedure

Step 1 Edit `\conf\enforcer.cfg`.

Step 2 Add **disable_wfp_stealth_mode**: 1

Step 3 Save the file.

Step 4 With administrative privileges, restart the tetenforcer service by:

a) Run the command: `sc stop tetenforcer` to stop TetEnforcer Service.

b) Run the command: `sc start tetenforcer` to start TetEnforcer Service.

Step 5 To verify:

a) With administrative privileges, run `cmd.exe`.

b) Run the command: `c:\program files\tetration\tetenf.exe -l -f <-verbose> <-output=outfile.txt>`.

```
“Tetration Internal Rule block portscan” filters are not configured.
```

Delete Configured WFP Filters

You can delete the configured Secure Workload WFP filters using `c:\program files\tetration\tetenf.exe`. To avoid accidental deletions of filters, when you run the delete command, specify the token in <*yyyymm*> format, where *yyyy* is the current year and *mm* is the current month in the numerical form. For example, if today’s date is 01/21/2021, then the token is **-token=202101**

Supported options are:

- With administrative privileges, run `cmd.exe`.
- To delete all configured Secure Workload filters, run `c:\program files\tetration\tetenf.exe -d -f -all - token=<yyyymm>`
- To delete all configured Secure Workload WFP objects, run `c:\program files\tetration\tetenf.exe -d -all -token=<yyyymm>`
- To delete a Secure Workload WFP filter by name, run `c:\program files\tetration\tetenf.exe -d -name=<WFP filter name> -token=<yyyymm>`

Known Limitations in WFP Mode

- The **Preserve Rules** setting in Agent Config Profile has no effect when you set Enforcement Mode to WFP.

Configure Policies for Windows Attributes

For more granularity when enforcing a policy on Windows-based workloads, you can filter network traffic by:

- Application Name
- Service Name
- User Names with or without User Groups

This option is supported in both WAF and WFP modes. Windows OS-based filters are categorized as *consumer filters* and *provider filters* in the generated network policy. The Consumer filters filter the network traffic that is initiated on the consumer workload and Provider filters filter the network traffic that is destined for the provider workload.

Before you begin

This procedure assumes you are modifying an existing policy. If you have not yet created the policy to which you want to add a Windows OS-based filter, create that policy first.

Important See Caveats, on page 50 and Known limitations, on page 50 for policies involving Windows attributes.

Procedure

Step 1 In the navigation pane, click **Defend** > **Segmentation**.

Step 2 Click the scope that contains the policy for which you want to configure Windows OS-based filters.

Step 3 Click the workspace in which you want to edit the policy.

Step 4 Click **Manage Policies**.

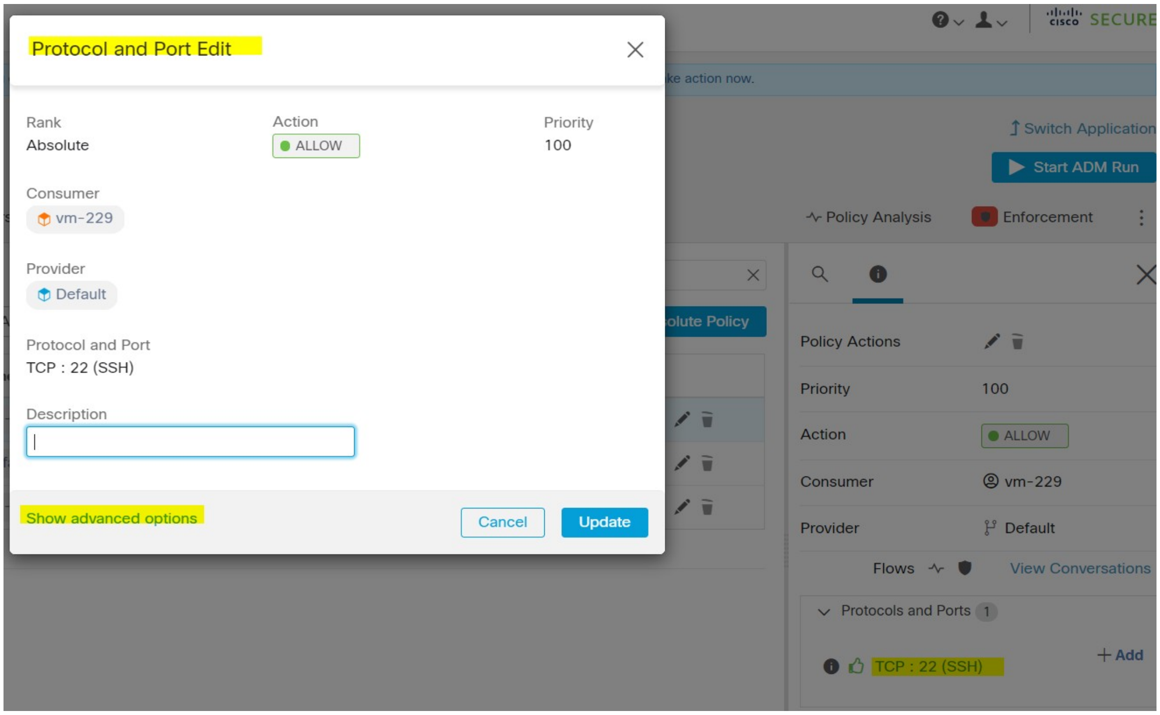
Step 5 Choose the policy to edit.

Important Consumer and Provider must include only Windows workloads.

Step 6 In the table row for the policy to edit, click the existing value in the **Protocols and Ports** column.

Step 7 In the pane on the right, click the existing value under **Protocols and Ports**.

In the example, click `TCP : 22 (SSH)`.



Protocol and Port Edit

Rank
Absolute

Action
ALLOW

Priority
100

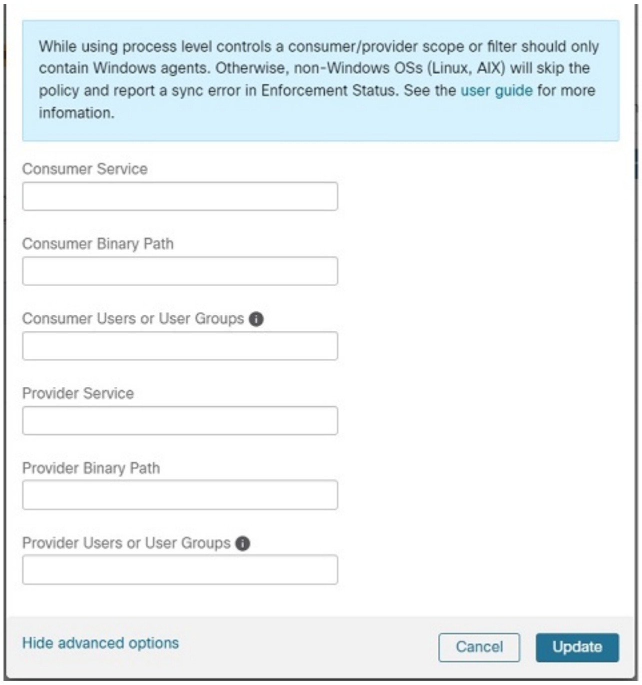
Consumer
vm-229

Provider
Default

Protocol and Port
TCP : 22 (SSH)

Description

Step 8 Click **Show advanced options**.



While using process level controls a consumer/provider scope or filter should only contain Windows agents. Otherwise, non-Windows OSs (Linux, AIX) will skip the policy and report a sync error in Enforcement Status. See the user guide for more infomation.

Consumer Service

Consumer Binary Path

Consumer Users or User Groups

Provider Service

Provider Binary Path

Provider Users or User Groups

Step 9 Configure consumer filters based on Application name, Service name, or User name.

- The application name must be a full pathname.
- Service name must be a short service name.

- User name can be a local user name (For example, tetter) or domain user name (For example, sensor-dev@sensor-dev.com or sensor-dev\sensor-dev)
- User group can be local user group (For example, Administrators) or domain user group (For example, domain users\\sensor-dev)
- Multiple user names and/ or user group names can be specified, separated by ",".(For example, sensor-dev\@sensor-dev.com,domain users\\sensor-dev)
- Service name and User name cannot be configured together.

Step 10 Configure provider filters based on Application name, Service name, or User name.

Follow the same guidelines as given for consumer filters in the previous step.

Step 11 Enter the paths to the binary, as applicable.

For example, enter **`c:\test\putty.exe`**

Step 12 Click **Update**.

Recommended Windows OS-Based Policy Configuration

Always specify ports and protocols in policies when possible; we recommend not to allow ANY port, ANY protocol.

For example, a generated policy with port and protocol restrictions might look like this:

```
dst_ports {
 start_port: 22
 end_port: 22
 consumer_filters {
   application_name: "c:\\test\\putty.exe"
 }
}}
ip_protocol: TCP
```

In contrast, if you allow network connections that are initiated by iperf.exe with ANY protocol and ANY port, the generated policy looks like this:

```
match_set {
  dst_ports {
    end_port: 65535
    consumer_filters {
      application_name: "c:\\test\\iperf.exe"
    }
  }
  address_family: IPv4
  inspection_point: EGRESS
  match_comment: "PolicyId=61008290755f027a92291b9d:61005f90497d4f47cedacb86:"
}
```

For the above filter, Secure Workload creates a policy rule to allow the network traffic on the provider as follows:

```
  match_set {
      dst_ports {
      end_port: 65535
    }
    address_family: IPv4
    inspection_point: INGRESS
    match_comment: "PolicyId=61008290755f027a92291b9d:61005f90497d4f47cedacb86:"
  }
```

This network rule opens all the ports on the Provider. We strongly recommend not to create OS-based filters with *Any* protocol.

Known limitations

- Windows 2008 R2 does not support Windows OS based filtering policies.
- Network policy can be configured with a single user name whereas MS Firewall UI supports multiple users.

Caveats

- While using the Windows OS-based policies, a consumer/ provider scope or filter should only contain Windows agents. Otherwise, non-Windows OSs (Linux, AIX) skip the policy and report a sync error in Enforcement Status.
- Avoid creating Windows OS filters with *loose* filtering criteria. Such criteria may open unwanted network ports.
- If OS filters are configured for consumer, then the policies are applicable only to consumer, similarly if it is configured for provider then it is applicable only to provider.
- Due to limited or no knowledge of the process context, user context or service context of the network flows, there will be discrepancy in the policy analysis if the policies have Windows OS-based filters.

Verify and Troubleshoot Policies with Windows OS-Based Filtering Attributes

If you use Windows OS-based filtering attributes, the following topics provide you with verification and troubleshooting information.

Cisco TAC can use this information as needed to troubleshoot such policies.

Policies Based on Application Name

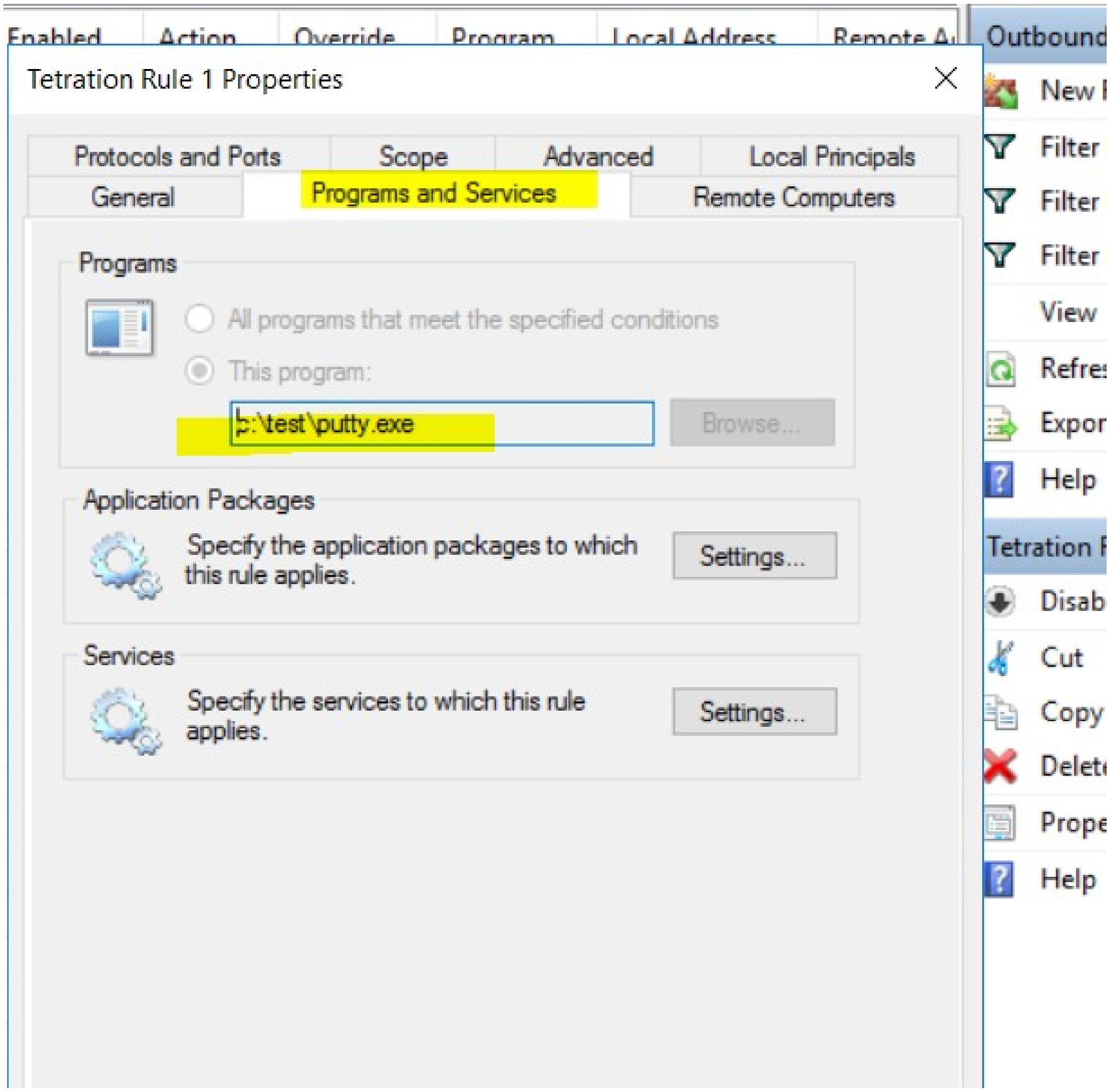
Use the following information to verify and troubleshoot policies based on application name on Windows OS workloads.

The following sections describe the way policies should appear on the workload for an application binary entered as **`c:\test\putty.exe`**.

Sample Policy Based on Application Name

```
dst_ports {
start_port: 22
end_port: 22
consumer_filters {
application_name: “c:\test\putty.exe”
}
}}
ip_protocol: TCP
address_family: IPv4
inspection_point: EGRESS
```

Generated Firewall Rule



Tetration Rule 1 Properties

○ All programs that meet the specified conditions

● This program:

c:\test\putty.exe

Specify the application packages to which this rule applies.

Specify the services to which this rule applies.

Generated Filter Using netsh

To verify, using native Windows tools, that a filter has been added to an advanced policy:

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- The output file, **filters.xml**, is generated in the current directory.

- Check FWPM_CONDITION_ALE_APP_ID for the application name in the output file: filters.xml.

```
<fieldKey>FWPM_CONDITION_ALE_APP_ID</fieldKey>
                     <matchType>FWP_MATCH_EQUAL</matchType>
                     <conditionValue>
                            <type>FWP_BYTE_BLOB_TYPE</type>
                            <byteBlob>
                                   <data>
↪→5c006400650076006900630065005c006800610072006400640069007300 6b0076006f006
↪→</data>
                                 <asString>\device\harddiskvolume2\temp\putty.exe</
↪→asString>
               </byteBlob>
       </conditionValue>
```

Generated WFP Filter Using tetenf.exe -l -f

```
Filter Name:                   Secure Workload Rule 1
------------------------------------------------------
EffectiveWeight:               18446744073709551592
LayerKey:                      FWPM_LAYER_ALE_AUTH_CONNECT_V4
Action:                        Permit
RemoteIP:                      10.195.210.15-10.195.210.15
Remote Port:                   22
Protocol:                      6
AppID:                         \device\harddiskvolume2\test\putty.exe
```

Invalid Application Name

- In WAF mode, Firewall rule is created for an invalid application name.
- In WFP mode, the WFP filter is not created for an invalid application name but the NPC is not rejected. The agent logs a warning message and configures the rest of the policy rules.

Policies Based on Service Name

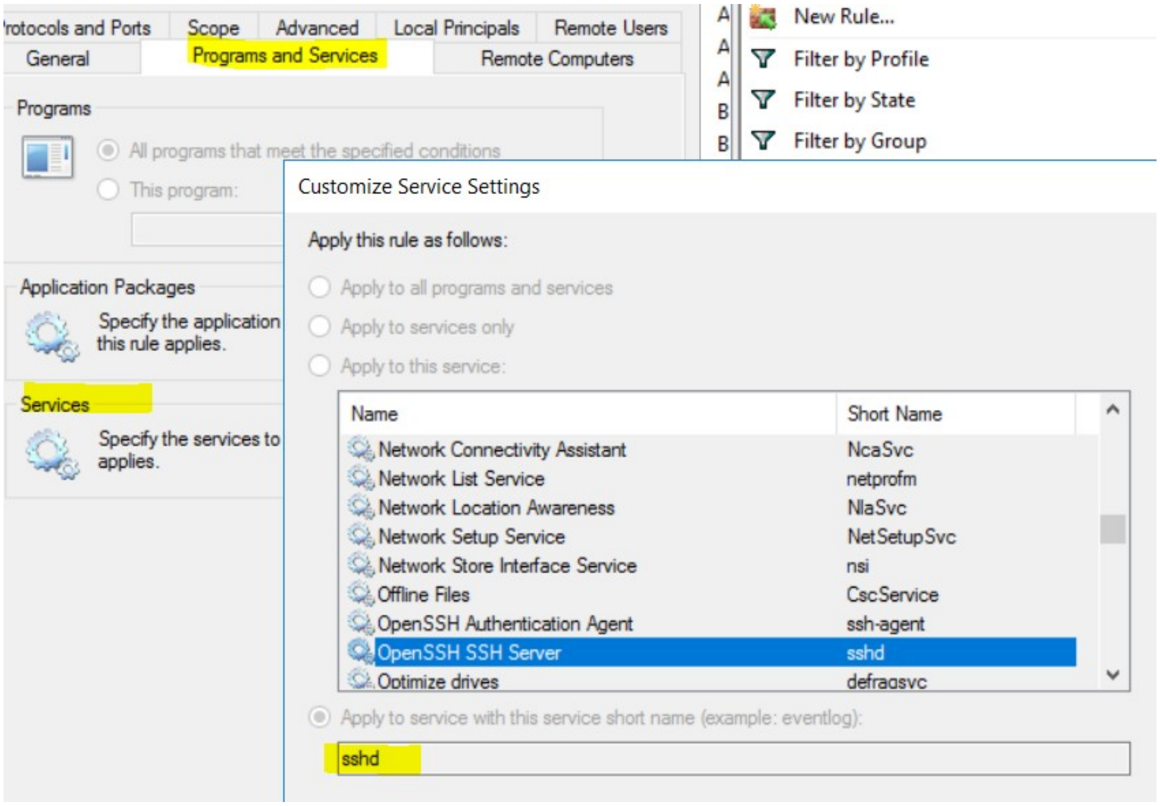
Use the following information to verify and troubleshoot policies based on Service name on Windows OS workloads.

The following sections describe the way that the policies should appear on the workload.

Sample Policy Based on Service Name

```
    dst_ports {
             start_port: 22
             end_port: 22
             provider_filters {
                    service_name: “sshd”
             }
         }}
         ip_protocol: TCP
         address_family: IPv4
         inspection_point: INGRESS
```

Generated Firewall Rule



Customize Service Settings

Apply this rule as follows:

○ Apply to all programs and services

○ Apply to services only

○ Apply to this service:

Name	Short Name
Network Connectivity Assistant	NcaSvc
Network List Service	netprofm
Network Location Awareness	NlaSvc
Network Setup Service	NetSetupSvc
Network Store Interface Service	nsi
Offline Files	CscService
OpenSSH Authentication Agent	ssh-agent
OpenSSH SSH Server	sshd
Optimize drives	defragsvc

● Apply to service with this service short name (example: eventlog):

sshd

Generated Filter Using netsh

To verify using native Windows tools, that a filter has been added for an advanced policy:

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- The output file, **filters.xml**, is generated in the current directory.
- Check FWPM_CONDITION_ALE_USER_ID for user name in the output file: filters.xml.

```
<item>
                    <fieldKey>FWPM_CONDITION_ALE_USER_ID</fieldKey>
                    <matchType>FWP_MATCH_EQUAL</matchType>
                    <conditionValue>
                              <type>FWP_SECURITY_DESCRIPTOR_TYPE</type>

<sd>O:SYG:SYD:(A;;CCRC;;;S-1-5-80-3847866527-469524349-687026318-
→516638107)</sd>
                    </conditionValue>
</item>
```

Generated WFP Filter Using tetenf.exe -l -f

```
Filter Name:       Secure Workload Rule 3
------------------------------------------------------
EffectiveWeight:            18446744073709551590
```

```
LayerKey:                   FWPM_LAYER_ALE_AUTH_RECV_ACCEPT_V4
Action:                     Permit
Local Port:                 22
Protocol:                   6
User or Service:            NT SERVICE\sshd
```

Invalid Service Name

- In WAF mode, the Firewall rule is created for a nonexistent service name.
- In WFP mode, the WFP filter is not created for a nonexistent service name.
- Service SID type must be *Unrestricted* or *Restricted*. If the service type is *None*, the Firewall Rule and WFP filter can be added but they have no effect.

  To verify the SID type, run the following command:

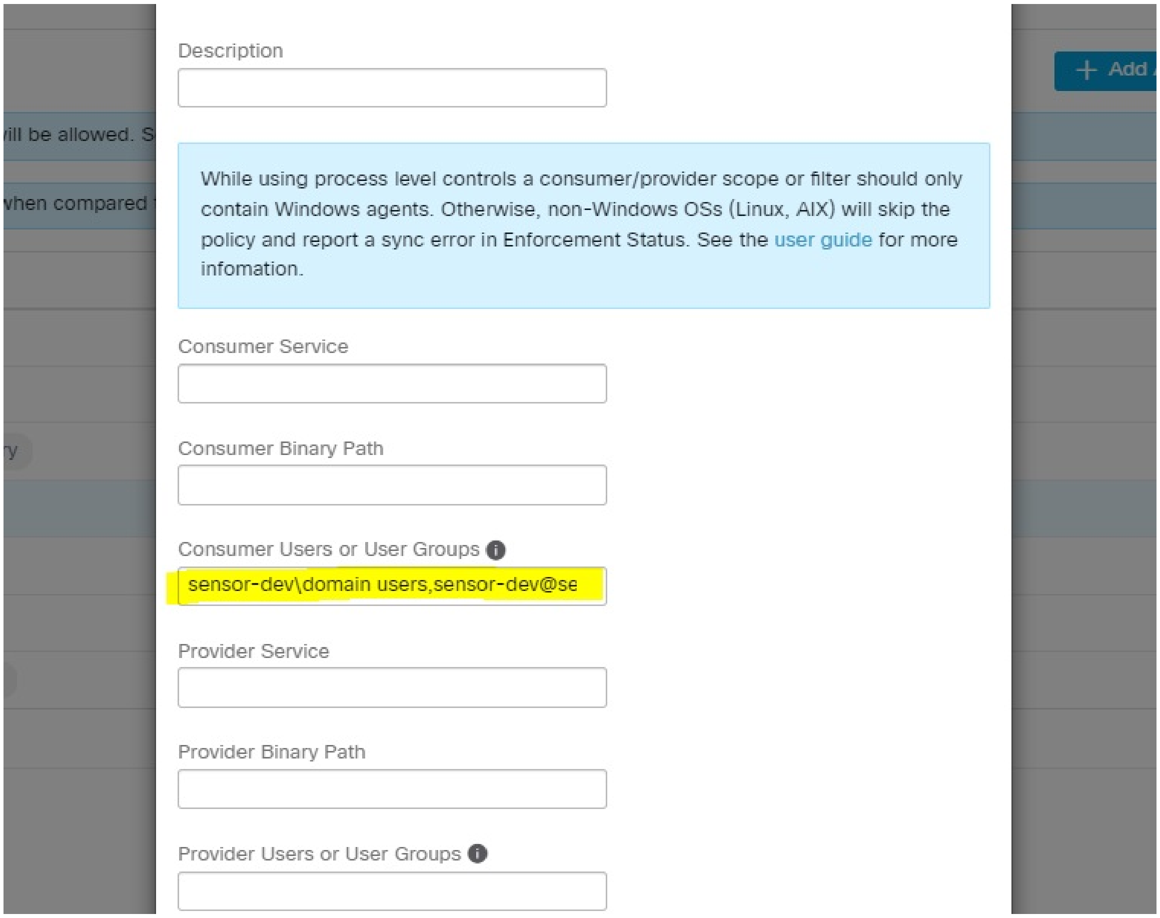
  ```
  sc qsidtype <service name>
  ```

Policies Based on User Group or User Name

Use the following information to verify and troubleshoot policies based on user name (with and without user group name) on Windows OS workloads.

Sections in this topic describe the way that the policies should appear on the workload.

Examples in this topic are based on policies that are configured with the following information:



Description

While using process level controls a consumer/provider scope or filter should only contain Windows agents. Otherwise, non-Windows OSs (Linux, AIX) will skip the policy and report a sync error in Enforcement Status. See the user guide for more infomation.

Consumer Service

Consumer Binary Path

Consumer Users or User Groups: sensor-dev\domain users,sensor-dev@se

Provider Service

Provider Binary Path

Provider Users or User Groups

Sample Policy Based on User Name

```
dst_ports {
          start_port: 30000
          end_port: 30000
          provider_filters {
               user_name: "sensor-dev\sensor-dev"
           }
}}
ip_protocol: TCP
address_family: IPv4
inspection_point: EGRESS
```

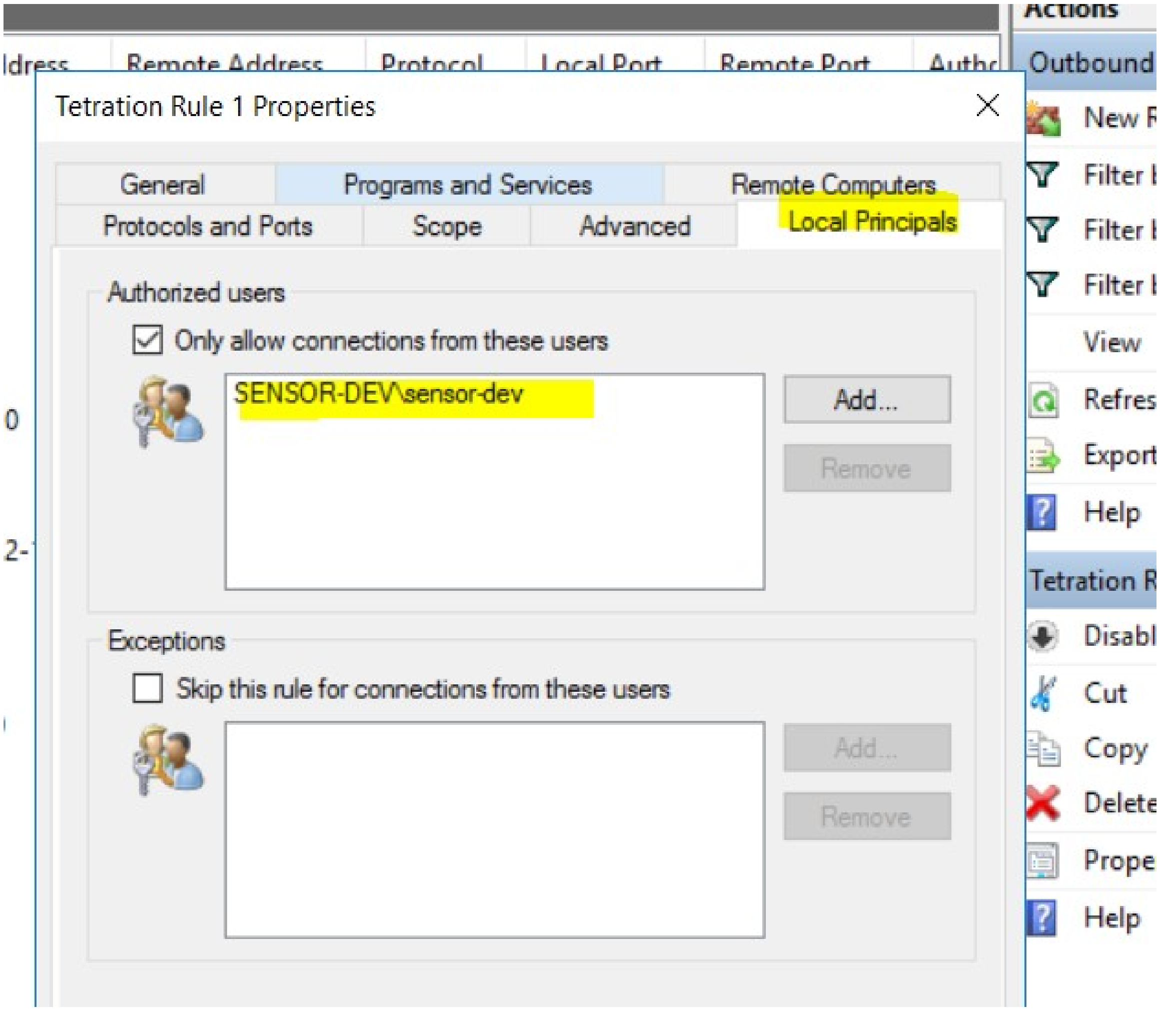
Sample Policy Based on User Group and User Name

```
dst_ports {
start_port: 30000
end_port: 30000
provider_filters {
user_name: "sensor-dev\domain users,sensor-dev\sensor-dev"
}
}}
ip_protocol: TCP
address_family: IPv4
inspection_point: EGRESS
```

Generated Firewall Rule

Firewall Rule Based on User Name

Example: Firewall rule based on User Name, sensor-dev\\sensor-dev



Tetration Rule 1 Properties

Authorized users

☑ Only allow connections from these users

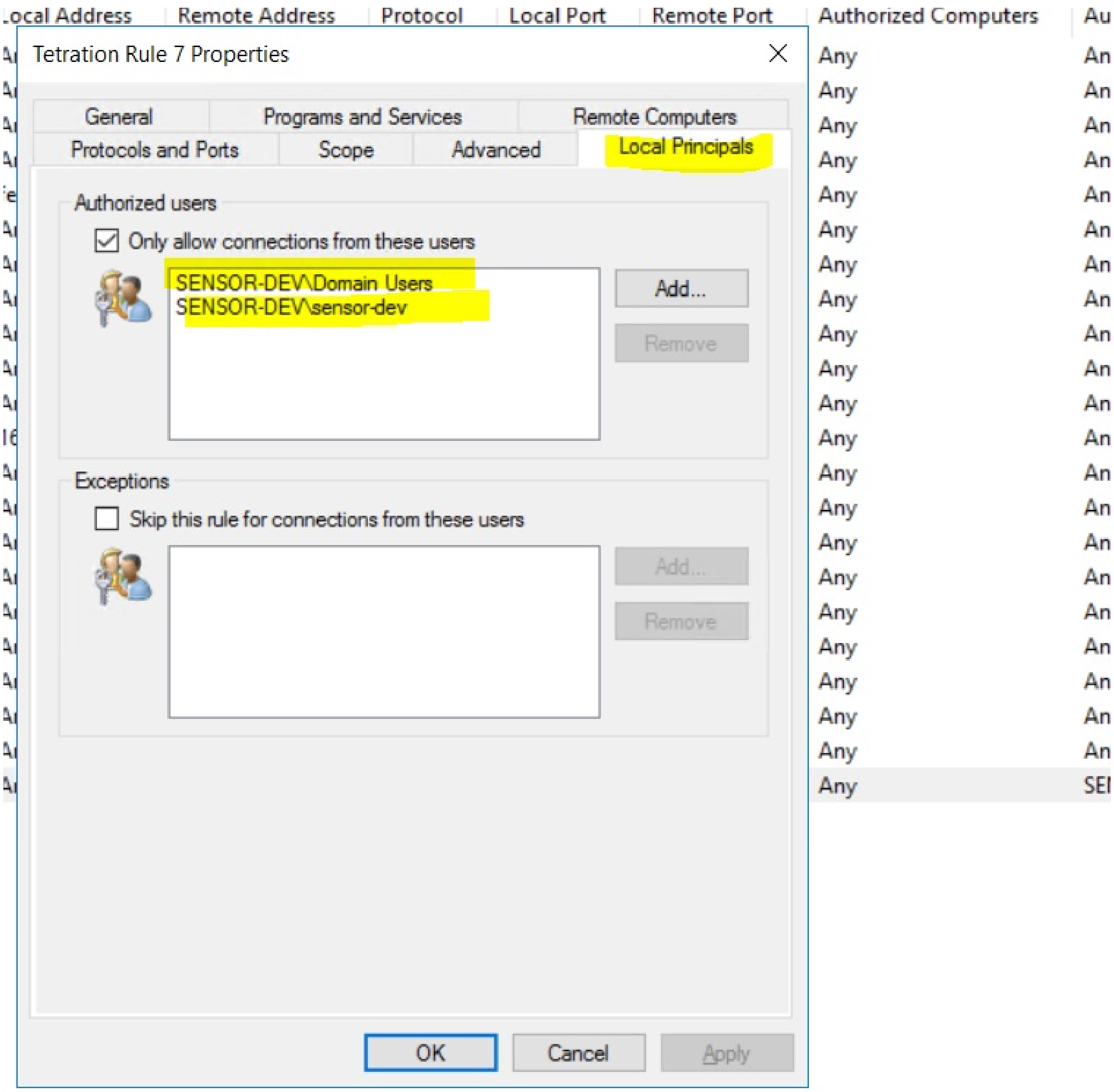
SENSOR-DEV\sensor-dev

Exceptions

□ Skip this rule for connections from these users

Firewall Rule Based on User Group and User Name

Example: Firewall rule based on User Name, sensor-dev\\sensor-dev and user group, domain users\\sensor-dev



Authorized users

☑ Only allow connections from these users

SENSOR-DEV\Domain Users
SENSOR-DEV\sensor-dev

Exceptions

☐ Skip this rule for connections from these users

Generated Filter Using netsh

To verify using native Windows tools that a filter has been added for an advanced policy:

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- The output file, **filters.xml**, is generated in the current directory.
- Check FWPM_CONDITION_ALE_USER_ID for user name in the output file: filters.xml.

```
<item>
            <fieldKey>FWPM_CONDITION_ALE_USER_ID</fieldKey>
            <matchType>FWP_MATCH_EQUAL</matchType>
            <conditionValue>
                   <type>FWP_SECURITY_DESCRIPTOR_TYPE</type>
```

```
                       <sd>O:LSD:(A;;CC;;;S-1-5-21-4172447896-825920244-2358685150)</sd>
                </conditionValue>
    </item>
```

Generated WFP Filters Using tetenf.exe -l -f

Filter based on User Name

Example: WFP Rule based on User Name, SENSOR-DEV\sensor-dev

```
Filter Name:                   Secure Workload Rule 1
------------------------------------------------------
EffectiveWeight:               18446744073709551590
LayerKey:                      FWPM_LAYER_ALE_AUTH_CONNECT_V4
Action:                        Permit
RemoteIP:                      10.195.210.15-10.195.210.15
Remote Port:                   30000
Protocol:                      6
User or Service:               SENSOR-DEV\sensor-dev
```

Filter based on User Group and User Name

Example: WFP Rule based on User Name, SENSOR-DEV\\sensor-dev and User Group name, SENSOR-DEV\\Domain Users

```
Filter Name:         Secure Workload Rule 1
------------------------------------------------------
EffectiveWeight:             18446744073709551590
LayerKey:                    FWPM_LAYER_ALE_AUTH_CONNECT_V4
Action:                      Permit
RemoteIP:                    10.195.210.15-10.195.210.15
Remote Port:                 30000
Protocol:                    6
User or Service:             SENSOR-DEV\Domain Users, SENSOR-DEV\sensor-dev
```

Service name and user name cannot be configured for a Network policy rule.

Note The network policy is rejected by the Windows agent if the user name or the user group is invalid.

Enforcement of Kubernetes Pods on Windows Nodes

After you install the Kubernetes DaemonSet agent on the Windows worker nodes, it captures the network flows from the Windows worker nodes and the Kubernetes pods in an AKS environment.

Requirements

- Enforcement of Kubernetes pods is supported in an AKS environment with Windows nodes.
- Enforcement mode MUST be WFP with **Preserve Rules** set to Off.
- Supported on Microsoft Windows Server 2019 and Windows Server 2022.

The policies are enforced on vSwitch for ports that are connected to pods using VFP. The Virtual Filtering Platform (VFP) is a component of vSwitch used to configure filters for processing network traffic. While enforcing the policies, the Preserve Mode is Off.

Each filter has the following attributes:

- Id: Filter Name
- Direction: In or Out
- RuleType: Switch or Host.
    - Configure the filter on vSwitch when the type is Switch.
    - Create a WFP filter when the type is Host.
- Action: Allow or Block
- LocalPorts: This can be a port or range. For example, 80 or 100-200.
- RemotePorts: Same as LocalPorts.
- LocalAddresses: It is an address or range. For example, 10.224.0.5, 10.224.1.0/24 (10.224.1.1-10.224.1.10 is not allowed).
- RemoteAddress: Same as LocalAddresses
- Protocol: ICMP/TCP/UDP/IGMP Protocol 255 is IPPROTO_RAW and 256 – PROTO_MAX

The ports can only be specified for UDP and TCP, and ports are not allowed in the policy unless a protocol is specified.

Configuring a policy on a virtual port is a transaction-based operation. If one of the filters is invalid, enforcing the entire policy is rendered unsuccessful.

This is the stateful enforcement. Application, user, or service-based policies are currently not supported.

Compatibility with Calico

Pods enforcement works in "preserve rules" off mode. When the Windows agent enforces the rules on pods, it deletes the already configured policies. If the Calico plug-in enforces the network policies after the agent, the agent identifies it as **deviation** and network policies that are configured by Calico are deleted and agent policies are re-enforced.

Note The enforced policies are deleted when the Windows agent is uninstalled on the Windows nodes.

Visibility of Configured VFP Filters

An option to list the pod filters using Secure Workload is not available. In an AKS environment, you can use the built-in PowerShell script. Run the following PowerShell script: `c:\k\debug\collectlogs.ps1`. View the output files **vfpoutput.txt** and **hnsdiag.txt** for the configured filters.

Delete VFP Filters Configured by Windows Agent

1. Run **cmd.exe** with administrative privileges.
2. Run the command: `<installation folder>\tetenf.exe -d -f -pods -token=<yyyymm>`.

Note The command deletes VFP filters for all the pods.

Troubleshoot Enforced Policies and Network Flows

1. Run the command: `netsh wfp start capture keywords=19`.
2. Run network traffic.
3. Stop capturing the flows: `netsh wfp stop capture`.
4. Extract **wfpdiag.xml** from the **wfpdiag.cab** file. View the dropped flows.

To map the allowed or dropped network flows to Pod policies:

1. Start ETW session: `logman start <session name> -p Microsoft-Windows-Hyper-V-VfpExt -o <output file.etl> -ets`
2. Run network traffic.
3. Stop capturing flows: `logman stop <session name>`.
4. In the command prompt, run: `tracerpt <output file.etl>`. The command creates the **dumpfile.xml** file. View the network flows.

Agent Enforcement on AIX Platform

On the AIX platform, the Secure Workload agent uses IPFilter utilities to enforce network policies. By default, after the agent is enabled on the host, the agent controls and programs the IPv4 filter table. IPv6 enforcement is not supported.

IPFilter

The IPFilter package on AIX is used to provide firewall services and is available on AIX as a kernel expansion pack. It loads as a kernel extension module, */usr/lib/drivers/ipf*. It includes ipf, ippool, ipfstat, ipmon, ipfs, and ipnat utilities that are used to program ipfilter rules and each of these rules specifies the match criteria for a packet. For more information, see the IPFilter pages in the AIX manual.

When enforcement is enabled, the agent uses IPFilter to program the IPv4 filter table that contains rules for allowing or dropping of IPv4 packets. The agent groups these rules to categorize and manage the policies using the controller. These rules include Secure Workload rules that are derived from the policies and rules that are generated by the agent.

When an agent receives platform-independent rules, it parses and converts them into ipfilter or ippool rules and inserts these rules into the filter table. After programming the firewall, the enforcement agent monitors the firewall for any rule or policy deviation and if so, reprograms the firewall. The agent keeps track of the policies that are programmed in the firewall and reports their status periodically to the controller.

A typical policy in a platform-independent network policy message consists of:

```
source set id: "test-set-1"
destination set id: "test-set-2"
source ports: 20-30
```

```
      destination ports: 40-50
      ip protocol: TCP
      action: ALLOW
      ...
      set_id: "test-set-1"
         ip_addr: 1.2.0.0
         prefix_length: 16
         address_family: IPv4
      set_id: "test-set-2"
         ip_addr: 5.6.0.0
         prefix_length: 16
         address_family: IPv4
```

Along with other information, the agent processes the policy and converts it into platform-specific ippool and ipfilter rule:

```
    table role = ipf type = tree number = 51400
    { 1.2.0.0/16; };

    table role = ipf type = tree number = 75966
    { 5.6.0.0/16; };

pass in quick proto tcp from pool/51400 port 20:30 to pool/75966 port 40:50 flags S/SA group
 TA_INPUT
pass out quick proto tcp from pool/75966 port 40:50 to pool/51400 port 20:30 flags A/A group
 TA_OUTPUT
```

Caveats

Host Firewall Backup

When enforcement is enabled for the first time in an Agent Config Profile, the agents running on AIX hosts, before taking control of the host firewall, store the current content of ippool and ipfilter into */opt/cisco/tetration/backup*. Successive disable or enable transitions of enforcement configuration do not generate backups. The directory is not removed upon agent uninstallation.

Known Limitations

IPv6 enforcement is not supported.

Check Agent Status and Statistics

Procedure

Step 1 In the navigation pane, click **Manage** > **Workloads** > **Agents**.

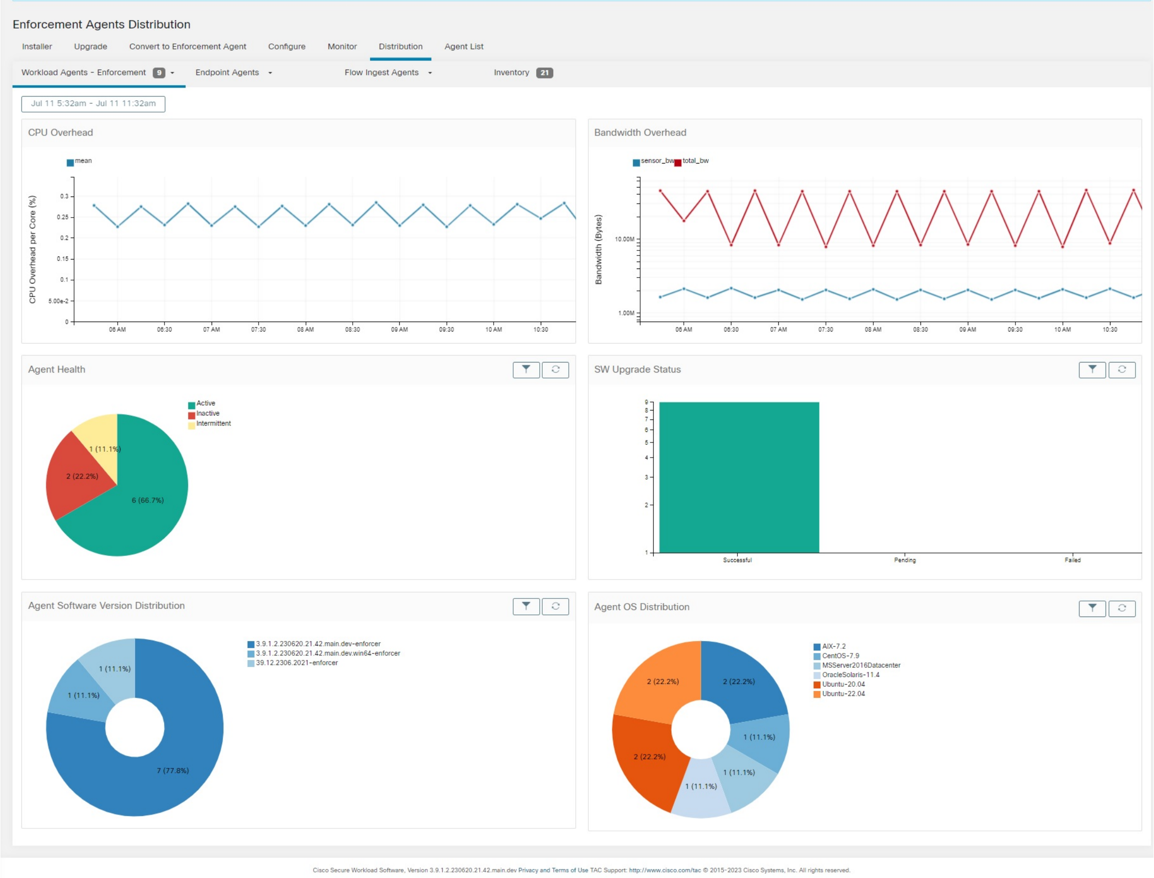
Step 2 Click the **Distribution** tab.

Step 3 Click an agent type from the top of the page.

Step 4 On this page, you can check CPU Overhead, Bandwidth Overhead, Agent Health, Software Update Status, Agent Software Version Distribution, and Agent OS Distribution.

For more information about this page, see the Agent Status and Statistics section.

Figure 2: Agent Distribution Page



Note **Agent Health**: The agent periodically checks in every 10–30 minutes. If there is no check-in for more than 1 hour 30 minutes, then the agent is inactive. To reduce false alarms, the agent health status is set to intermittent instead of inactive if the check-in gap is between 1 hour and 1 hour 30 minutes.

For more information on the enforcement status, see the Enforcement Status section.

View Agent Details

The following steps provide one of the available options to navigate to the Workload Profile page, which displays details about the workload and its installed agent.

Procedure

Step 1 In the navigation pane, click **Organize** > > **Scopes and Inventory**.

Step 2 Search for a workload for which you want to view details.

Step 3 Click the IP address to view the details such as agent health, IP address, Scopes, Inventory Type, Enforcement Groups, Experimental Groups, User Labels, and Traffic Volume (Total Bytes/Total Packets).

For more information, see Workload Profile, on page 387.

Software Agent Config

Requirements and Prerequisites for Configuring Software Agents

- Ensure that you have the required Secure Workloaduser role credentials:
  - Site Administrator
  - Customer Support

  For more information, see User Roles and Access to Agent Configuration, on page 63.

- Ensure that you have privileges on the host to run the agent service on each workload. For more information, see Service Management of Agents.

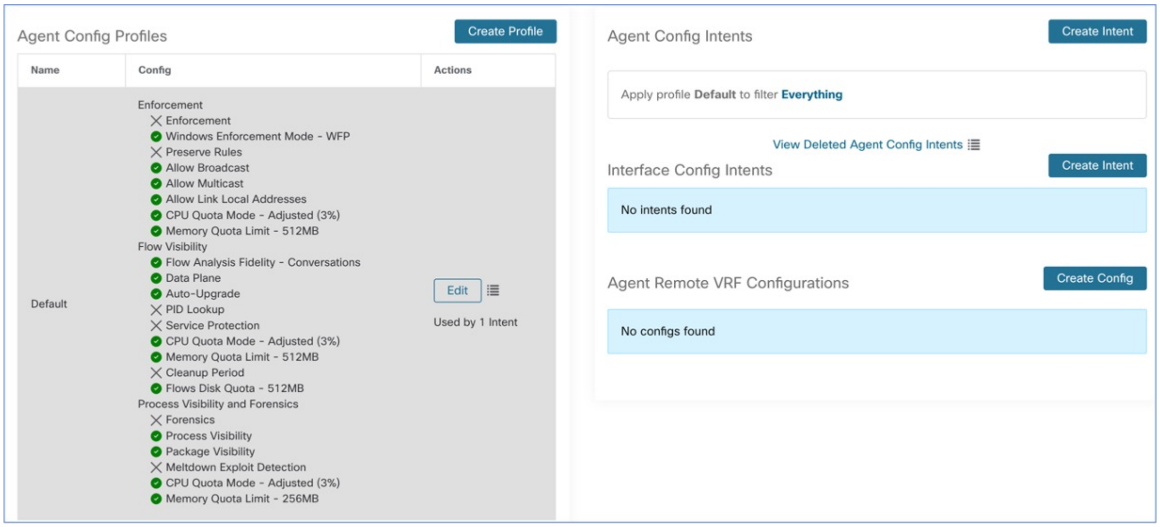
- Verify the supported platforms, requirements, and installation instructions for agents. For more information, see Deploying Software Agents.

User Roles and Access to Agent Configuration

1. Root scope owners have access only to create a Configuration Profile and Configuration Intent specification.
2. Root scope owners can create configuration profiles that are associated with only owned scopes and impose these configuration profiles on agents that are owned filters or scopes.

Note Under the Agent Configuration Profile, you can now see the number of intents using the configuration profile before you edit the profile.

Figure 3: Software Agent Configuration Tab for Scope Owner Users



Agent Config Profiles

Name	Config	Actions
Default	Enforcement ✗ Enforcement ✓ Windows Enforcement Mode - WFP ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Conversations ✓ Data Plane ✓ Auto-Upgrade ✗ PID Lookup ✗ Service Protection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB ✗ Cleanup Period ✓ Flows Disk Quota - 512MB Process Visibility and Forensics ✗ Forensics ✓ Process Visibility ✓ Package Visibility ✗ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit Used by 1 Intent

Agent Config Intents

Apply profile **Default** to filter **Everything**

View Deleted Agent Config Intents

Interface Config Intents

No intents found

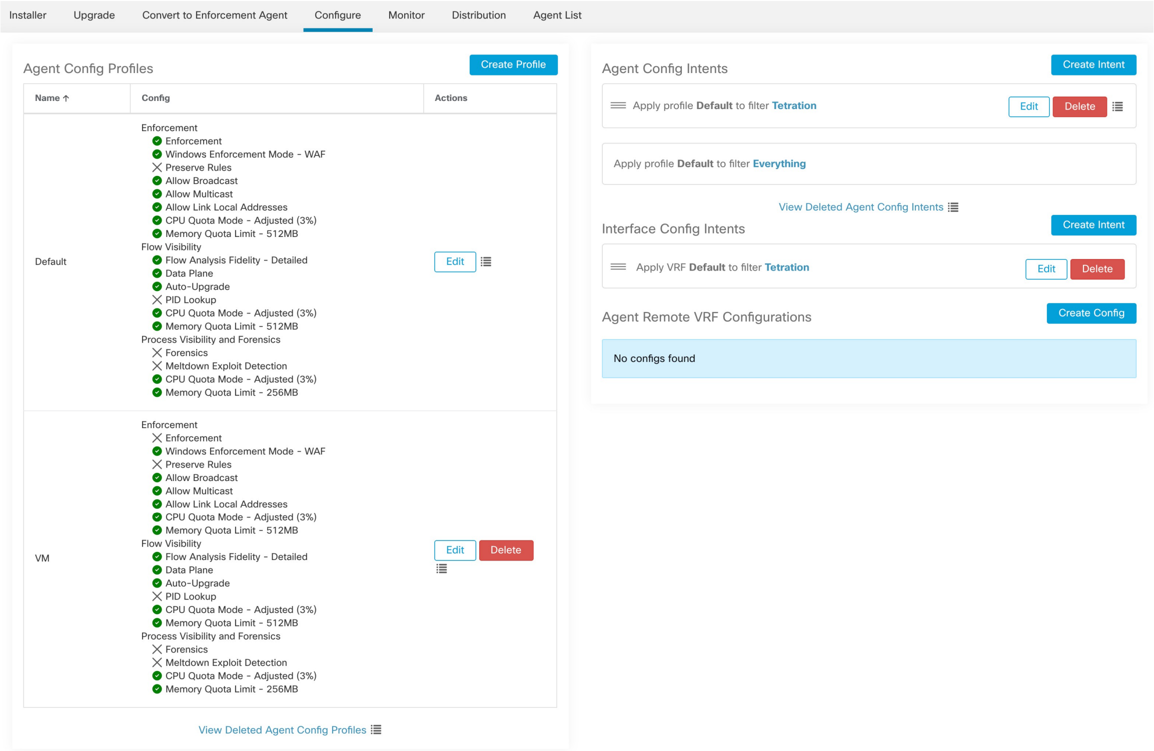
Agent Remote VRF Configurations

No configs found

Figure 4: Software Agent Configuration Tab for Scope Owner Users

3. Site administrators have access to all the components in the Agent Configuration page that include specifying interface configuration intents and remote virtual routing and forwarding configurations.

Figure 5: Software Agent Configurtion Tab for Site Administrators



Agent Config Profiles

Name ↑	Config	Actions
Default	Enforcement ✓ Enforcement ✓ Windows Enforcement Mode - WAF ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Detailed ✓ Data Plane ✓ Auto-Upgrade ✗ PID Lookup ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Process Visibility and Forensics ✗ Forensics ✗ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit
VM	Enforcement ✗ Enforcement ✓ Windows Enforcement Mode - WAF ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Detailed ✓ Data Plane ✓ Auto-Upgrade ✗ PID Lookup ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Process Visibility and Forensics ✗ Forensics ✗ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit Delete

View Deleted Agent Config Profiles

Agent Config Intents

Apply profile **Default** to filter **Tetration**

Apply profile **Default** to filter **Everything**

View Deleted Agent Config Intents

Interface Config Intents

Apply VRF **Default** to filter **Tetration**

Agent Remote VRF Configurations

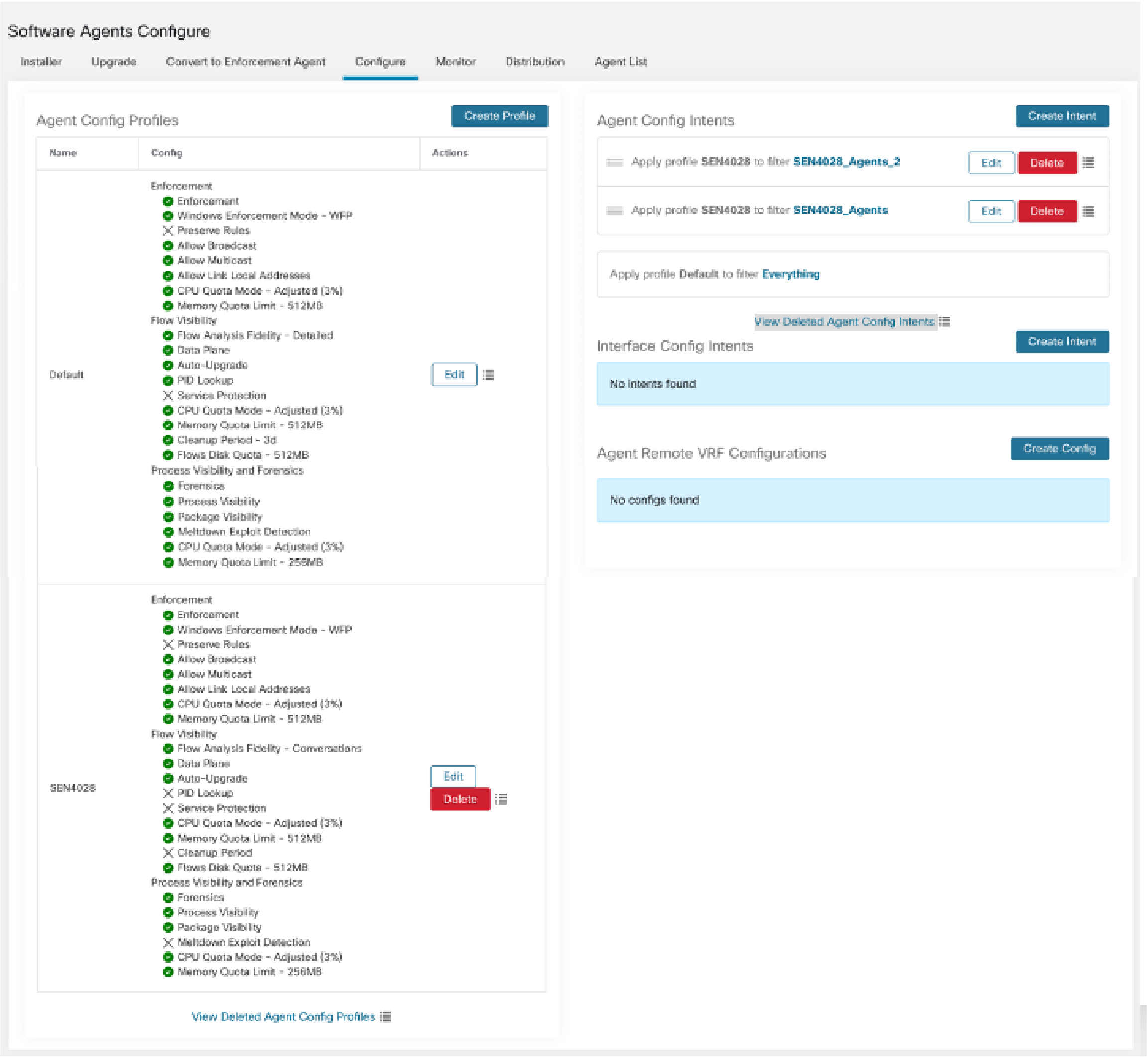
No configs found

Configure Software Agents

On the Software Agent Configuration page, configure the software agents to create intents that are associated with either an **Inventory Filter** or a **Scope**. For each agent, apply the first matching intent. For more information, see Inventory, on page 339.

Note For any Secure Workload deployment, a default agent configuration is applied to all agents that are not associated with any specific configuration profile.

Figure 6: Software Agent Configuration


Software Agents Configure
Installer
Upgrade
Convert to Enforcement Agent
Configure
Monitor
Distribution
Agent List
Create Profile
Create Intent
Edit
Delete
Create Intent
Create Config
View Deleted Agent Config Profiles
View Deleted Agent Config Intents

Agent Config Profiles

Name	Config	Actions
Default	Enforcement ✓ Enforcement ✓ Windows Enforcement Mode - WFP ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Detailed ✓ Data Plane ✓ Auto-Upgrade ✓ PID Lookup ✗ Service Protection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB ✓ Cleanup Period - 3d ✓ Flows Disk Quota - 512MB Process Visibility and Forensics ✓ Forensics ✓ Process Visibility ✓ Package Visibility ✓ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit
SEN4028	Enforcement ✓ Enforcement ✓ Windows Enforcement Mode - WFP ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Conversations ✓ Data Plane ✓ Auto-Upgrade ✗ PID Lookup ✗ Service Protection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB ✗ Cleanup Period ✓ Flows Disk Quota - 512MB Process Visibility and Forensics ✓ Forensics ✓ Process Visibility ✓ Package Visibility ✗ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit Delete

Agent Config Intents

Apply profile **SEN4028** to filter **SEN4028_Agents_2**

Apply profile **SEN4028** to filter **SEN4028_Agents**

Apply profile **Default** to filter **Everything**

Interface Config Intents

No intents found

Agent Remote VRF Configurations

No configs found

Create an Agent Configuration Profile

Before you begin

See Requirements and Prerequisites for Configuring Software Agents, on page 63.

Procedure

Step 1 In the navigation bar, click **Manage** > **Workloads** > **Agents**.

Step 2 Click the **Configure** tab.

Step 3 Click the **Create Profile** button.

Step 4 Enter a name for the profile (required) and choose the scopes where the profile is available.

Step 5 Enter the appropriate values in the fields listed in the table:

Table 7: Enforce Configuration

Option	Description
Enforcement	**Enable** - Enable policy enforcement on the agent. After you enable enforcement, the agent enforces the most recently received policy set. **Disable** (Default) - The agent does not enforce a policy. **Note** If you enable, disable and re-enable policy enforcement on the agent, it clears the firewall state and sets the catch-all default action to ALLOW.
Preserve Rules	**Enable** - Preserves existing firewall rules on the agent. **Disable** (Default) - Clears existing firewall rules before applying enforcement policy rules from Secure Workload. Behaviour of the Preserve Rules attribute is platform-specific. You can view the details of the attributes in the Preserve Rules section in each platform.
Allow Broadcast	**Enable** (Default) - Adds rules to the firewall to allow ingress and egress broadcast traffic on workload. **Disable** - Does not add any rules. The broadcast traffic drops if the default policy on the agent is DENY.
Allow Multicast	**Enable** (Default) - Adds rules to the firewall to allow ingress and egress multicast traffic on workload. **Disable** - Does not add any rules. The Multicast traffic drops if the default policy on the agent is DENY.
Allow Link Local	**Enable** (Default) - Adds rules to the firewall to allow link local addresses traffic on workload. **Disable** - Does not add any rules. The Multicast traffic drops if the default policy on the agent is DENY.

Option	Description
CPU Quota Mode for enforcement process	**Adjusted** (Default) - The CPU limit adjusts according to the number of CPUs on the system. For example, if there are 10 CPUs, set the CPU limit to 3%, the agents use only a total of 30% (measured by top). **Top** - The CPU limit value matches the top view on average. For example, if you set the CPU limit to 3% and there are 10 CPUs in the system, the CPU usage is 3%. It is a fairly restrictive mode, use it only when necessary. **Disable** - Disable the CPU limit feature. The agent uses CPU resources that used in the operating system. For more information, see Secure Workload Data Sheet.
CPU Quota Limit (%)	Specify the actual limit in percentage of the system processing power.
Memory Quota Limit (MB)	Specify the memory limit (in MB) for processes. If the process hits this limit, it restarts.
Windows Enforcement Mode	On Windows workloads, agents can enforce network policies using: • **WFP** - Windows Filtering Platform (by directly programming WFP filters in the Windows Filter Engine). See Agent Enforcement on the Windows Platform in WFP Mode, on page 44. • **WAF** (Default) - Windows Advanced Firewall. See Agent Enforcement on the Windows Platform in WAF mode, on page 41.

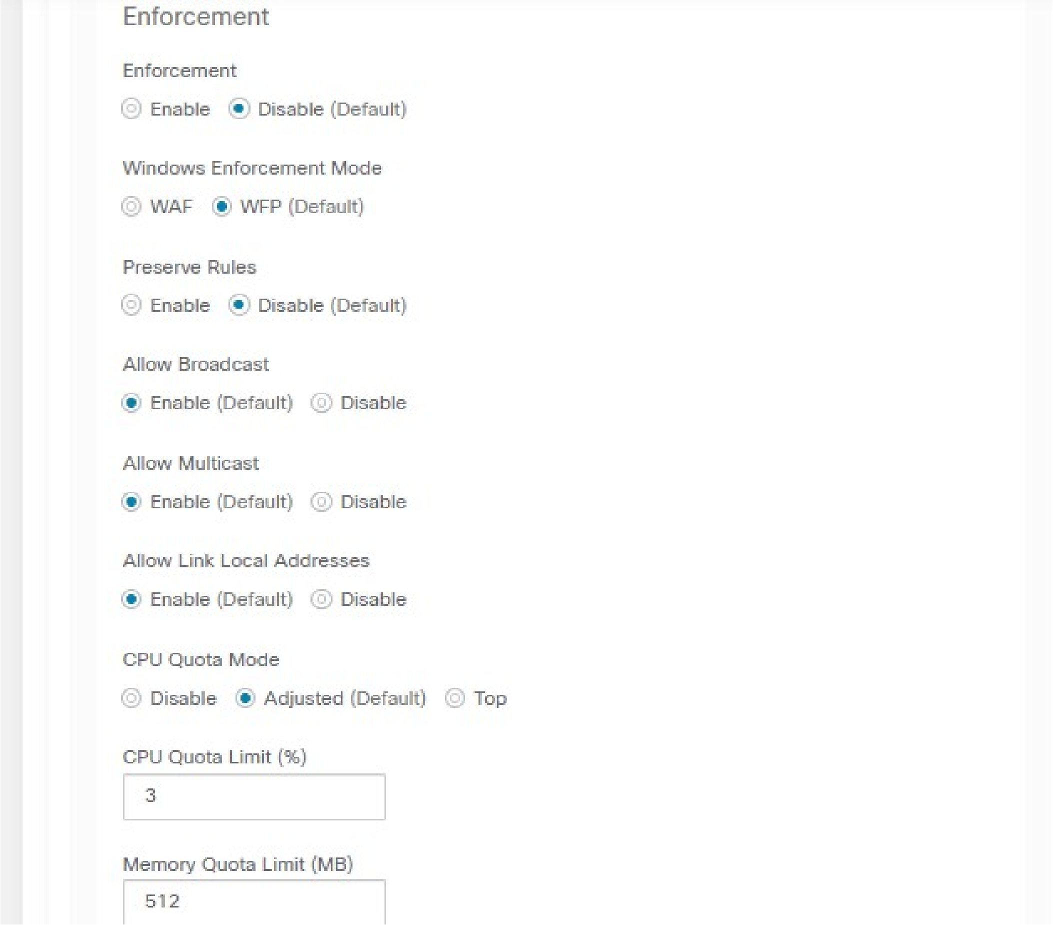
Table 8: Flow Visibility Config

Field	Description
Flow Analysis Fidelity	**Conversations** - Enable conversation mode on all sensors. **Detailed** (Default) - Enable detailed mode on all sensors.
Data Plane	**Enable** (Default) - Enable the agent to send reports to the cluster. **Disable** - Disable the agent’s reports.
Auto-Upgrade	**Enable** (Default) - Automatically upgrade the agent when a new package is available. **Disable** - Do not automatically upgrade the agent.
PID Lookup	**Enable** - Enable process ID lookups on the agent. When enabled, the agent makes best-effort attempts to associate network flows with running processes in the workload. This operation is expensive, therefore the agent throttles the number of operations in each export cycle to keep the CPU overhead under control. It is possible that some flows are not associated with any processes even when you enable the config. **Disable** (Default) - Do not enable process ID lookups on the agent.

Field	Description
Service Protection	**Enable** - Enable service protection on the agent. When enabled, the agent ensures it prevents users from disabling the service, from uninstalling the agent, and from restarting the service. However, after disabling the service protection, you can continue to stop or can uninstall the agent. **Note** • Do not disable service protection for normal auto upgrade of an agent. • Do not enable service protection for manual upgrade of an agent. • Service protection blocks any forced upgrades, such as using the installer script - forceUpgrade option. • Any system-initiated upgrade works when you enable the service protection. **Disable(*)**-By default, disable the service protection on the agent. **Detailed** (Default) - Enable detailed mode on all agents. **Note** This feature is available only for Windows agent.
CPU Quota Mode	**Adjusted** (Default) - Adjust the CPU limit according to the number of CPUs on the system. For example, if there are 10 CPUs in the system, set the CPU limit to 3%. Choose this mode to allow the agent to use a total of 30% (measured by top). **Top**- The CPU limit value matches the top view on average. For example, set the CPU limit to 3% for the 10 CPUs in the system, the CPU usage is only 3%. It is a fairly restrictive mode and uses it only when necessary. **Disable** - Disable the CPU limit feature. The agent uses CPU resources that are used in the operating system.
CPU Quota Limit (%)	Specify the actual limit in percentage of the system processing power that the agent can use.
Memory Quota Limit (MB)	Specify the memory limit in MB that the process allows to use. If the process hits this limit, the process restarts.
Cleanup period (days)	**Enable** - Enable automated cleanup on the agent. Enter the number of days after which remove the inactive agent. **Disable** (Default) - Do not enable automated cleanup on the agent.
Flow Analysis Fidelity	**Conversations** - Enable conversation mode on all agents. **Detailed** (Default) - Enable detailed mode on all agents.
Flows Disk Quota (MB)	Specify in MB the total size limit of stored flow data.

Field	Description
Flows Disk Quota (MB)	Enter the maximum size limit (in MB) for storing the flow data. If the Flows Disk Quota field is: • 0: The agents do not store offline flows locally. • Blank: Enable the Flows Time Window field. After you enter the duration in the Flows Time Window, the Flows Disk Quota field automatically sets the value to16 GB. You can either choose the Flows Disk Quota or the Flows Time Window option for flow log buffering in case of connectivity break between the agent and the cluster. For example, if you have set the Flows Time Window as one hour and the agent is unable to communicate with the cluster, the agent stores flow data for the last hour. Any flow data locally stored on the workload beyond the last hour is overridden by newer logs.
Flows Time Window (Hours)	Specify in hours how long the agent must capture and store flows locally. Choose either **Flows Disk Quota** or **Flows Time Window**; it's either size-based or time-based rotation. On chooseing Flows Time Window, set the Flows Disk Quota to 16 GB. Setting Flows Disk Quota to 0 disables this feature. The flow data is rotated when it reaches either size limit or time limit.
Flows Time Window (Hours)	This field is displayed only when there is no value that is entered in the Flows Disk Quota field. Enter the duration, in hours, for the agents to capture the flows and store them locally. • After the connectivity to the agents is restored, the agents send the live flow data. • While sending the live flow data, the agents also initiates to upload the buffered telemetry data. The telemetry data is sent in small packets at regular intervals. • Depending on the size of the buffered telemetry data and transmission transfer speed, it takes multiple intervals to send all the buffered data. • The agents progressively deletes the locally stored flow data. Remove the outdated flow data that is stored locally after it reaches the configured size or time limit.

Figure 7: Flow Visibility



Enforcement

Enforcement

○ Enable ● Disable (Default)

Windows Enforcement Mode

○ WAF ● WFP (Default)

Preserve Rules

○ Enable ● Disable (Default)

Allow Broadcast

● Enable (Default) ○ Disable

Allow Multicast

● Enable (Default) ○ Disable

Allow Link Local Addresses

● Enable (Default) ○ Disable

CPU Quota Mode

○ Disable ● Adjusted (Default) ○ Top

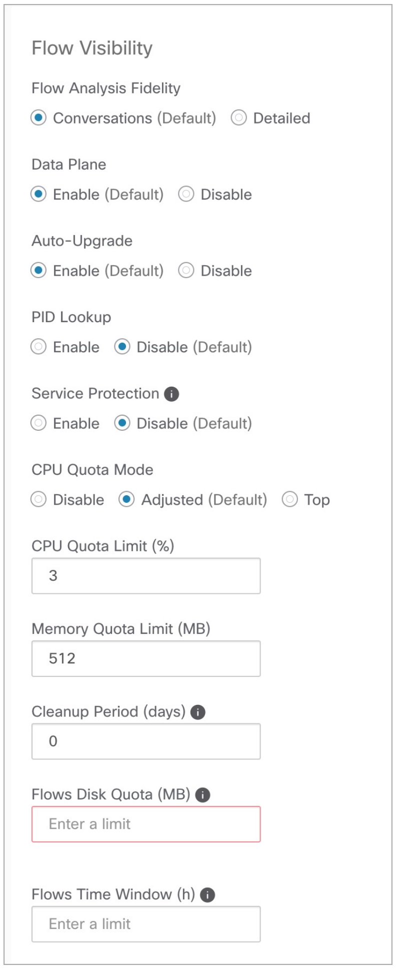
CPU Quota Limit (%)

3

Memory Quota Limit (MB)

512

Figure 8:



Flow Visibility

Flow Analysis Fidelity

● Conversations (Default) ○ Detailed

Data Plane

● Enable (Default) ○ Disable

Auto-Upgrade

● Enable (Default) ○ Disable

PID Lookup

○ Enable ● Disable (Default)

Service Protection

○ Enable ● Disable (Default)

CPU Quota Mode

○ Disable ● Adjusted (Default) ○ Top

CPU Quota Limit (%)

3

Memory Quota Limit (MB)

512

Cleanup Period (days)

0

Flows Disk Quota (MB)

Enter a limit

Flows Time Window (h)

Enter a limit

Table 9: Process Visibility and Forensics Config

Field	Description
Forensics	**Enable** - Enable forensics on the agent. This feature consumes extra CPU cycles that are specified in the CPU limit below. For example, if the CPU limit is 3% and you enable this feature, the agent uses up to 6% in total. **Disable** (Default) - Disable forensics on the agent.
Meltdown Exploit Detection	**Enable** - Enable Forensics and Meltdown exploit detection on the agent. For more information, see Side Channel in the Compatibility, on page 573. **Disable** (Default) - Disable Meltdown exploit detection on the agent.

Field	Description
CPU Quota Mode	**Adjusted** (Default) - Adjust the CPU limit according to the number of CPUs on the system. For example, set the CPU limit to 3% with 10 CPUs in the system. Choose this mode to use a total of 30% (measured by top). **Top** - The CPU limit value matches the top view on average. For example, set the CPU limit to 3% with 10 CPUs in the system, the CPU usage remains at 3%. Use this restrictive mode only if necessary. **Disable** - Disable the CPU limit feature, the agent uses CPU resources permissible by the operating system.
CPU Quota Limit (%)	Specify the actual limit, in percentage, of the system processing power the agent can use.
Memory Quota Limit (MB)	Specify the memory limit (in MB). If the storage limit goes beyond the specified limit, the process restarts.

Step 6 Click **Save**

What to do next

Associate this profile with an agent config intent. For more information, see Creating an Agent Config Intent, on page 73.

Creating an Agent Config Intent

Before you begin

- See Requirements and Prerequisites for Configuring Software Agents, on page 63.
- Create an agent config profile. See Create an Agent Configuration Profile, on page 66.

Procedure

Step 1 In the navigation bar on the left, click **Manage** > **Agents**.

Step 2 Click the **Configure** tab.

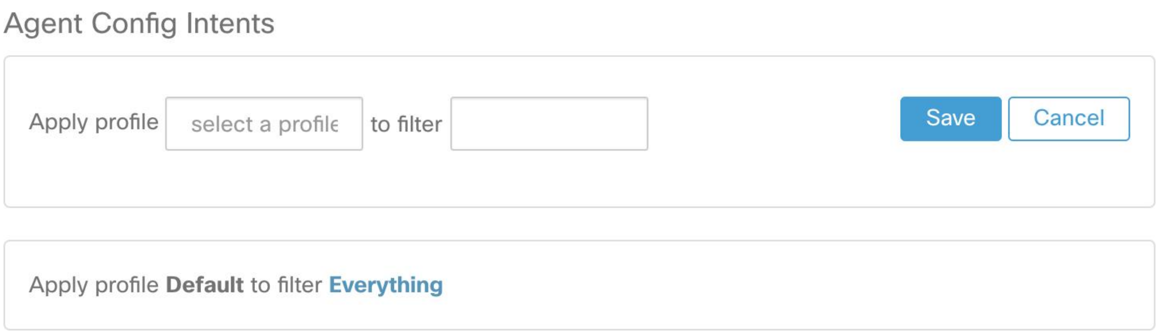
Step 3 Click the **Create Intent** button next to the **Agent Config Intent** heading.

Step 4 Enter the appropriate values in the fields listed in the table below:

Field	Description
Profile (required)	Enter the name of an existing profile and select it from the dropdown menu.
Filter (required)	Enter the name of an existing filter or scope or select *Create new filter* from the dropdown menu. See Filters for more information on creating filters.

Step 5 Click **Save**.

Figure 9: Agent Config Intents



Agent Config Intents

Apply profile select a profile to filter

Apply profile **Default** to filter **Everything**

Creating a Remote VRF configuration for agents

This is the recommended way to assign VRFs for Secure Workload software agents. Using this configuration, Secure Workload appliance assigns VRFs to software sensors based on the source IP address and source port seen for those agent on connections to Secure Workload appliance.

Procedure

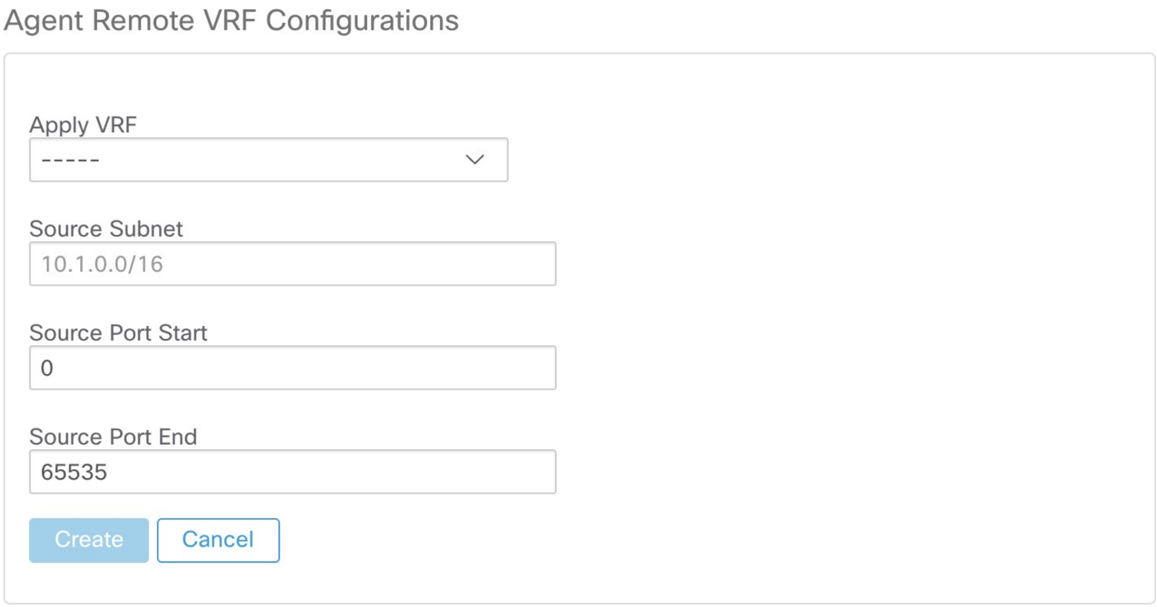
Step 1 In the navigation bar on the left, click **Manage** > **Agents**.

Step 2 Click the **Configure** tab.

Step 3 Click the **Create Config** button next to the **Agent Remote VRF Configurations** heading.

Step 4 Enter the appropriate values in the fields and click **Save**.

Figure 10: Remote VRF configuration



Agent Remote VRF Configurations

Apply VRF: -----

Source Subnet: 10.1.0.0/16

Source Port Start: 0

Source Port End: 65535

Create an Interface Configuration Intent

We recommend assigning virtual routing and forwarding (VRFs) to agents in using Remote VRF configuration settings. In rare cases, when agent hosts have multiple interfaces that must be assigned to different VRFs, you can choose to assign them VRFs using Interface Configuration Intents.

Procedure

Step 1 Navigate to **Manage** > **Agents**.

Step 2 Click the **Configure** tab.

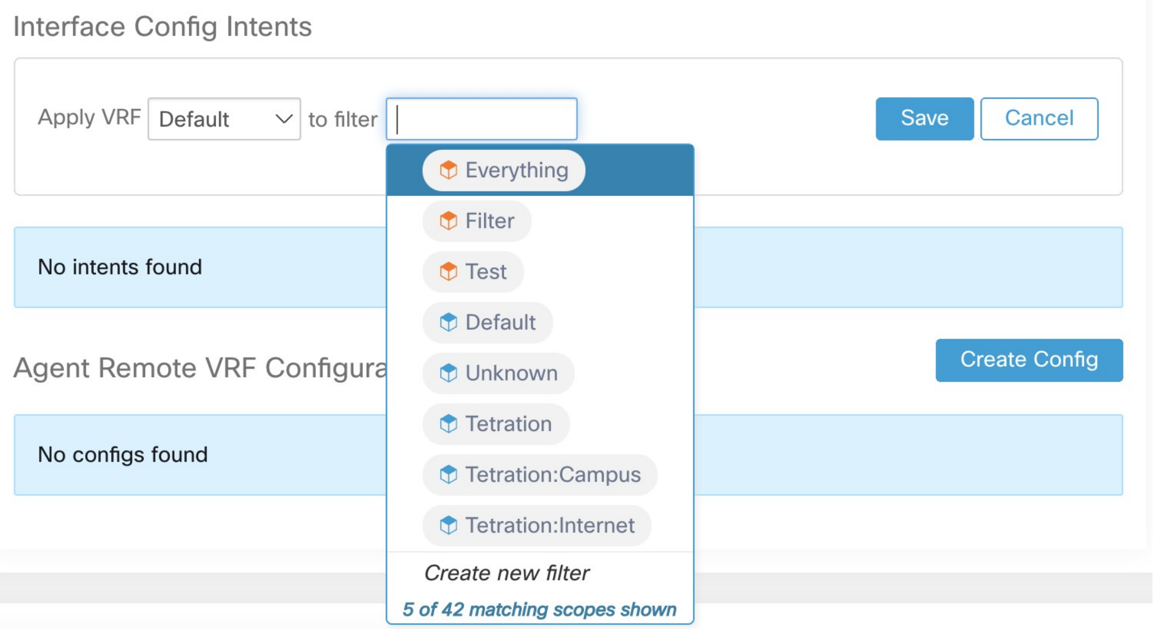
Step 3 Click the **Create Intent** button next to the **Interface Config Intent** heading.

Step 4 Enter the appropriate values in the fields listed in the table:

Field	Description
VRF	Choose a VRF from the drop-down list (required).
Filter	Enter the name of an existing filter or scope or choose *Create a new filter* from the drop-down list (required). For more information, see Filters.

Step 5 Click **Save**.

Figure 11: Interface Configuration Intents



Note When you delete an interface with a higher priority config intent, the agents do not fall back to the default catch all intent.

View Detailed Agent Status in the Workload Profile

Procedure

Step 1 Follow the steps above to check Agent status.

Step 2 On the Enforcement Agents page, click **Agent OS Distribution**. Select an operating system and click filter image on the top-right corner of the box.

Step 3 On the Software Agent List page, agents with selected operating system Distribution is listed.

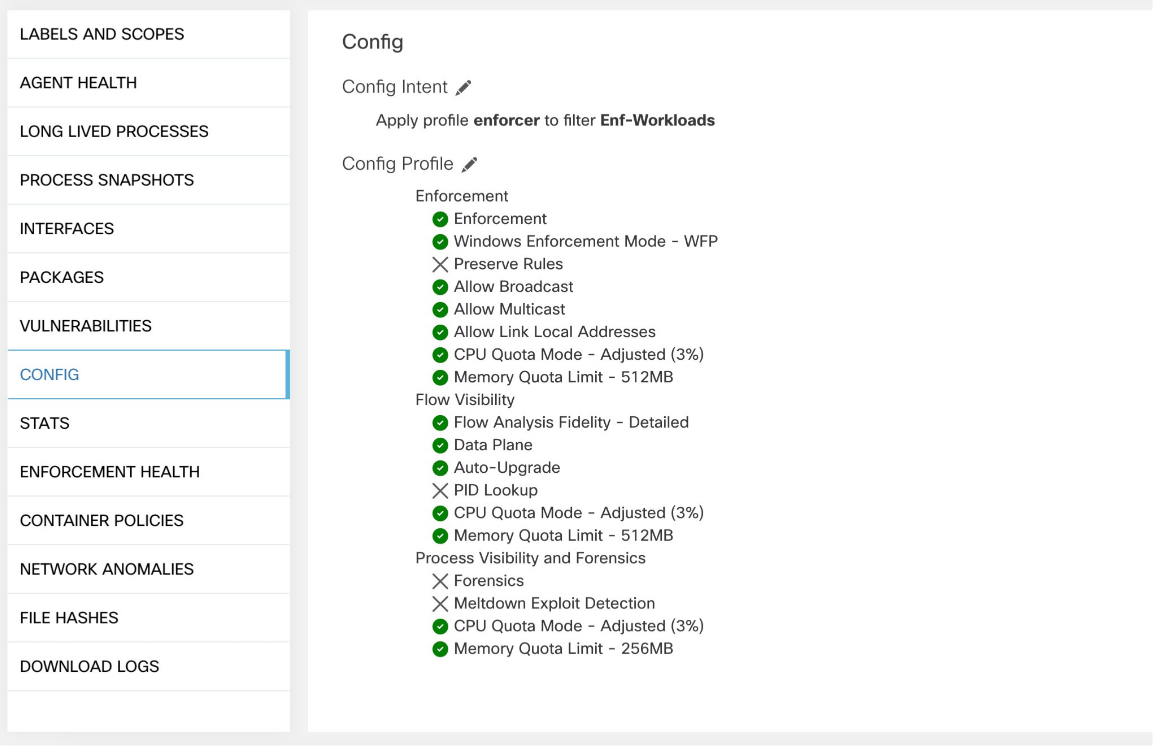
Step 4 Click on **Agent** for the agent details, and click IP address. On the Workload Profile page, you can view details of the Host Profile, Agent Profile and agent specific details, such as Bandwidth, Long- lived Processes, Packages, Process Snapshot, Configuration, Interfaces, Stats, Policies, Container Policies and so on.

Step 5

Step 6 Click **Config tab** to see the configuration on the endhost.

Step 7 Click **Policies tab** to see the enforced policies on the endhost.

Figure 12: Workload Profile - Config



Config

Config Intent

Apply profile **enforcer** to filter **Enf-Workloads**

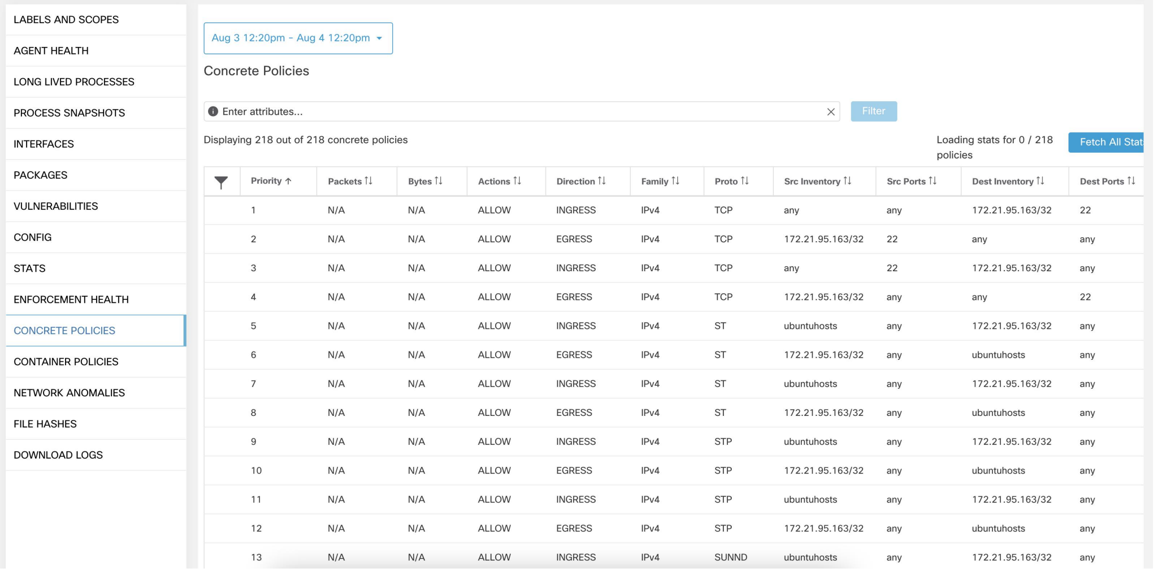
Config Profile

Enforcement
- ✓ Enforcement
- ✓ Windows Enforcement Mode - WFP
- ✗ Preserve Rules
- ✓ Allow Broadcast
- ✓ Allow Multicast
- ✓ Allow Link Local Addresses
- ✓ CPU Quota Mode - Adjusted (3%)
- ✓ Memory Quota Limit - 512MB

Flow Visibility
- ✓ Flow Analysis Fidelity - Detailed
- ✓ Data Plane
- ✓ Auto-Upgrade
- ✗ PID Lookup
- ✓ CPU Quota Mode - Adjusted (3%)
- ✓ Memory Quota Limit - 512MB

Process Visibility and Forensics
- ✗ Forensics
- ✗ Meltdown Exploit Detection
- ✓ CPU Quota Mode - Adjusted (3%)
- ✓ Memory Quota Limit - 256MB

Figure 13: Workload Profile - Policies



Concrete Policies

Displaying 218 out of 218 concrete policies

Loading stats for 0 / 218 policies

Priority ↑	Packets ⇅	Bytes ⇅	Actions ⇅	Direction ⇅	Family ⇅	Proto ⇅	Src Inventory ⇅	Src Ports ⇅	Dest Inventory ⇅	Dest Ports ⇅
1	N/A	N/A	ALLOW	INGRESS	IPv4	TCP	any	any	172.21.95.163/32	22
2	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.21.95.163/32	22	any	any
3	N/A	N/A	ALLOW	INGRESS	IPv4	TCP	any	22	172.21.95.163/32	any
4	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.21.95.163/32	any	any	22
5	N/A	N/A	ALLOW	INGRESS	IPv4	ST	ubuntuhosts	any	172.21.95.163/32	any
6	N/A	N/A	ALLOW	EGRESS	IPv4	ST	172.21.95.163/32	any	ubuntuhosts	any
7	N/A	N/A	ALLOW	INGRESS	IPv4	ST	ubuntuhosts	any	172.21.95.163/32	any
8	N/A	N/A	ALLOW	EGRESS	IPv4	ST	172.21.95.163/32	any	ubuntuhosts	any
9	N/A	N/A	ALLOW	INGRESS	IPv4	STP	ubuntuhosts	any	172.21.95.163/32	any
10	N/A	N/A	ALLOW	EGRESS	IPv4	STP	172.21.95.163/32	any	ubuntuhosts	any
11	N/A	N/A	ALLOW	INGRESS	IPv4	STP	ubuntuhosts	any	172.21.95.163/32	any
12	N/A	N/A	ALLOW	EGRESS	IPv4	STP	172.21.95.163/32	any	ubuntuhosts	any
13	N/A	N/A	ALLOW	INGRESS	IPv4	SUNND	ubuntuhosts	any	172.21.95.163/32	any

Note **Fetch All Stats** is not supported on Windows agent hosts, which is used to provide statistics for individual policies.

Rehoming of Agents

Rehoming of agents is the method to move users from On-premises to SaaS or SaaS to On-premises.

User Roles

- Site Administrator
- Customer Support Representative

You can migrate to or from a SaaS environment, especially, when you move from SaaS to On-premises, you must work with an internal support team.

Workflow

- Enter the Activation Key, Sensor virtual IP, and Sensor certificate authority (CA) and Enable Rehoming, on page 78.
- Select Agents to Rehome, on page 79.
- Disable Rehoming, on page 80.

Note At any given time, you can move an agent to only one destination. We recommend that you Disable Agent Rehoming after you move the agent.

Enable Rehoming

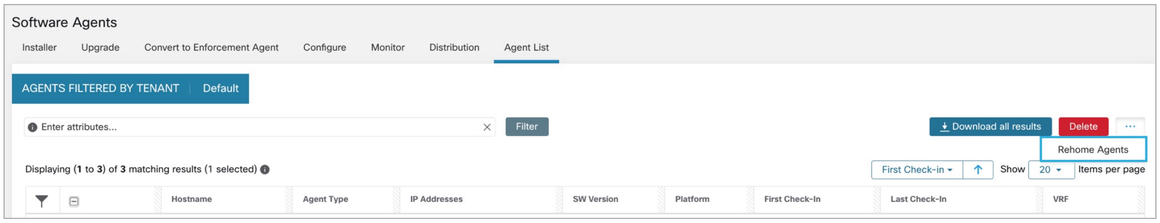
Procedure

Step 1 In the left navigation menu, click **Manage** > **Workloads** > **Agents**.

Step 2 Click the **Agent List** tab.

Step 3 Click the menu icon and select **Rehome Agents**.

Figure 14: Rehome Agents

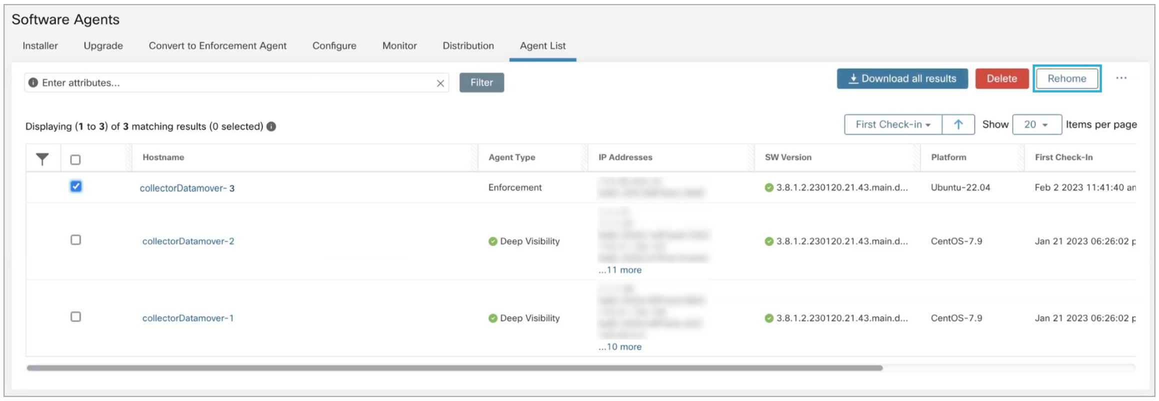


Displaying (1 to 3) of 3 matching results (1 selected)

Step 4 On the **Agent Rehoming** window, fill in the following details:

Field	Description
Destination Scope Activation Key	**a.** Navigate to **Manage** > **Workloads** > **Agents**. **b.** Click the **Installer** tab. **c.** Select **Manual install using classic packaged installers**. **d.** Click **Next**. **e.** Click **Agent Activation Key**. **f.** Copy the **Key** value and paste it into the **Destination Scope Activation Key** field.
Destination Sensor VIP	**a.** Navigate to **Platforms** > **Cluster Configuration**. **b.** Copy the **Sensor VIP** and paste it into the **Destination Sensor VIP field**.
HTTPS proxy	Enter a proxy domain or address if the agent needs to use a proxy for outbound communication.
Destination Sensor CA Cert	**a.** Navigate to **Platforms** > **Cluster Configuration**. **b.** Click **Download Sensor CA Cert**.

Figure 15: Enable Agent Rehoming



Software Agents

Installer | Upgrade | Convert to Enforcement Agent | Configure | Monitor | Distribution | Agent List

Enter attributes... | Filter | Download all results | Delete | Rehome

Displaying (1 to 3) of 3 matching results (0 selected)

First Check-in | Show 20 | Items per page

	□	Hostname	Agent Type	IP Addresses	SW Version	Platform	First Check-In
	☑	collectorDatamover- 3	Enforcement	[redacted]	● 3.8.1.2.230120.21.43.main.d...	Ubuntu-22.04	Feb 2 2023 11:41:40 an
	□	collectorDatamover-2	● Deep Visibility	[redacted] ...11 more	● 3.8.1.2.230120.21.43.main.d...	CentOS-7.9	Jan 21 2023 06:26:02 p
	□	collectorDatamover-1	● Deep Visibility	[redacted] ...10 more	● 3.8.1.2.230120.21.43.main.d...	CentOS-7.9	Jan 21 2023 06:26:02 p

Step 5 Click **Enable Agent Rehoming**.

The configuration is saved. The Rehome button appears at the top right.

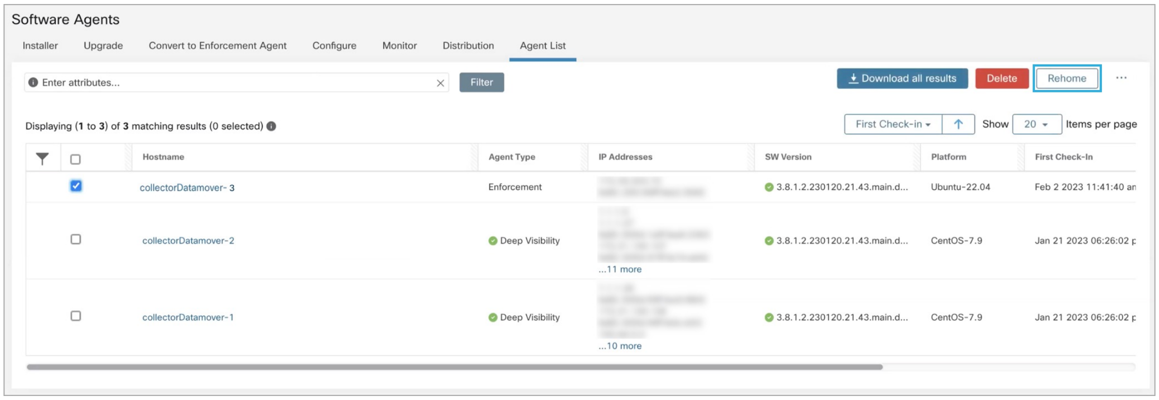
Select Agents to Rehome

Procedure

Step 1 Select an agent.

Step 2 Click **Rehome**.

Figure 16: Select Agents to Rehome



Software Agents

Installer | Upgrade | Convert to Enforcement Agent | Configure | Monitor | Distribution | Agent List

Enter attributes... | Filter | Download all results | Delete | Rehome

Displaying (1 to 3) of 3 matching results (0 selected)

First Check-in | Show 20 | Items per page

	□	Hostname	Agent Type	IP Addresses	SW Version	Platform	First Check-In
	☑	collectorDatamover- 3	Enforcement	[redacted]	● 3.8.1.2.230120.21.43.main.d...	Ubuntu-22.04	Feb 2 2023 11:41:40 an
	□	collectorDatamover-2	● Deep Visibility	[redacted] ...11 more	● 3.8.1.2.230120.21.43.main.d...	CentOS-7.9	Jan 21 2023 06:26:02 p
	□	collectorDatamover-1	● Deep Visibility	[redacted] ...10 more	● 3.8.1.2.230120.21.43.main.d...	CentOS-7.9	Jan 21 2023 06:26:02 p

Step 3 Click **Yes** to confirm.

Disable Rehoming

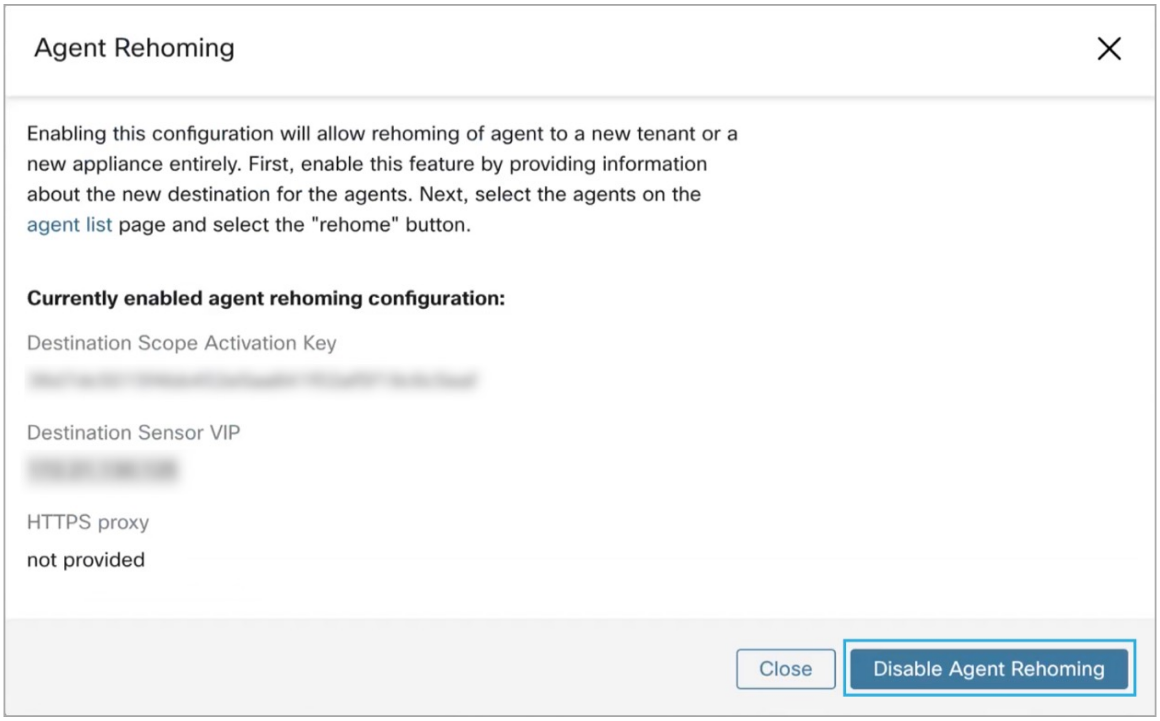
Note If there are multiple users rehoming to or from SaaS, the site administrator has to move each tenant or an appliance separately. To do this, disable Rehoming to clear the settings, and then enable Rehoming for the new user.

Procedure

Step 1 Click the menu icon and choose **Rehome Agents**.

Step 2 On the **Agent Rehoming window**, click **Disable Agent Rehoming**.

Figure 17: Disable Agent Rehoming



Agent Rehoming

Enabling this configuration will allow rehoming of agent to a new tenant or a new appliance entirely. First, enable this feature by providing information about the new destination for the agents. Next, select the agents on the agent list page and select the "rehome" button.

Currently enabled agent rehoming configuration:

Destination Scope Activation Key

[redacted]

Destination Sensor VIP

[redacted]

HTTPS proxy

not provided

Generate Agent Token

In the agent configuration profile, you can enable service protection to prevent uninstallation, disabling, and stopping Windows agent services. To perform any changes to the agents, you can disable this protection on the agent configuration profile. However, if you are unable to disable the protection because of connectivity issues, you can generate an agent token to disable the service protection on workload. The token is valid for 15 minutes.

Supported roles to generate and retrieve agent tokens:

- **Site administrators**: For clusters or tenants.
- **Customer support**: For tenants.
- **Agent installer**: For agent-specific tokens.

Note You can generate time-based agent tokens only for Windows OS-based software agents.

To generate and download agent tokens, perform these steps:

Procedure

Step 1 In the navigation pane, click **Manage** > **Workloads** > **Agents** > **Agent List**.

Based on your requirement, you can choose one of the agent token types—Cluster, tenant, or agent-specific. For the agent-specific token, go to Step 5.

Step 2 Click the menu icon and choose **Agent Token**.

Note The **Agent Token** option is only visible for site administrators or customer support user roles.

Step 3 Select a token type:

- Token For Cluster—This option is visible only to site administrators and the token is applicable for all the agents.
- Token For Tenant—Applicable for the agents under a selected tenant.

Step 4 To download the token key, click **Download Token**.

Step 5 To view and download token key details of a specific agent:

a) Go to the **Agent List** tab and click the required agent. Under **Agent Details** > **Agent Token**, you can view the token key and expiry details of the token.

b) To download the agent-specific token, click **Download Token**.

What to do next

After downloading the agent token file, run the following command on the agent to disable service protection: `"C:\Program Files\Cisco Tetration\TetSen.exe” -unprotect <token>`, where `token` is the downloaded agent token.

After the service protection is disabled using a token, it may be automatically re-enabled when the service restarts and connects to the Secure Workload cluster.

Host IP Address Change when Enforcement is Enabled

Changing the IP address on hosts when enforcement is enabled may have an impact if the host IP is seen in the host firewall rules and catch all is set to deny. In this scenario, the following steps are recommended to change the host IP address:

Procedure

Step 1 On the Secure Workload UI, create a new Agent Config Profile with enforcement disabled.

Step 2 Create Intent with list of hosts that need IP address change with their old and new IP address.

Step 3 Apply the newly created Agent Config Profile to the Intent and save the Intent.

Step 4 These selected hosts should have enforcement disabled.

Step 5 Change the IP address on these hosts.

Step 6 On the Secure Workload UI, update the filters in the scope with the new IP address of these hosts.

Step 7 Verify the IP address change from Agent Workload Profile page “Interfaces” tab. In the “Policies” tab, make sure policies are generated with new IP address.

Step 8 Remove the Intent/Profile created above.

Step 9 If the original Agent Config Profile for the scope had enforcement disabled, then enable enforcement.

Upgrading Software Agents

Upgrade Agents from UI

Agents can be upgraded using Agent Config Intent workflow as described here - Software Agent Config. While configuring an agent config profile, there is an **Auto Upgrade** option which can be enabled or disabled. If the option is enabled, the agents matching inventory filter criteria are automatically upgraded to the latest available version.

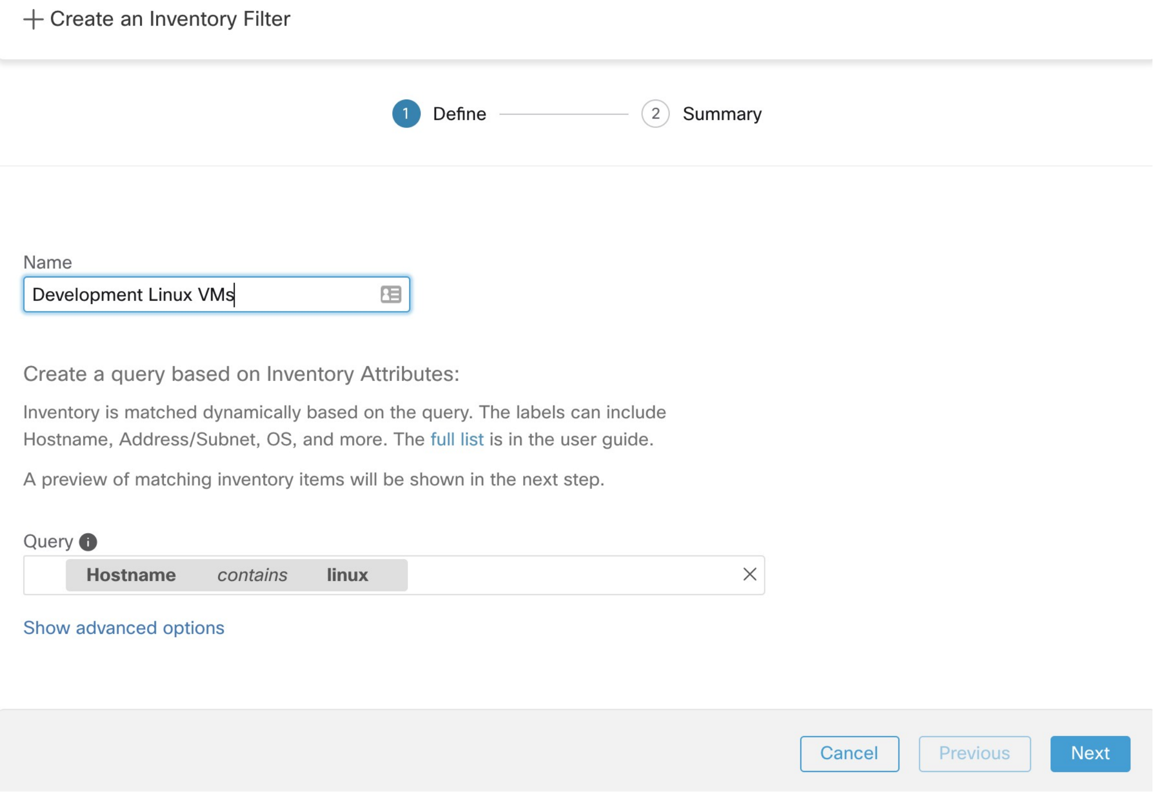
On the **Software Agents** > **Agent List** page, software agents with outdated versions are highlighted with a warning sign under the **SW Version** column. It is important to upgrade these agents to the latest available version on the cluster.

To use software agent config intent workflow to configure software agent upgrade:

Procedure

Step 1 Create an inventory filter on the **Inventory Filters** page. For more information, see Filters.

Figure 18: Inventory Filter



+ Create an Inventory Filter

1 Define — 2 Summary

Name

Development Linux VMs

Create a query based on Inventory Attributes:

Inventory is matched dynamically based on the query. The labels can include Hostname, Address/Subnet, OS, and more. The full list is in the user guide.

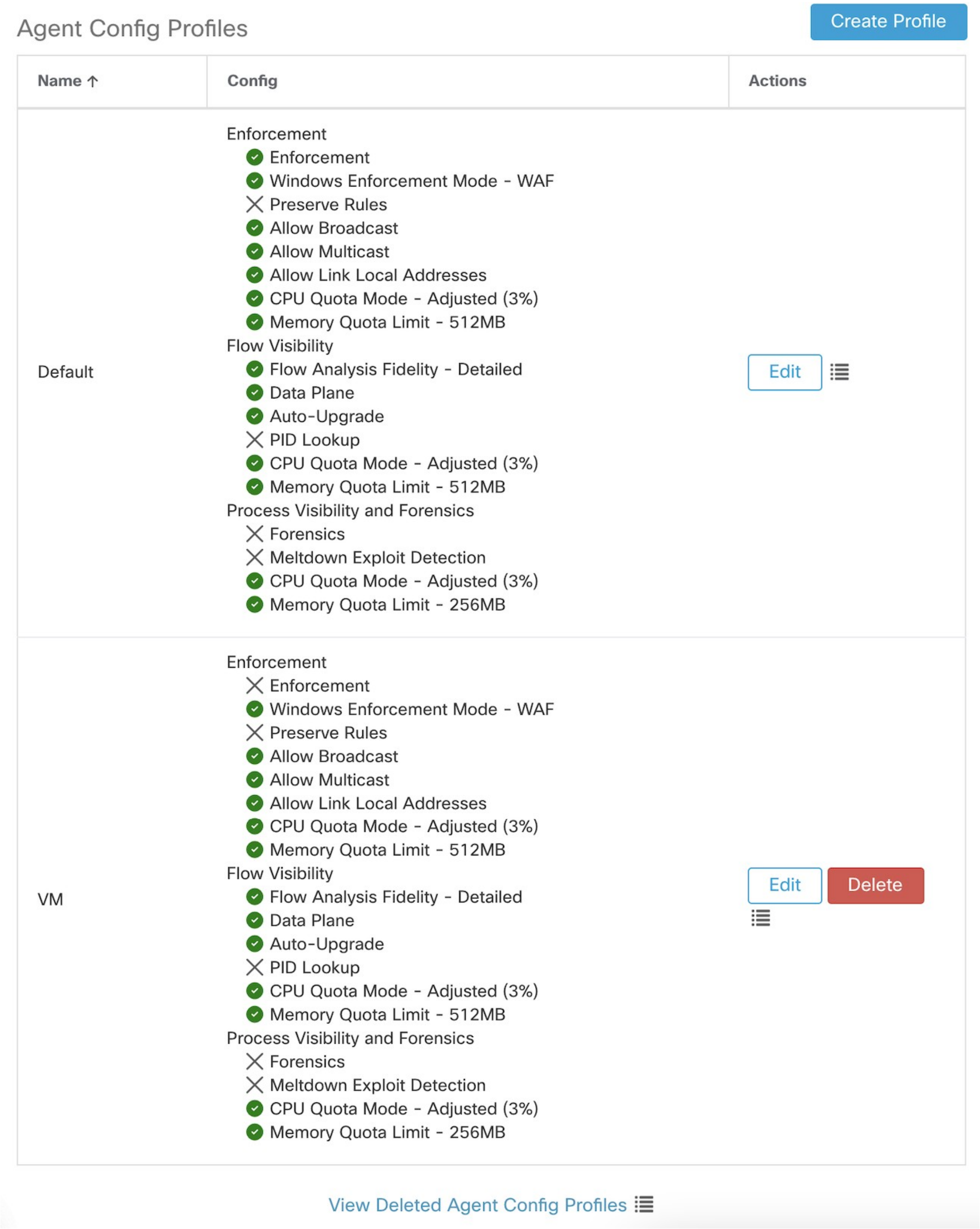
A preview of matching inventory items will be shown in the next step.

Query

Hostname *contains* linux

Step 2 Create an Agent Config profile for the agents selected by the inventory filter. Optionally, you can enable the **Auto Upgrade** option to automatically upgrade the selected agents.

Figure 19: Agent Config



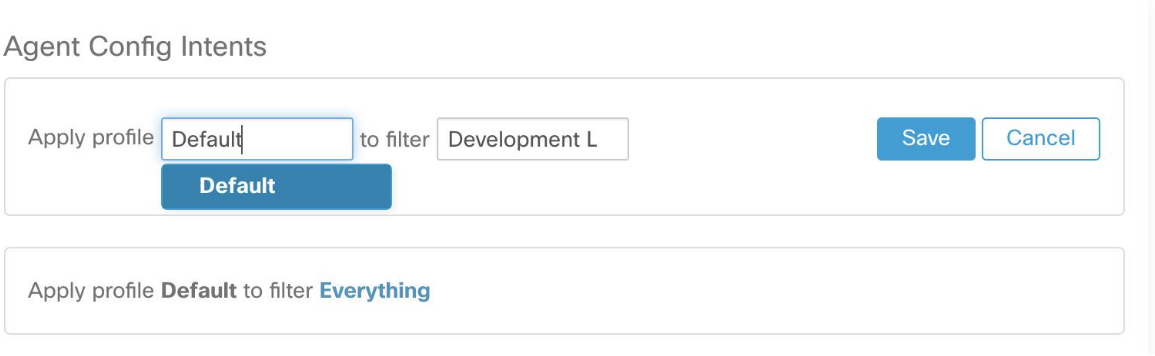
Agent Config Profiles

Name ↑	Config	Actions
Default	Enforcement ✓ Enforcement ✓ Windows Enforcement Mode - WAF ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Detailed ✓ Data Plane ✓ Auto-Upgrade ✗ PID Lookup ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Process Visibility and Forensics ✗ Forensics ✗ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit ☰
VM	Enforcement ✗ Enforcement ✓ Windows Enforcement Mode - WAF ✗ Preserve Rules ✓ Allow Broadcast ✓ Allow Multicast ✓ Allow Link Local Addresses ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Flow Visibility ✓ Flow Analysis Fidelity - Detailed ✓ Data Plane ✓ Auto-Upgrade ✗ PID Lookup ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 512MB Process Visibility and Forensics ✗ Forensics ✗ Meltdown Exploit Detection ✓ CPU Quota Mode - Adjusted (3%) ✓ Memory Quota Limit - 256MB	Edit Delete ☰

Step 3 Create an agent config intent to apply the config profile to the agents selected using inventory filter. If the auto upgrade option is enabled, the selected agents are automatically upgraded.

It normally takes up to 30 minutes to upgrade an agent after an agent profile is applied to them.

Figure 20: Agent Config Intent



Agent Config Intents

Apply profile Default to filter Development L

Apply profile **Default** to filter **Everything**

Note Auto Upgrade setting in the default agent profile applies to ERSPAN.

Manual Agent Upgrade

The following section explains how to manually upgrade agents without using the Sensor Config intent workflow.

Procedure

Step 1 In the left navigation pane, click **Manage** > **Workloads** > **Agents**.

Step 2 Click the **Upgrade** tab.

Deep visibility and enforcement agents are displayed and for each agent only newer versions to which it is upgradable are listed. By default, the latest version is selected.

Step 3 To filter specific agents, enter your search query in the filter box. For example, enter Platform = CentOS-7.6.

Step 4 Select the agents to be upgraded to the selected version and click **Upgrade**.

Note Under normal circumstances, allowing the agent to automatically upgrade is strongly recommended and is the only supported upgrade method. If you want to control the upgrade by manually downloading the latest version and directly deploying it to the agents which are running on workloads, ensure that you follow the safety precautions.

Upgrade Behaviour of Kubernetes/Openshift Agent

Agents installed on Kubernetes/Openshift nodes using the daemonset installer script are capable of self-upgrade. The upgrade process is controlled by either the auto-upgrade option or by manually triggering an upgrade for any node in the Kubernetes/Openshift cluster. The mechanism of the upgrade in this environment is to upgrade the Docker image in the daemonset specification, which means that an upgrade of one agent affects all agents covered by the daemonset, as explained in the next paragraph.

When a Daemonset Pod specification changes, Kubernetes/Openshift will trigger a graceful shutdown, fetch the new docker image(s) and start the Secure Workload agent pods on ALL nodes in the Kubernetes/Openshift cluster. This will cause agents to be upgraded on other nodes, even if the policy to allow upgrades is applicable only to a subset of the nodes in the cluster.

If auto-upgrade is disabled for all nodes, manual upgrade is possible by downloading a new installer script and re-running the install. The installation script auto-detects the case of new installation vs upgrading an existing installation and will work to manually upgrade the daemonset pods when it detects an installation is already in place.

Removing Software Agents

Remove a Deep Visibility or Enforcement Linux Agent

RPM based installation:

1. Run command: **rpm -e tet-sensor**

The Agent uninstallation event will be communicated to the cluster and the agent will be marked as uninstalled on **Software Agent** page.

Manually delete the agent from UI on **Software Agent** pageor the user can enable automated cleanup or removal of the agent by turning on the **cleanup period** from agent config profiles.

Note By default, the **cleanup period** is turned off.

Ubuntu .deb based installation:

Fresh installation of Ubuntu agents now uses the native .deb format.

1. Run command: **dpkg –purge tet-sensor**

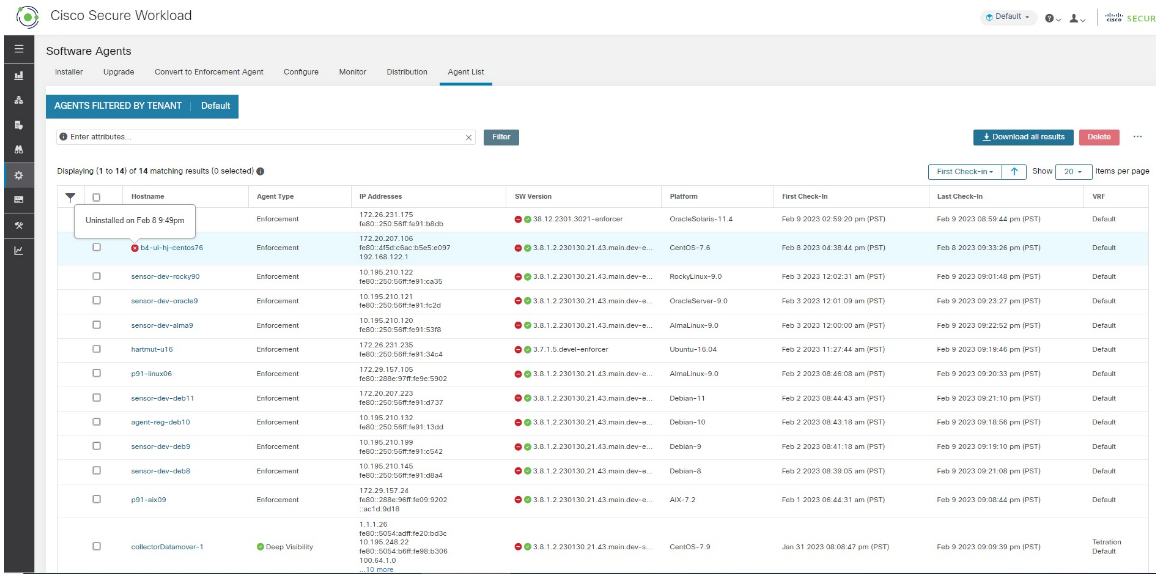
The Agent uninstallation event will be communicated to the cluster and the agent will be marked as uninstalled on **Software Agent** page.

Manually delete the agent from UI on **Software Agent** page or the user can enable automated cleanup or removal of the agent by turning on the **cleanup period** from agent config profiles.

Note

- By default, the **cleanup period** is turned off.
- During the agent operations, it is possible that some kernel modules will be loaded automatically by the kernel. For example, if enforcement is enabled in Linux, Netfilter modules might be loaded. Agents do not have a list of modules loaded by kernel. Therefore, during agent uninstallation, it cannot possibly unloaded the kernel modules.
- If enforcement agent applied a policy to the system firewall, uninstalling agent clears the applied policy and opens the system firewall.

Figure 21: Agent uninstallation alert



Displaying (1 to 14) of 14 matching results (0 selected)

	□	Hostname	Agent Type	IP Addresses	SW Version	Platform	First Check-In	Last Check-In	VRF
			Enforcement	172.26.231.175 fe80::250:56ff:fe91:b8db	38.12.2301.3021-enforcer	OracleSolaris-11.4	Feb 9 2023 02:59:20 pm (PST)	Feb 9 2023 08:59:44 pm (PST)	Default
	□	b4-ui-hj-centos76	Enforcement	172.20.207.106 fe80::4f5d:c6ac:b5e5:e097 192.168.122.1	3.8.1.2.230130.21.43.main.dev-e...	CentOS-7.6	Feb 8 2023 04:38:44 pm (PST)	Feb 8 2023 09:33:26 pm (PST)	Default
	□	sensor-dev-rocky90	Enforcement	10.195.210.122 fe80::250:56ff:fe91:ca35	3.8.1.2.230130.21.43.main.dev-e...	RockyLinux-9.0	Feb 3 2023 12:02:31 am (PST)	Feb 9 2023 09:01:48 pm (PST)	Default
	□	sensor-dev-oracle9	Enforcement	10.195.210.121 fe80::250:56ff:fe91:fc2d	3.8.1.2.230130.21.43.main.dev-e...	OracleServer-9.0	Feb 3 2023 12:01:09 am (PST)	Feb 9 2023 09:23:27 pm (PST)	Default
	□	sensor-dev-alma9	Enforcement	10.195.210.120 fe80::250:56ff:fe91:53f8	3.8.1.2.230130.21.43.main.dev-e...	AlmaLinux-9.0	Feb 3 2023 12:00:00 am (PST)	Feb 9 2023 09:22:52 pm (PST)	Default
	□	hartmut-u16	Enforcement	172.26.231.235 fe80::250:56ff:fe91:34c4	3.7.1.5.devel-enforcer	Ubuntu-16.04	Feb 2 2023 11:27:44 am (PST)	Feb 9 2023 09:19:46 pm (PST)	Default
	□	p91-linux06	Enforcement	172.29.157.105 fe80::288e:97ff:fe9e:5902	3.8.1.2.230130.21.43.main.dev-e...	AlmaLinux-9.0	Feb 2 2023 08:46:08 am (PST)	Feb 9 2023 09:20:33 pm (PST)	Default
	□	sensor-dev-deb11	Enforcement	172.20.207.223 fe80::250:56ff:fe91:d737	3.8.1.2.230130.21.43.main.dev-e...	Debian-11	Feb 2 2023 08:44:43 am (PST)	Feb 9 2023 09:21:10 pm (PST)	Default
	□	agent-reg-deb10	Enforcement	10.195.210.132 fe80::250:56ff:fe91:13dd	3.8.1.2.230130.21.43.main.dev-e...	Debian-10	Feb 2 2023 08:43:18 am (PST)	Feb 9 2023 09:18:56 pm (PST)	Default
	□	sensor-dev-deb9	Enforcement	10.195.210.199 fe80::250:56ff:fe91:c542	3.8.1.2.230130.21.43.main.dev-e...	Debian-9	Feb 2 2023 08:41:18 am (PST)	Feb 9 2023 09:19:10 pm (PST)	Default
	□	sensor-dev-deb8	Enforcement	10.195.210.145 fe80::250:56ff:fe91:d8a4	3.8.1.2.230130.21.43.main.dev-e...	Debian-8	Feb 2 2023 08:39:05 am (PST)	Feb 9 2023 09:21:08 pm (PST)	Default
	□	p91-aix09	Enforcement	172.29.157.24 fe80::288e:96ff:fe09:9202 ::ac1d:9d18	3.8.1.2.230130.21.43.main.dev-e...	AIX-7.2	Feb 1 2023 06:44:31 am (PST)	Feb 9 2023 09:08:44 pm (PST)	Default
	□	collectorDatamover-1	Deep Visibility	1.1.1.26 fe80::5054:adff:fe20:bd3c 10.195.248.22 fe80::5054:b6ff:fe98:b306 100.64.1.0 ...10 more	3.8.1.2.230130.21.43.main.dev-s...	CentOS-7.9	Jan 31 2023 08:08:47 pm (PST)	Feb 9 2023 09:09:39 pm (PST)	Tetration Default

Removing a Deep Visibility/Enforcement Windows Agent

There are two options to uninstall Secure Workload agents:

Procedure

Step 1 Go to Control Panel / Programs / Programs And Features, and uninstall **Cisco Secure Workload Agent** (Cisco Tetration Agent).

Step 2 Alternatively, run the shortcut **Uninstall.lnk** within **‘C:\Program Files\Cisco Tetration‘**

Step 3 If enforcement agent applied a policy to the system firewall, uninstalling agent clears the applied policy, and opens the system firewall.

The Agent uninstallation event will be communicated to the cluster and the agent will be marked as uninstalled on **Software Agent** page.

Manually delete the agent from UI on the **Software Agent** page or the user can enable automated cleanup or removal of the agent by turning on the **cleanup period** from agent config profiles.

Note By default, the **cleanup period** is turned off.

Note

- If Npcap has been installed during agent installation, it will also get uninstalled.
- By default log files, config files and certs will not get removed during uninstall. If you’d like to remove them, run the shortcut **UninstallAll.lnk** in same folder.

Remove a Deep Visibility or Enforcement AIX Agent

Procedure

Run command: **‘installp -u tet-sensor‘**.

The Agent uninstallation event will be communicated to the cluster and the agent will be marked as uninstalled on the **Software Agent** page.

Manually delete the agent from UI on the **Software Agent** page or the user can enable automated cleanup or removal of the agent by turning on the **cleanup period** from agent config profiles.

Note

- By default, the **cleanup period** is turned off.
- The Deep Visibility Agent is controlled by System Resource Controller as tet-sensor. It is possible to start, stop, restart, and remove it. The service is made persistent with inittab as tet-sen-engine.
- The Enforcement Agent is controlled by System Resource Controller as tet-enforcer. It is possible to start, stop, restart, and remove it. The service is made persistent with inittab as tet-enf-engine.
- During the agent operations, it is possible that some kernel modules will be loaded automatically by the kernel. For example, if enforcement is enabled in AIX, ipfilter modules are loaded. Agents do not have a list of modules loaded by kernel. Therefore, during agent uninstallation, it cannot possibly unloaded the kernel modules.
- If enforcement agent applied a policy to the system firewall, uninstalling agent clears the applied policy and opens the system firewall.

Remove Universal Linux Agent

Procedure

Step 1 Run the uninstall script: **‘/usr/local/tet-light/uninstall.sh‘**

Step 2 Delete the agent from UI on the **Software Agent** page

Remove Universal Windows Agent

Procedure

Step 1 Run the uninstall script: **‘C:\Program Files\Cisco Tetration\Lightweight Sensor\uninstall.cmd‘**

Step 2 Delete the agent from UI on the **Software Agent** page

Remove an Enforcement Kubernetes or OpenShift Agent

Procedure

Step 1 Locate the original installer script or download a new script from the Secure Workload UI.

Step 2 Run the uninstall option: **install.sh –uninstall**. The same considerations apply as during the install.

- Only supported on Linux x86_64 architectures.
- Either ~/.kube/config contains an admin credentials user or use the –kubeconfig option to point to the kubectl admin credentials file.

Step 3 Delete the agents for all the Kubernetes nodes from UI on the **Software Agent** page

Remove a Deep Visibility Solaris Agent

Procedure

Step 1 Run command: `pkg uninstall tet-sensor`

Step 2 Delete the agent on the **Software Agent** page.

Data collected and exported by workload agents

This section describes the main components of a software agent, how it is registered with backend services, what data are collected and exported to the cluster for analytical purposes.

Registration

After the agent has been successfully installed onto the system, it needs to register with the backend services to obtain a valid unique identifier. The following information is sent in the registration request:

- Hostname
- BIOS-UUID
- Platform information (such as CentOS-6.5)
- Self-generated client certificate (generated with openssl command)
- Agent type (visibility or enforcement.)

If the agent fails to obtain a valid id from the server, it will keep retrying until it gets one. It is very important that the agent is registered, otherwise all the subsequent communication with other services (such as collectors) will be rejected.

Agent upgrade

Periodically (around 30 minutes), the agent sends a message to backend service to report its current version. The backend service uses the agent's id and its current version to decide whether a new software package is available for the agent. The following information is sent:

- Agent's id (obtained after successful registration)
- Current agent's version

Config server

Agents export the following information to the configured config server:

- Hostname
- Agent's id (obtained after successful registration)
- List of interfaces, each includes:
  1. Interface's name
  2. IP family (IPv4 or IPv6)
  3. IP addresses
  4. Netmask
  5. Mac addresses
  6. Interface's index

As soon as any interface property changes (such as an IP address of an existing interface changes, or a new interface comes up), this list is refreshed and reported to the config server.

Network Flow

Network flow information is the summarization of all packets flowing through the system. There are two modes of capturing flow information: Detailed and Conversation. By default, the Detailed mode of capture is used. The captured flows are exported to a collector and the exported information includes:

- Flow identifier: Uniquely identify the network flow. It includes the general information such as: IP protocol, source and destination IP, and layer 4 ports.
- IP Information: Contains information that is seen in the IP header, such as: TTL, IP flags, Packet ID, IP options, and Fragmentation flags.
- TCP Information: Contains information that is seen in the TCP header, such as: sequence number, Ack number, TCP options, Rcvd windows size.

- Flow Information: Statistics of the flow (such as total packets, total bytes, TCP flags statistics, packet length statistics, and socket statistics), interface index from which the flow was observed, start time and end time of flow.
- In a K8s environment, the agent captures network flows from pods and hosts, and then correlates the flows and reports as related flows. This is qualified with the following CNIs:
    - Calico
    - Flannel
    - Weave
    - AKS/GKE/AWS VPC CNI
    - Openshift CNI
    - Cilium CNI

Note Network flows are captured from pods and hosts, however, the correlation of flows is not possible when Cilium CNI is used.

In Conversation mode, the agent exports only TCP flows that are bidirectional in nature along with other connectionless flows. Conversation mode is supported for Windows, AIX, and Linux platforms. For more information on Conversation mode, see Conversation Mode.

Note

- In K8s environment, correlation of Pod or Host flows are not done in Conversation mode.
- In either of the modes, agents do not export the following flows:
    - ARP/RARP conversations
    - Agent's flows to collectors

Machine information

Machine info describes all the processes running on the host. In addition, it contains network information that is associated with the processes and the command used to launch the processes. Machine info is exported every minute and includes the following information:

- Process ID
- User ID: owner of the process
- Parent Process ID
- Command string used to launch the process
- Socket information: protocol (such as UDP or TCP), address type: IPv4 or IPv6, source and destination IP, source and destination port, TCP state, process's start and end time, path to process binary
- Forensic information: for more information, see the section Compatibility, on page 573.

Agent statistics

Agent keeps track of various statistics, including system’s statistics and its own, such as:

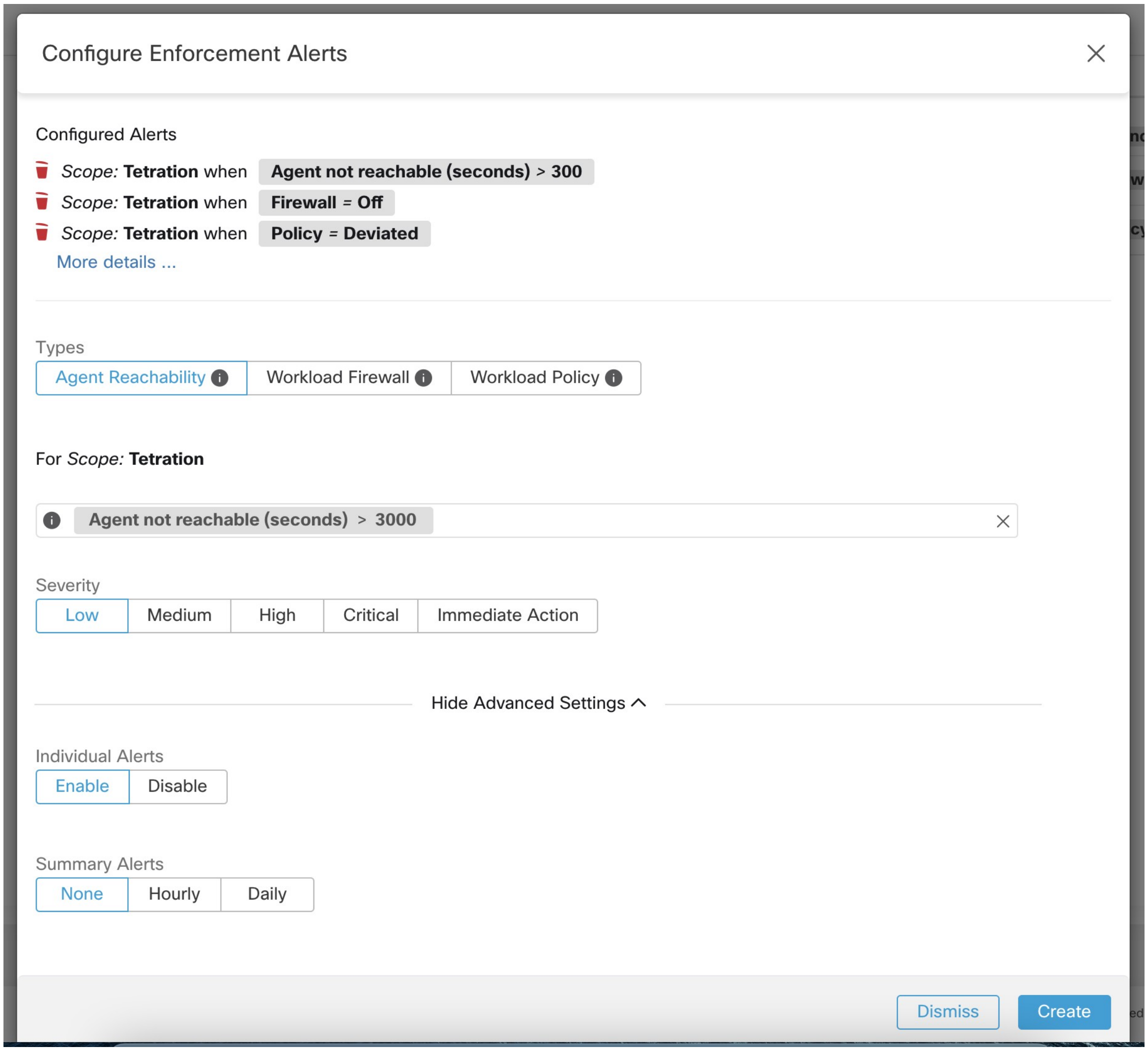
- Agent’s start time and uptime
- Agent’s run time in user mode and kernel mode
- Number of packets received and dropped
- Number of successful and failed SSL connections
- Total flow packets and bytes
- Total exported flows and packets to collectors
- Agent’s memory and CPU usage

Enforcement Alerts

There are three types of enforcement alerts:

- Agent Reachability

  This alert detects when the agent is not reachable. This alert triggers if the agent has not communicated with the Secure Workload cluster for more than the configured number of seconds.



Configure Enforcement Alerts

Configured Alerts

- *Scope:* **Tetration** when **Agent not reachable (seconds)** > **300**
- *Scope:* **Tetration** when **Firewall** = **Off**
- *Scope:* **Tetration** when **Policy** = **Deviated**

More details ...

Types

Agent Reachability | Workload Firewall | Workload Policy

For *Scope:* **Tetration**

Agent not reachable (seconds) > **3000**

Severity

Low | Medium | High | Critical | Immediate Action

Hide Advanced Settings

Individual Alerts

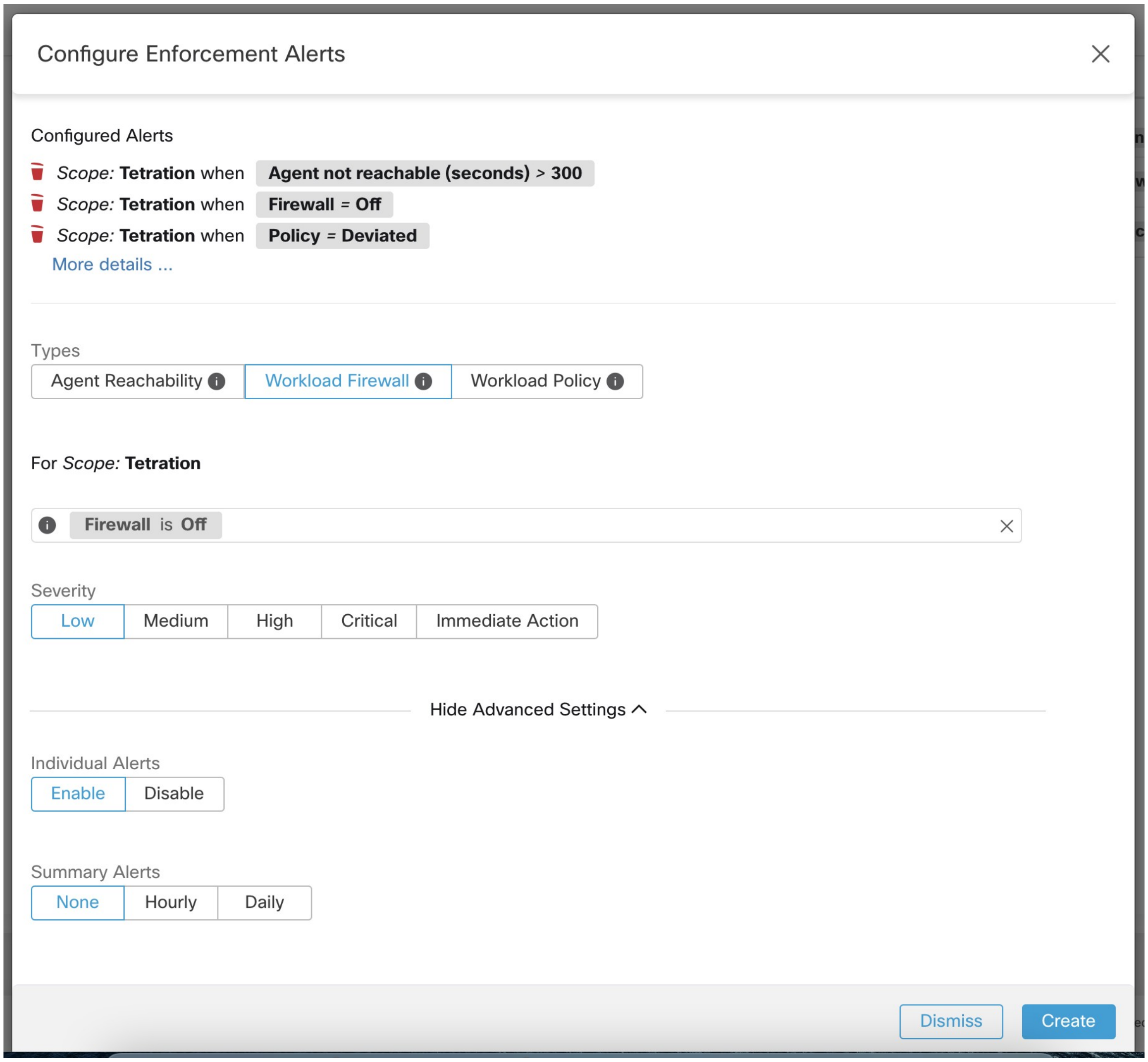
Enable | Disable

Summary Alerts

None | Hourly | Daily

- Workload Firewall

  This alert triggers if enforcement is configured on a workload but the workload Firewall is detected to be off, since this condition will prevent Secure Workload Agent from enforcing traffic policies.



Configure Enforcement Alerts

Configured Alerts

- *Scope:* **Tetration** when **Agent not reachable (seconds)** > **300**
- *Scope:* **Tetration** when **Firewall** = **Off**
- *Scope:* **Tetration** when **Policy** = **Deviated**

More details ...

Types: Agent Reachability | [✓ Workload Firewall] | Workload Policy

For *Scope:* **Tetration**

Firewall is **Off**

Severity: [✓ Low] | Medium | High | Critical | Immediate Action

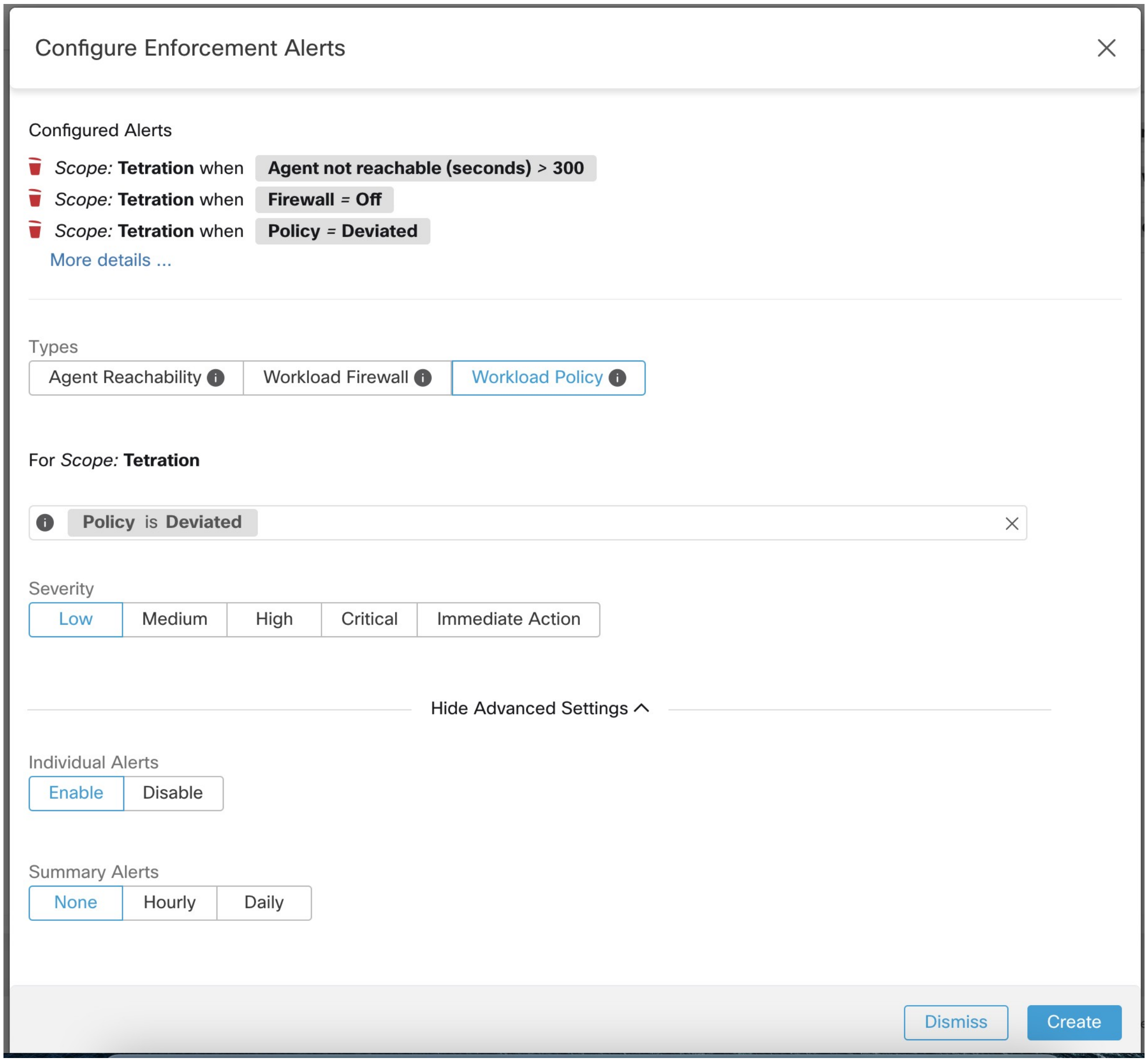
Hide Advanced Settings

Individual Alerts: [✓ Enable] | Disable

Summary Alerts: [✓ None] | Hourly | Daily

- Workload Policy

  This alert triggers if the workload firewall rules are different from the Secure Workload policies applicable to this workload (the workload's "concrete policies".)



Configure Enforcement Alerts

Configured Alerts

- *Scope:* **Tetration** when **Agent not reachable (seconds)** > **300**
- *Scope:* **Tetration** when **Firewall** = **Off**
- *Scope:* **Tetration** when **Policy** = **Deviated**

More details ...

Types: Agent Reachability | Workload Firewall | [✓ Workload Policy]

For *Scope:* **Tetration**

Policy is **Deviated**

Severity: [✓ Low] | Medium | High | Critical | Immediate Action

Hide Advanced Settings

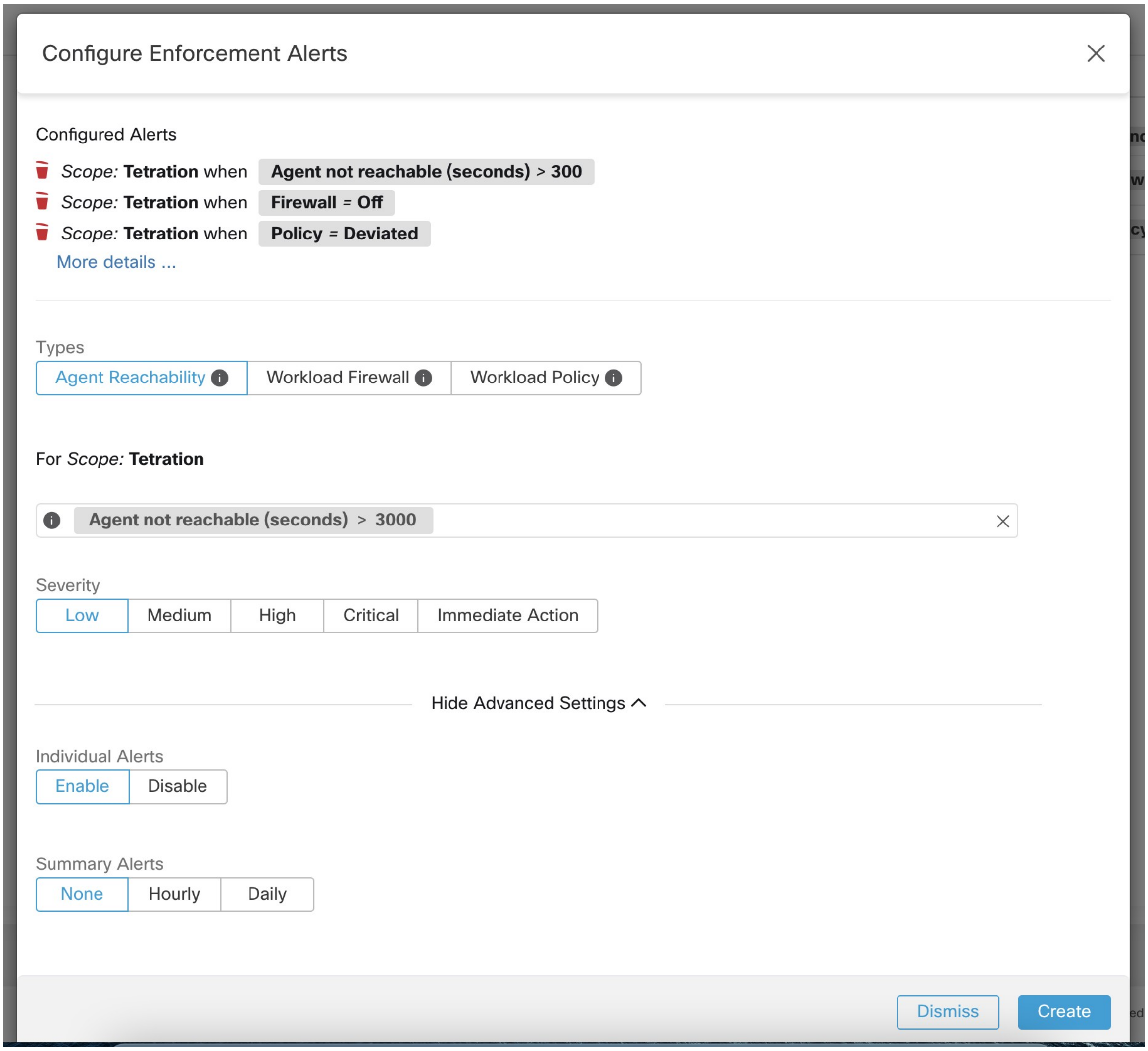
Individual Alerts: [✓ Enable] | Disable

Summary Alerts: [✓ None] | Hourly | Daily

You can set the Severity of the alert as well as other per-type configuration parameters.

To configure enforcement alerts, see Configure Alerts, on page 641.

Figure 22: Configuring Enforcement alerts



Configure Enforcement Alerts

Configured Alerts

- *Scope:* **Tetration** when **Agent not reachable (seconds)** > **300**
- *Scope:* **Tetration** when **Firewall** = **Off**
- *Scope:* **Tetration** when **Policy** = **Deviated**

More details ...

Types

[✓ Agent Reachability] Workload Firewall Workload Policy

For *Scope:* **Tetration**

Agent not reachable (seconds) > **3000**

Severity

[✓ Low] Medium High Critical Immediate Action

Hide Advanced Settings

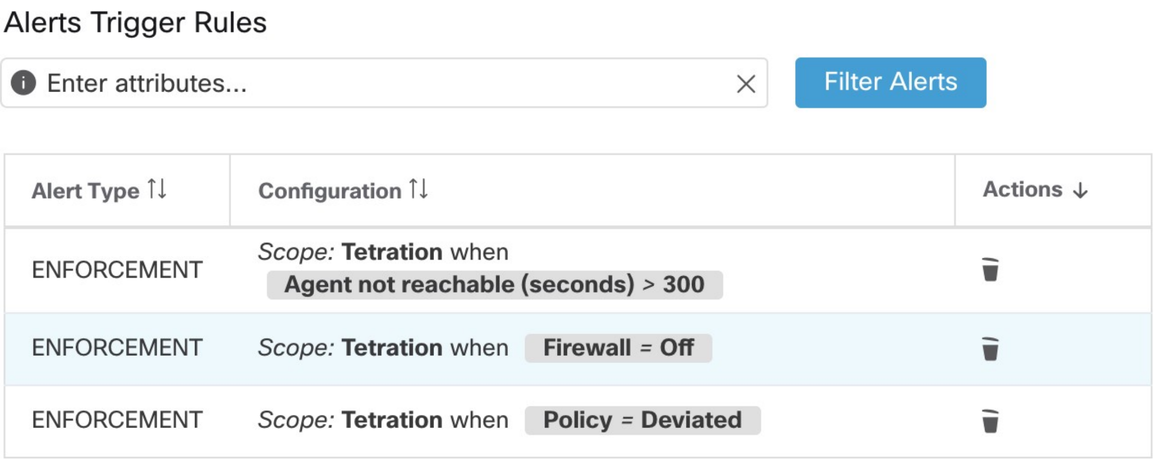
Individual Alerts

[✓ Enable] Disable

Summary Alerts

[✓ None] Hourly Daily

Figure 23: Viewing configured Enforcement Alerts on the alerts configuration page



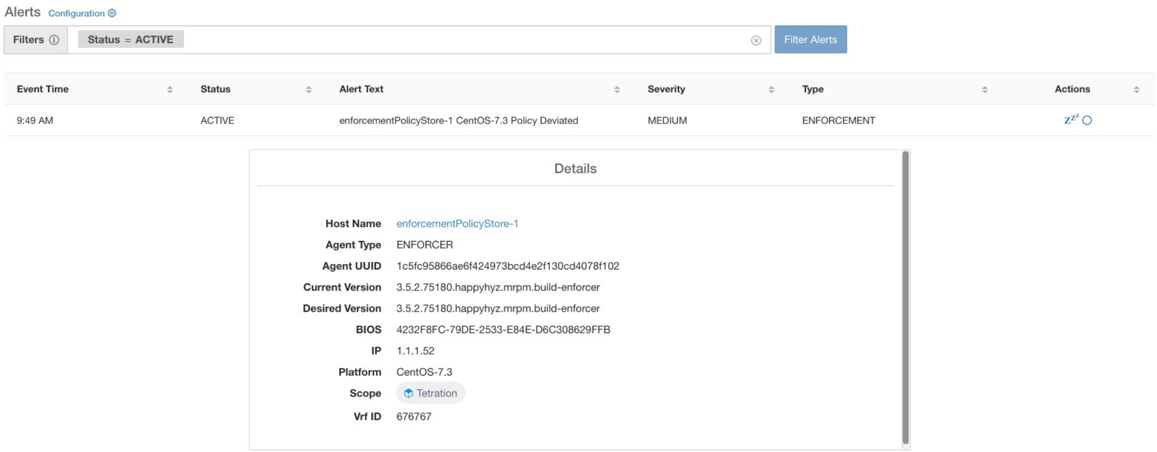
Alerts Trigger Rules

Enter attributes...

Alert Type	Configuration	Actions
ENFORCEMENT	*Scope:* **Tetration** when **Agent not reachable (seconds)** > **300**	🗑
ENFORCEMENT	*Scope:* **Tetration** when **Firewall** = **Off**	🗑
ENFORCEMENT	*Scope:* **Tetration** when **Policy** = **Deviated**	🗑

Enforcement UI Alerts Details

Figure 24: Enforcement alert details



Alerts Configuration

Filters ⓘ Status = ACTIVE

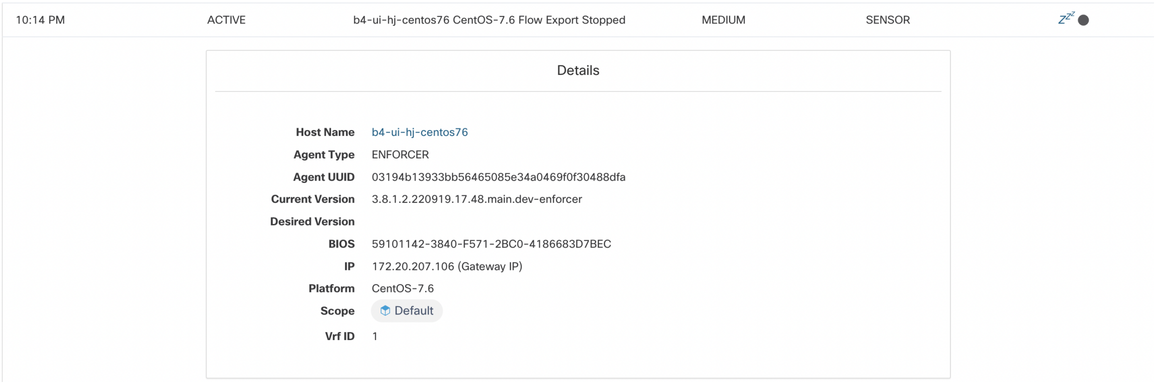
Filter Alerts

Event Time	Status	Alert Text	Severity	Type	Actions
9:49 AM	ACTIVE	enforcementPolicyStore-1 CentOS-7.3 Policy Deviated	MEDIUM	ENFORCEMENT	zᶻᶻ ○

Details

Host Name	enforcementPolicyStore-1
Agent Type	ENFORCER
Agent UUID	1c5fc95866ae6f424973bcd4e2f130cd4078f102
Current Version	3.5.2.75180.happyhyz.mrpm.build-enforcer
Desired Version	3.5.2.75180.happyhyz.mrpm.build-enforcer
BIOS	4232F8FC-79DE-2533-E84E-D6C308629FFB
IP	1.1.1.52
Platform	CentOS-7.3
Scope	Tetration
Vrf ID	676767

Figure 25: Enforcement alert details when proxy is enabled on the host



10:14 PM	ACTIVE	b4-ui-hj-centos76 CentOS-7.6 Flow Export Stopped	MEDIUM	SENSOR	zᶻᶻ ●

Details

Host Name	b4-ui-hj-centos76
Agent Type	ENFORCER
Agent UUID	03194b13933bb56465085e34a0469f0f30488dfa
Current Version	3.8.1.2.220919.17.48.main.dev-enforcer
Desired Version	
BIOS	59101142-3840-F571-2BC0-4186683D7BEC
IP	172.20.207.106 (Gateway IP)
Platform	CentOS-7.6
Scope	Default
Vrf ID	1

Enforcement Alert Details

See Common Alert Structure for general alert structure and information about fields. The *alert_details* field is structured and contains the following subfields for enforcement alerts

Field	Alert Type	Format	Explanation
AgentType	*all*	string	"ENFORCER" or "SENSOR" depending on the installed type
HostName	*all*	string	Host name on which the agent is deployed
IP	*all*	string	IP address of the node/gateway

Field	Alert Type	Format	Explanation
Bios	*all*	string	BIOS UUID of the node
Platform	*all*	string	Platform/OS information of the node
CurrentVersion	*all*	string	Software version of the agent on the node
DesiredVersion	*all*	string	Software version desired for the agent
LastConfigFetchAt	*all*	integer	Unix timestamp of when the agent last sent https request

Example of alert_details for an enforcement alert

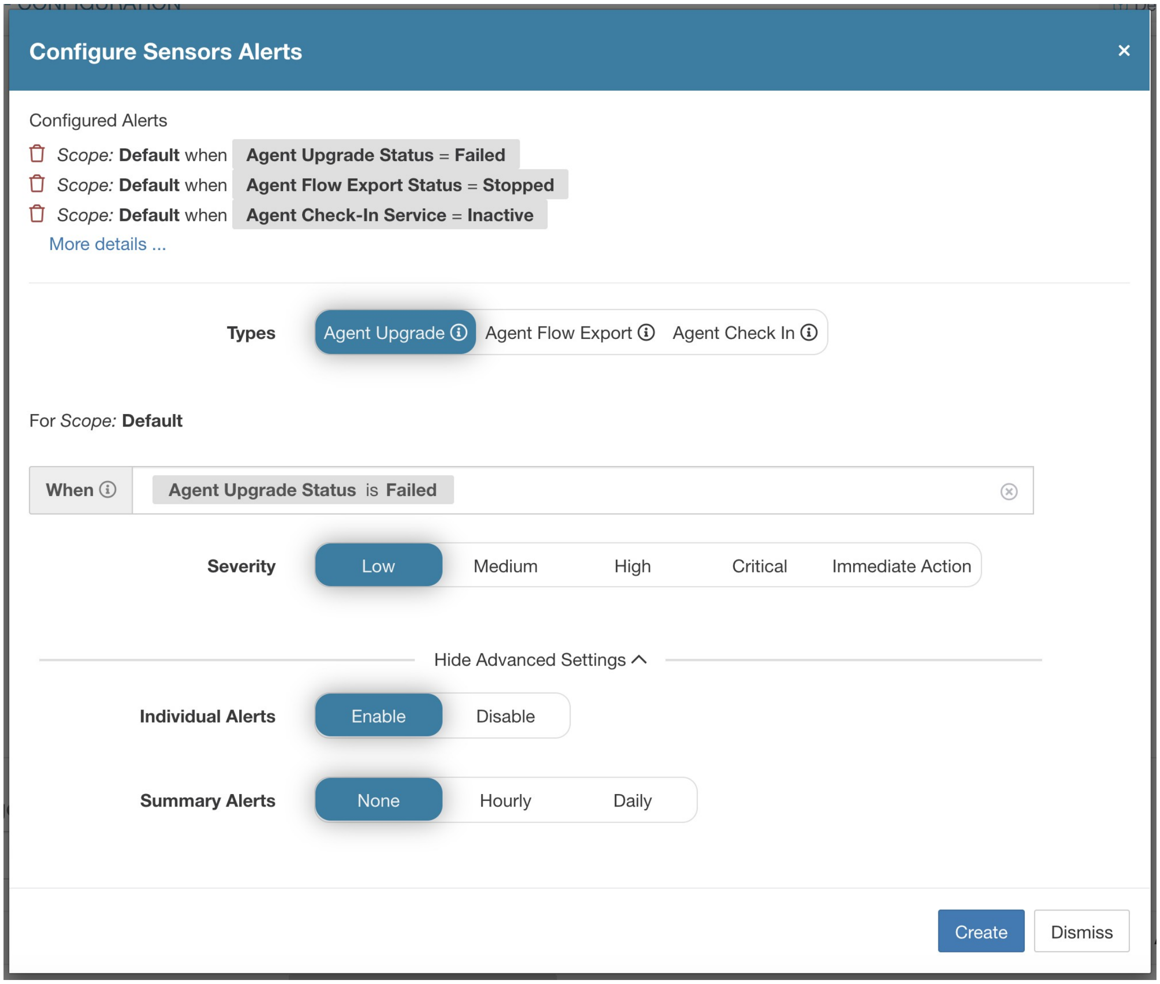
```
{
  "AgentType":"ENFORCER",
  "Bios":"72EF1142-03A2-03BC-C2F8-F600567BA320",
  "CurrentVersion":"3.5.1.1.mrpm.build.win64-enforcer",
  "DesiredVersion":"",
  "HostName":"win2k12-production-db",
  "IP":"172.26.231.193",
  "Platform":"MSServer2012R2Standard"
}
```

Sensor Alerts

Note Starting 3.5 release, Sensor Alerts can be configured using the *Alert Configuration Model*.

Sensor Alerts can be configured using the *Alert Configuration Model*. See Alert Configuration Modal for general information about the model

Figure 26: Configuring Sensor alerts



Configure Sensors Alerts

Configured Alerts

Scope: **Default** when **Agent Upgrade Status** = **Failed**

Scope: **Default** when **Agent Flow Export Status** = **Stopped**

Scope: **Default** when **Agent Check-In Service** = **Inactive**

More details ...

Types: [✓ Agent Upgrade] Agent Flow Export Agent Check In

For *Scope:* **Default**

When: **Agent Upgrade Status** is **Failed**

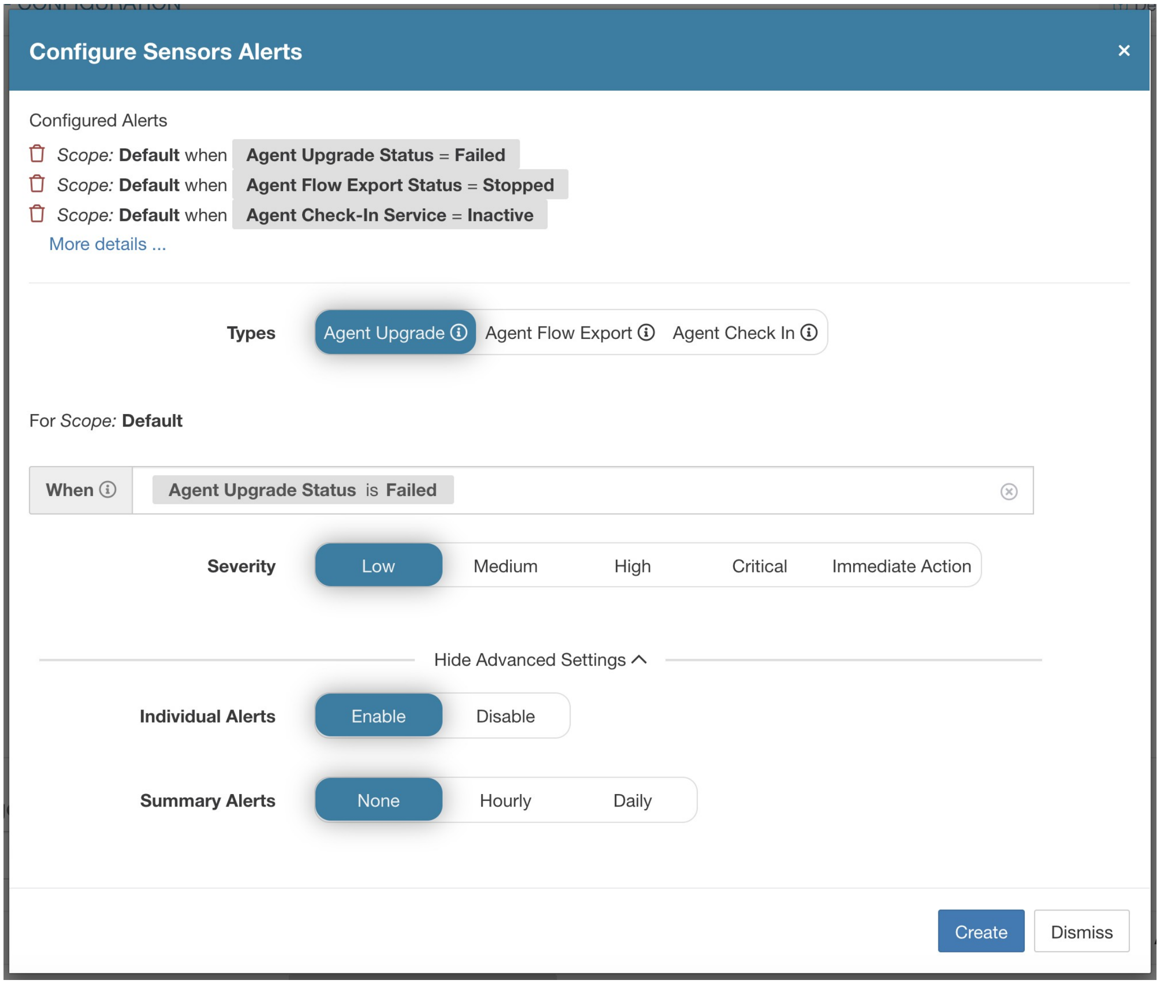
Severity: [✓ Low] Medium High Critical Immediate Action

Hide Advanced Settings

Individual Alerts: [✓ Enable] Disable

Summary Alerts: [✓ None] Hourly Daily

Sensor Alert Configuration provides the ability to configure three different types of alerts, allowing the user to set the Severity of the alert as well as other per-type configuration parameters:



Configure Sensors Alerts ×

Configured Alerts

- *Scope:* **Default** when **Agent Upgrade Status** = **Failed**
- *Scope:* **Default** when **Agent Flow Export Status** = **Stopped**
- *Scope:* **Default** when **Agent Check-In Service** = **Inactive**

More details ...

Types [✓ Agent Upgrade ⓘ] Agent Flow Export ⓘ Agent Check In ⓘ

For *Scope:* **Default**

When ⓘ **Agent Upgrade Status** is **Failed**

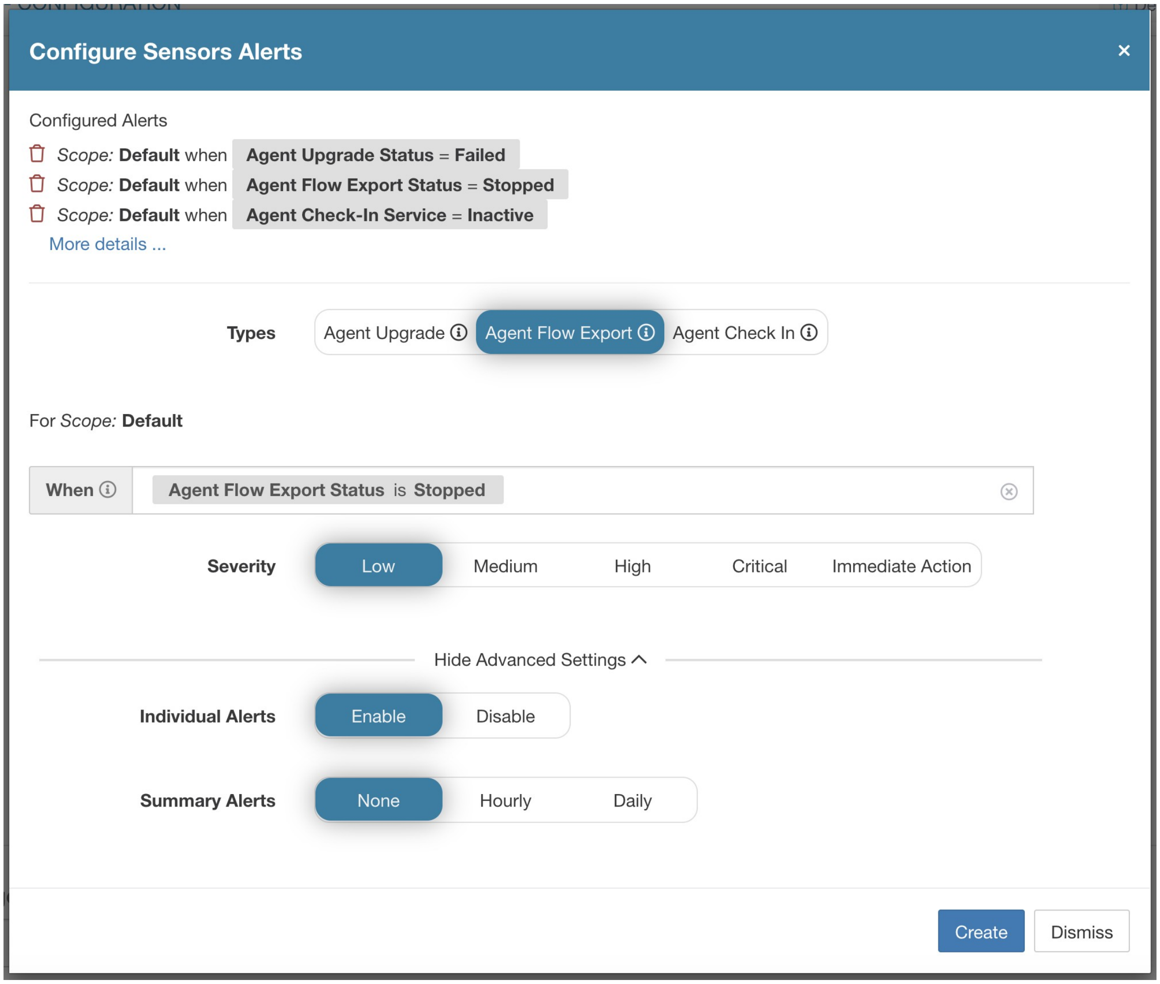
Severity [✓ Low] Medium High Critical Immediate Action

Hide Advanced Settings ^

Individual Alerts [✓ Enable] Disable

Summary Alerts [✓ None] Hourly Daily

Configuring Sensor alerts to report when agent failed to upgrade. This alert will trigger if agent failed to upgrade to the desired version.



Configure Sensors Alerts

Configured Alerts

- *Scope:* **Default** when **Agent Upgrade Status** = **Failed**
- *Scope:* **Default** when **Agent Flow Export Status** = **Stopped**
- *Scope:* **Default** when **Agent Check-In Service** = **Inactive**

More details ...

Types: Agent Upgrade | [✓ Agent Flow Export] | Agent Check In

For *Scope:* **Default**

When: **Agent Flow Export Status** is **Stopped**

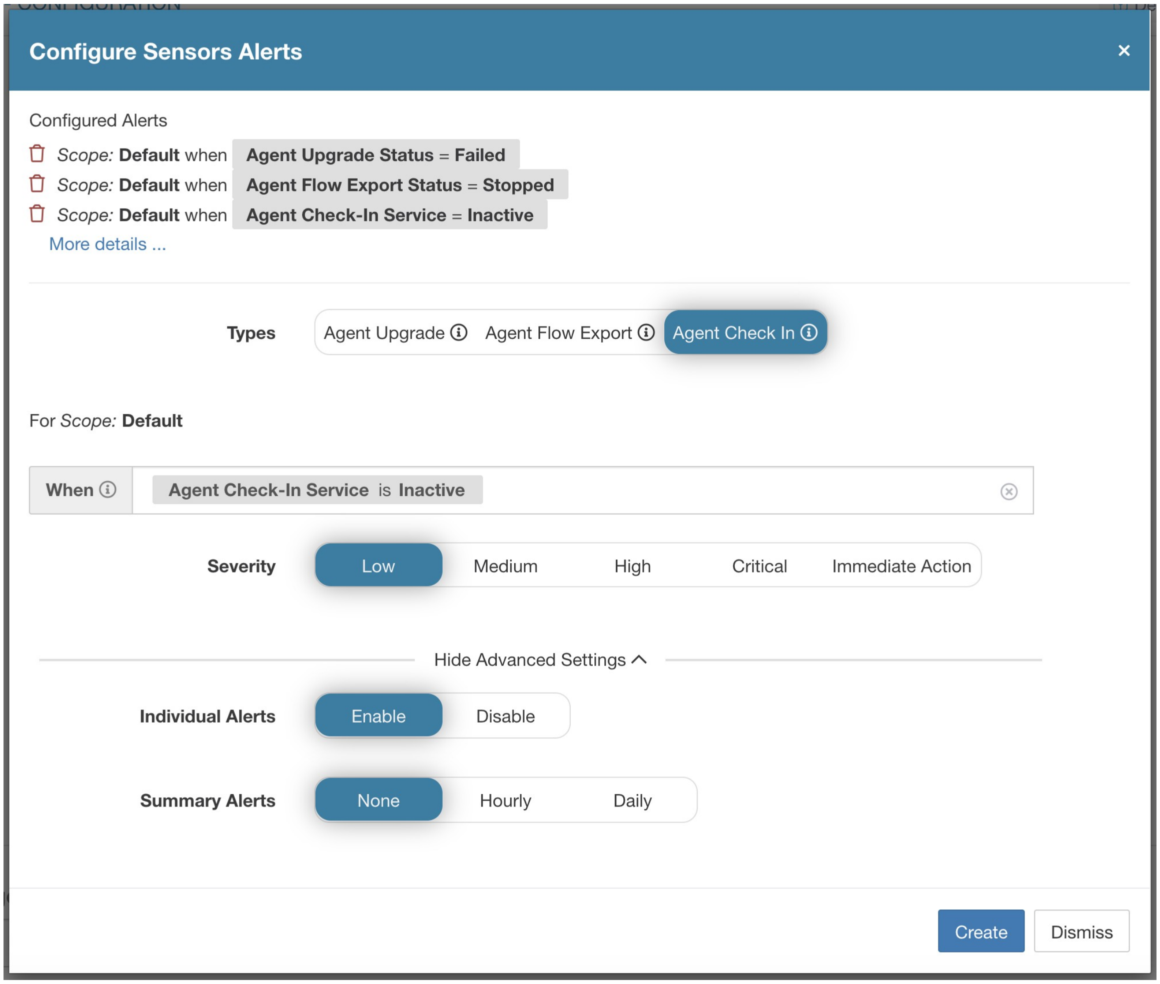
Severity: [✓ Low] | Medium | High | Critical | Immediate Action

Hide Advanced Settings

Individual Alerts: [✓ Enable] | Disable

Summary Alerts: [✓ None] | Hourly | Daily

Configuring Sensor alerts to detect when agent flow export has stopped. This alert will trigger if connectivity between the agent and the cluster is somewhere being blocked, therefore preventing flows and other system information from being sent or delivered.



Configure Sensors Alerts ×

Configured Alerts

- *Scope:* **Default** when **Agent Upgrade Status** = **Failed**
- *Scope:* **Default** when **Agent Flow Export Status** = **Stopped**
- *Scope:* **Default** when **Agent Check-In Service** = **Inactive**

More details ...

Types: Agent Upgrade | Agent Flow Export | [✓ Agent Check In]

For *Scope:* **Default**

When: **Agent Check-In Service** is **Inactive**

Severity: [✓ Low] | Medium | High | Critical | Immediate Action

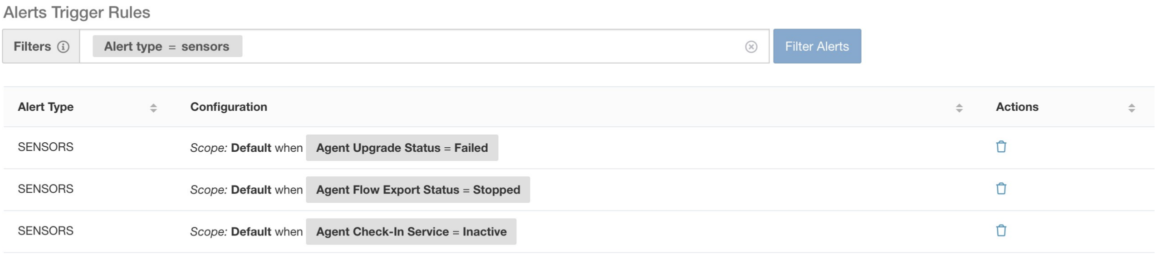
Hide Advanced Settings

Individual Alerts: [✓ Enable] | Disable

Summary Alerts: [✓ None] | Hourly | Daily

Configuring Sensor alerts to detect when agent check_in has timed out. This alert will trigger if the cluster has not received a check-in request from an agent for more than 90 minutes.

Figure 27: Viewing configured Sensor Alerts on the alerts configuration page



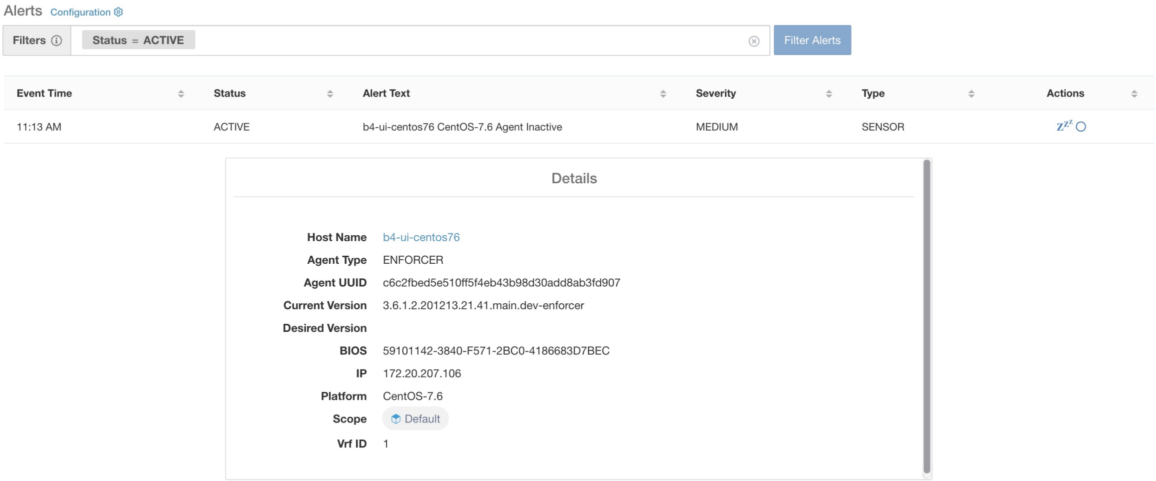
Alerts Trigger Rules

Filters: **Alert type** = **sensors**

Alert Type	Configuration	Actions
SENSORS	*Scope:* **Default** when **Agent Upgrade Status** = **Failed**	🗑
SENSORS	*Scope:* **Default** when **Agent Flow Export Status** = **Stopped**	🗑
SENSORS	*Scope:* **Default** when **Agent Check-In Service** = **Inactive**	🗑

Sensor UI Alerts Details

Figure 28: Sensor alert details



Event Time	Status	Alert Text	Severity	Type	Actions
11:13 AM	ACTIVE	b4-ui-centos76 CentOS-7.6 Agent Inactive	MEDIUM	SENSOR	

Details

Host Name	b4-ui-centos76
Agent Type	ENFORCER
Agent UUID	c6c2fbed5e510ff5f4eb43b98d30add8ab3fd907
Current Version	3.6.1.2.201213.21.41.main.dev-enforcer
Desired Version	
BIOS	59101142-3840-F571-2BC0-4186683D7BEC
IP	172.20.207.106
Platform	CentOS-7.6
Scope	Default
Vrf ID	1

Sensor Alert Details

See Common Alert Structurefor general alert structure and information about fields. The *alert_details* field is structured and contains the following subfields for sensor alerts

Field	Alert Type	Format	Explanation
AgentType	*all*	string	“ENFORCER” or “SENSOR” depending on the installed type
HostName	*all*	string	Host name on which the agent is deployed
IP	*all*	string	IP address of the node/gateway
Bios	*all*	string	BIOS UUID of the node
Platform	*all*	string	Platform/OS information of the node
CurrentVersion	*all*	string	Software version of the agent on the node
DesiredVersion	*all*	string	Software version desired for the agent
LastConfigFetchAt	*all*	integer	Unix timestamp of when the agent last sent https request

Example of alert_details for a sensor alert

```
{
  "AgentType":"SENSOR",
  "Bios":"72EF1142-03A2-03BC-C2F8-F600567BA320",
  "CurrentVersion":"3.5.1.1.mrpm.build.win64-sensor",
  "DesiredVersion":"",
  "HostName":"win2k12-production-db",
  "IP":"172.26.231.193",
  "Platform":"MSServer2012R2Standard"
}
```

Troubleshooting Software Agents

This section lists some potential issues that the customers could possibly face during deployment and operating the software agents, methods could be used to troubleshoot the problems and some remedies that the customers could apply.

General

Log files: Log files are typically stored inside the <install-location>/logs or <install-location>/log folder. These log files are monitored and rotated by the Secure Workload services.

Agent deployment

Linux

Q: When I ran the command “rpm -Uvh tet-sensor-1.101.2-1.el6-dev.x86_64.rpm”, it failed to install the agents and threw the error as follows:

```
error: can't create transaction lock on /var/lib/rpm/.rpm.lock (Permission denied).
```

A: If you do not have the right privileges to install the agents, either switch to root or use sudo to install the agents.

Q: What happened when running “sudo rpm -Uvh tet-sensor-1.0.0-121.1b1bb546.el6-dev.x86_64.rpm” I hit an error as follows:

```
 Preparing...              ########################################### [100%]
 which: no lsb_release in (/sbin:/bin:/usr/sbin:/usr/bin:/usr/X11R6/bin)
 error: %pre(tet-sensor-site-1.0.0-121.1b1bb546.x86_64) scriptlet failed, exit status 1
error:   install: %pre scriptlet failed (2), skipping tet-sensor-site-1.0.0-121.1b1bb546
```

A: The system does not satisfy the requirements to install the agents. In this particular case, lsb_release tool is not installed. See the section sw_agents_deployment-label for more information and install the required dependencies.

Q: When running “sudo rpm -Uvh tet-sensor-1.0.0-121.1b1bb546.el6-dev.x86_64.rpm” I hit an error as follows

```
Unsupported OS openSUSE project
```

```
  error: %pre(tet-sensor-1.101.1-1.x86_64) scriptlet failed, exit status 1
  error: tet-sensor-1.101.1-1.x86_64: install failed
  warning: %post(tet-sensor-site-1.101.1-1.x86_64) scriptlet failed, exit status 1
```

A: Your OS has not yet been supported to run software agents (in this particular case, “openSUSE project” is a non- supported platform). See the section sw_agents_deployment-label for more information.

Q: I have all the dependencies installed, and ran installation with proper privileges. The installation went well, no error was thrown. How do I know the agents installation really succeeded?

A: After the agents has been installed, you can run this command to verify:

```
$ ps -ef | grep -e csw-agent -e tet-
root     14158     1  0 Apr03 ?        00:00:00 csw-agent
root     14160 14158  0 Apr03 ?        00:00:00 csw-agent watch_files
root     14161 14158  0 Apr03 ?        00:00:03 csw-agent check_conf
root     14162 14158  0 Apr03 ?        00:01:03 tet-sensor -f conf/.sensor_config
root     14163 14158  0 Apr03 ?        00:02:38 tet-main --sensoridfile=./sensor_id
root     14164 14158  0 Apr03 ?        00:00:22 tet-enforcer --logtostdderr
tet-sen+ 14173 14164  0 Apr03 ?        00:00:21 tet-enforcer --logtostdderr
tet-sen+ 14192 14162  0 Apr03 ?        00:07:23 tet-sensor -f conf/.sensor_config
```

You must see three entries of *csw-agent* and at least two entries of *tet-sensor*. If the services are not running, ensure that the following directories are available, else the installation has failed.

- `/usr/local/tet` for most Linux distributions
- `/opt/cisco/tetration` for AIX, Ubuntu
- `/opt/cisco/secure-workload` for Solaris, Debian

Windows

Q: When I run the PowerShell agent installer script, I get one of the following errors:

1. The underlying connection was closed: An unexpected error occurred on a receive.
2. The client and server cannot communicate, because they do not possess a common algorithm

A: It is most likely because host and the server has mismatched SSL/TLS protocols configured. One can check the SSL/TLS version using the following command:

```
[Net.ServicePointManager]::SecurityProtocol
```

To set the SSL/TLS to be matching with server one can use the following command (note, this is not a permanent change, only temporary with the current PowerShell session):

```
[Net.ServicePointManager]::SecurityProtocol =
[System.Net.SecurityProtocolType]'Ssl3,Tls,Tls11,Tls12'
```

Q: When I run the MSI installer from the downloaded bundle, I get the following error:

```
This installation package could not be opened. Verify that the package exists and that you
 can access it, or contact the application vendor to verify that this is a valid Windows
Installer package.
```

A: Make sure *C:\Windows\Installer* path exists. If running the MSI installer from the command line, make sure to not include the relative path when pointing to the msi file. Example of correct syntax:

```
msiexec /i "TetrationAgentInstaller.msi" /l*v "msi_install.log" /norestart
```

Q: I have observed that Windows Sensor software fails to upgrade if underlying NIC is Nutanix VirtIO Network Driver.

A: There is an incompatibility issue between Npcap 0.9990 and Nutanix VirtIO Network Driver version earlier than 1.1.3 and Receive Segment Coalescing is enabled.

The resolution for this is to upgrade Nutanix VirtIO Network Driver to version 1.1.3 or later.

Q: I have installed windows sensor. The sensor doesnt seem to register and the sensor_id file contains the following: uuid-invalid-platform

A: You may not have system32 in PATH variable for Windows. Check if system32 is in PATH, if not run the following:

```
set PATH=%PATH%;C:\Windows\System32\
```

Q: I am not receiving the network flows from Kubernetes Pods on Windows Nodes.

A: To verify if the required sessions are running to capture the flows from Kubernetes pods on Windows nodes, perform the following:

1. Run **cmd.exe** with administrative privileges.
2. Run the following command: `logman query -ets`

   Ensure that the following sessions are running:

   - CSW_MonNet: Captures network flows
   - CSW_MonHCS: Monitors creation of pods
   - CSW_MonNat: Monitors NATed flows

Kubernetes

If the installer script fails during Kubernetes Daemonset Installation, there are a large number of possible reasons.

Q: Is the Docker Registry serving images reachable from nodes ?

A: Debug Direct or HTTPS Proxy issues with the cluster pulling images from Cisco Secure Workload cluster

Q: Is the container runtime complaining about SSL/TLS insecure errors ?

A: Verify that the Secure Workload HTTPS CA certificates are installed on all Kubernetes nodes in the appropriate location for the container runtime.

Q: Docker Registry authentication and authorization of image downloads failures ?

A: From each node, attempt to manually docker pull the images from the registry urls in the Daemonset spec using the Docker pull secrets from the secret created by the Helm Chart. If the manually image pull also fails, need to pull logs from the Secure Workload Cluster registryauth service to debug the issue further.

Q: Is the Kubernetes cluster hosted inside the Secure Workload appliance heathy ?

A: Check the service status page for the cluster to ensure all related services are healthy. Run the dstool snapshot from the explore page and retrieve the logs generated.

Q: Are the Docker Image Builder daemons running ?

A: Verify from the dstool logs that the build daemons are running.

Q: Are the jobs that build Docker images failing ?

A: Verify from the dstool logs that the images have not been built. Docker build pod logs can be used to debug errors during the buildkit builds. Enforcement Coordinator logs can also be used to debug the build failures further.

Q: Are the jobs creating Helm Charts failing ?

A: Verify from the dstool logs that the Helm Charts have not been built. Enforcement Coordinator logs will contain the output of the helm build jobs and can be used to debug the exact reason for the Helm Chart build job failures.

Q: Installation bash script was corrupt ?

A: Attempt to download the installation bash script again. The bash script contains binary data appended to it. If the bash script is edited in any way with a text editor or saved as a text file, special characters in the binary data may be mangled/modified by the text editor.

Q: Kubernetes cluster configuration – too many variants and flavors, we support classic K8s.

A: If the customer is running a variant of Kubernetes, there can be many failure modes at different stages of the deployment. Classify the failure stage - kubectl command run failure, helm command run failures, pod image download failures, pod privileged mode options rejected, pod image trust content signature failures, pod image security scan failures, pod binaries fail to run (architecture mismatch), pods run but the Secure Workload services fail to start, Secure Workload services start but have runtime errors due to unusual operating environment.

Q: Are the Kubernetes RBAC credentials failing ?

A: In order to run privileged daemonsets, we need admin privileges to the K8s cluster. Verify the the kubectl config file has its default context pointing towards the target cluster and admin-equivalent user for that cluster.

Q: Busybox image available or downloadable from all cluster nodes ?

A: Fix the connectivity issues and manually test that the busybox image can be downloaded. The exact version of busybox that is used in the pod spec must be available (pre-seeded) or downloadable on all cluster nodes.

Q: API Server and etcd errors or a general timeout during the install ?

A: Due to the instantiation of daemonset pods on all nodes in the Kubernetes cluster, the CPU/Disk/Network load on the cluster can spike suddenly. This is highly dependent on the customer specific installation details. Due to the overload, the installation process (images pulled on all nodes and written to disks) might take too long or overload the Kubernetes API server or the Secure Workload Docker Registry endpoint or, if configured, the proxy server temporarily. After a brief wait for image pulls on all nodes to complete and a reduction in CPU/Disk/Network load on the Kubernetes cluster nodes, retry the installation script again. API Server and etcd errors from the Kubernetes control plane indicate that the Kubernetes control plane nodes may be underprovisioned or affected by the sudden spike in activity.

Q: Secure Workload Agent experiencing runtime issues with its operations ?

A: Refer to the Linux Agent troubleshooting section if the pods are correctly deployed and the agent has started running but is experiencing runtime issues. The troubleshooting steps are the same once the Kubernetes deployment has successfully installed and started the pods.

Anomaly Types

These are the most common issues encountered on the workflow when using and managing Secure Workload Agents.

Agent Inactivity

Agent has stopped checking to the cluster services. This can happen due to several reasons:

- The host might have been down
- The network connectivity has been broken or blocked by firewall rules
- The agent service has been stopped

All platforms

- Verify the host is active and healthy
- Verify the agent service is up and running
- Verify the network connectivity to the cluster is working

Upgrade Failure

Agent upgrade has failed. This can be triggered by few cases such as:

- Not finding the package when the check in script attempts to download it - the upgrade package cannot be unpacked or the installer from the package cannot be verified.
- Installation process failing from an OS issue or dependency.

Windows

- Missing CA root certificate: Certificate Issues
- If agent was originally installed manually with a MSI install package, check if the Windows edition matches list of supported platforms in user guide: Check If Platform Is Currently Supported
- Check to make sure OS is configured correctly for Windows Installer operation: Windows Installer Issues
- Make sure there is enough free disk space on host

Linux

- If the host OS has been upgraded since the last agent installation, verify the current release matches list of supported platforms in user guide: Check If Platform Is Currently Supported
- Make sure there have been no changes to the required dependencies since the last installation. You can run the agent installer script with *–no-install* option to re-verify these dependencies.
- Make sure there is enough free disk space on host

AIX

- Make sure there have been no changes to the required dependencies since the last installation. You can run the agent installer script with *–no-install* option to re-verify these dependencies.
- Make sure there is enough free disk space on host

Convert Failed

The current agent type mismatches desired agent type and the convert attempt has timed out. This issue can be caused by a communication issue when an agent does check_in to download the package, or wss service failed to push convert_commnad to the agent.

All Platforms

- Verify the current release and agent type matches list of supported platforms in user guide: Check If Platform Is Currently Supported

Convert Capability

The ability to convert the agent from one type (such as deep visibility) to another type (such as enforcement) is not available by all agents. If an agent that is not capable to do the conversion is required to convert, the anomaly will be reported.

Policy Out of Sync

The current policy (NPC) version last reported by the agent does not match the current version generated on the cluster. This can be caused by a communications error between the agent and the cluster, the agent failing to enforce the policy with the local firewall, or the agent enforcement service not running.

Windows

- If enforcement mode is WAF, verify there are no GPOs present on the host that would prevent the Firewall from being enabled, adding rules (with Preserve Rules Off) or setting default actions: GPO Configurations
- Verify there is connectivity between the host and the cluster: SSL Troubleshooting
- Verify the generated rule count is less than **2000**
- Verify the WindowsAgentEngine service is running: *sc query windowsagentengine*
- Verify there are available system resources

Linux

- Verify iptables and ipset is present with the *iptables* and *ipset* command
- Verify there is connectivity between the host and the cluster: SSL Troubleshooting
- Verify the tet-enforcer process is running: *ps -ef | grep tet-enforcer*

AIX

- Verify ipfilter is installed and running with the *ipf -V* command

- Verify there is connectivity between the host and the cluster: SSL Troubleshooting
- Verify the tet-enforcer process is running: *ps -ef | grep tet-enforcer*

Flow Export: Pcap Open

If the Secure Workload Agent cannot open the pcap device to capture flows, you see errors in the Agent logs. A successfully opened Pcap device will report as follows:

Windows Log: *C:\Program Files\Cisco Tetration\Logs\TetSen.exe.log*

```
I0609 15:25:52.354 24248 Started capture thread for device <device_name>
I0609 15:25:52.354 71912 Opening device {<device_id>}
```

Linux Log: */usr/local/tet/logs/tet-sensor.log*

```
I0610 03:24:22.354 16614 Opening device <device_name>
[2020/06/10 03:24:23:3524] NOTICE: lws_client_connect_2: <device_id>: address 172.29.
↪136.139
```

Flow Export: HTTPS Connectivity

Connectivity between the agent and the cluster is externally blocked therefore preventing flows and other system information from being delivered. This is caused by one or more configuration issues with network firewalls, SSL decryption services, or third party security agents on the host.

- If there are known firewalls or SSL decryption security devices between the agent and the cluster, make sure that communications to all Secure Workload collector and VIPs IP addresses are being permitted. For on-prem clusters, the list of collectors will be listed under **Troubleshoot** > **Virtual Machines** in the navigation bar at the left side of the Secure Workload web interface. Look for collectorDatamover-*. For Secure Workload cloud, all the IP addresses that need to be permitted will be listed in your Portal.
- To help identify if there is SSL decryption, openssl s_client can be used to make a connection and display the returned certificate. Any additional certificate added to the chain will be rejected by the Agent's local CA. SSL Troubleshooting

Certificate Issues

Windows

Certificate Issues for MSI installer

MSI installer is signed using code signing certificate:

For MSI Installer, version 3.6.x onwards and 3.5.1.31 onwards

- Leaf Certificate: Cisco Systems, Inc
- Intermediate Certificate: DigiCert Trusted G4 Code Signing RSA4096 SHA384 2021 CA1
- Root Certificate: DigiCert Trusted Root G4

For MSI Installer, earlier versions

- Leaf Certificate: Cisco Systems, Inc

- Intermediate Certificate: Symantec Class 3 SHA256 Code Signing CA
- Root Certificate: VeriSign Class 3 Public Primary Certification Authority - G5

It uses timestamp certificate:

For MSI Installer, version 3.6.x onwards and 3.5.1.31 onwards

- Leaf Certificate: Symantec SHA256 TimeStamping Signer - G3
- Intermediate Certificate: Symantec SHA256 TimeStamping CA
- Root Certificate: VeriSign Universal Root Certification Authority

For MSI Installer, earlier versions

- Leaf Certificate: Symantec SHA256 Timestamping Signer - G2
- Intermediate Certificate: Symantec SHA256 Timestamping CA
- Root Certificate: VeriSign Universal Root Certification Authority

Windows Sensor Installation or upgrade will fail if digital signature of MSI installer is invalid. Digital signature is invalid if

- MSI Installer Signing Root Certificate or MSI Installer timestamp Root Certificate is not in a “Trusted Root Certification Authority” store
- MSI Installer Signing Root Certificate or MSI Installer timestamp Root Certificate is expired or revoked.

Issue 1

Installation of agent might fail with below error in the TetUpdate.exe.log “Msi signature is not trusted. 0x800b0109"

Resolution

- Run the command *certmgr* from command prompt
- Check if MSI Installer Signing Root Certificate or MSI Installer timestamp Root Certificate is in *Untrusted Certificates* store.
- Move it to *Trusted Root Certification Authority* store.

Issue 2

Windows Sensor upgrade fails with the following error in TetUpdate.exe.log “Msi signature is not trusted. 0x800B010C"

A certificate was explicitly revoked by its issuer.

Resolution

- Run the command *certmgr* from command prompt
- Check if MSI Installer Signing Root Certificate or MSI Installer timestamp Root Certificate is in *Untrusted Certificates* store.

- Copy it to *Trusted Root Certification Authority* store.

Issue 3

Windows Sensor upgrade fails with the following in TetUpdate.exe.log “Msi signature is not trusted. 0x80096005"

Resolution

- Run the command *certmgr* from command prompt
- Check if MSI Installer Signing Root Certificate and MSI Installer timestamp Root Certificate is in “Trusted Root Certification Authority” store

If it the certificate is missing, import it from other machine.

To import the certificate, follow below steps:

First export the certificate VeriSign Universal Root Certification Authority from one of Working server. Follow below steps:

- Run the command *certmgr* from command prompt
- Right click on the certificate “VeriSign Universal Root Certification Authority” under “Trusted Root Certification Authorities” and go to All tasksExport.
- Copy the exported certificate to the Non-working server and then import the certificate.

To import the certificate, follow below steps:

First export the certificate VeriSign Universal Root Certification Authority from one of Working server. Follow below steps:

- Run the command *certmgr* from command prompt
- Right click on the certificates tab under Trusted Root Certification Authorities and go to All tasksImport.
- Select the Root certificate that you copied and add it in the store.

Certificate Issues for NPCAP installer

Applicable to Windows 2012 , Windows 2012 R2, Windows 8, Windows 8.1

NPCAP version: 1.55

NPCAP Signing Certificate:

- Leaf Certificate: Insecure.Com LLC
- Intermediate Certificate: DigiCert EV Code Signing CA (SHA2)
- Root Certificate: DigiCert High Assurance EV Root CA

NPCAP Timestamp certificate:

- Leaf Certificate: DigiCert Timestamp 2021

- Intermediate Certificate: DigiCert SHA2 Assured ID Timestamping CA
- Root Certificate: DigiCert Assured ID Root CA

Issue 1

Windows Agent Installation might fail with below error in msi_installer.log

```
CheckServiceStatus : Exception System.InvalidOperationException: Service npcap was not found
 on computer
'.'. —> System.ComponentModel.Win32Exception: The specified service does not exist as an
installed service
```

Resolution

- Run the command *certmgr* from command prompt
- Check “DigiCert High Assurance EV Root CA” in “Trusted Root Certification Authority” store.
- If it the certificate is missing, import it from other machine.

To import the certificate, follow below steps:

First export the certificate “DigiCert High Assurance EV Root CA” from one of Working server. Follow below steps:

- Run the command *certmgr* from command prompt
- Right click on the certificate “DigiCert High Assurance EV Root CA” under “Trusted Root Certification Authorities” and go to All tasksExport.
- Copy the exported certificate to the Non-working server and then import the certificate.

To import the certificate, follow below steps:

- Run the command *certmgr* from command prompt
- Right click on the certificates tab under Trusted Root Certification Authorities and go to All tasksImport.
- Select the Root certificate that you copied and add it in the store.

Applicable to Windows 2008 R2

NPCAP version: 0.991

NPCAP Signing Certificate:

- Leaf Certificate: Insecure.Com LLC
- Intermediate Certificate: DigiCert EV Code Signing CA
- Root Certificate: DigiCert High Assurance EV Root CA

NPCAP Timestamp certificate:

- Leaf Certificate: DigiCert Timestamp Responder
- Intermediate Certificate: DigiCert Assured ID CA-1

- Root Certificate: VeriSign DigiCert Assured ID Root CA

Issue 1

Windows Agent Installation might fail with below error in msi_installer.log

```
CheckServiceStatus : Exception System.InvalidOperationException: Service npcap was not found
 on
computer ‘.’. —> System.ComponentModel.Win32Exception: The specified service does not exist
 as an
installed service
```

Resolution

- Run the command *certmgr* from command prompt
- Check *DigiCert High Assurance EV Root CA* in *Trusted Root Certification Authority* store.
- If it the certificate is missing, import it from other machine.

To import the certificate, follow below steps:

First export the certificate “DigiCert High Assurance EV Root CA” from one of Working server. Follow below steps:

- Run the command *certmgr* from command prompt
- Right click on the certificate “DigiCert High Assurance EV Root CA” under “Trusted Root Certification Authorities” and go to All tasksExport.
- Copy the exported certificate to the Non-working server and then import the certificate.

To import the certificate, follow below steps:

- Run the command *certmgr* from command prompt
- Right click on the certificates tab under Trusted Root Certification Authorities and go to All tasksImport.
- Select the Root certificate that you copied and add it in the store.

Windows Host Rename

Scenario 1: Not able to see IP Addresses and VRF info after renaming the Windows Host Steps to fix the issue:

- Remove the entry(with new Hostname that is missing IP Addresses and VRF info) from the TaaS UI.
- Uninstall ‘Cisco Secure Workload Agent’ from the Windows Host and delete the ‘Cisco Tetration’ directory (typically the path for this will be : ‘C:Program FilesCisco Tetration’).
- Install ‘Cisco Secure Workload Agent’ on the Windows Host.

Following the above steps should register the Agent on the TaaS UI successfully with the IP Addresses and VRF info.

Scenario 2: Planned Windows Host rename (in advance) Steps to follow:

- Uninstall ‘Cisco Secure Workload Agent’ from the Windows Host and delete the ‘Cisco Tetration’ directory (typically the path for this will be : ‘C:Program FilesCisco Tetration’).
- Rename the Windows Host and Reboot.
- Install ‘Cisco Secure Workload Agent’ on the Windows Host(with new Hostname).

Following the above steps for planned Host rename should register the Agent on the TaaS UI with new Hostname.

Check If Platform Is Currently Supported

Windows

- Run the command *winver.exe*
- Compare this release to what is listed here: Supported Platforms and Requirements

Linux

- Run *cat /etc/os-release*
- Compare this release to what is listed here: Supported Platforms and Requirements

AIX

- Run the command *uname -a*
- Note: The major and minor versions are reversed

```
p7-ops2> # uname -a
AIX p7-ops2 1 7 00F8AF944C00
```

- In this example, the first number after the host name is the minor and the second number is the major version, so AIX version 7.1. Compare this release to what is listed here: Supported Platforms and Requirements

Windows Installer Issues

- Make sure there is a *C:\Windows\Installer* directory. This is not visible in File Explorer, easiest way to verify is in a CMD session and running: *dir C:\Windows\Installer*
- Check if the *Windows Installer* service is not disabled. It must be set to *Manual*
- Check to see if there are no other errors being reported by Windows Installer. Check Windows System Event logs under **Windows Logs** > **Application** > **Source** > **MsiInstaller**

Required Windows Services

Below is a list of services, that when disabled, have been linked to installation issues of the agent. It is recommended these services are running during the initial installation and any upgrade of the Deep Visibility and Enforcement agents.

Table 10: Required Windows Services

Service	Purpose for installation
Device Setup Manager	Device driver management for the installation of the Npcap filter driver.
Device Install Service	Also used for the installation of the Npcap filter driver.
Windows Installer	Required for the installation of agent MSI package.
Windows Firewall	Required for WAF enforcement mode.
Application Experience	Used to determine capability executables on the system.

Note Application Experience service only applies to Windows Server 2008, 2008R2, 2012, 2012R2 and Win- dows 7. If disabled, a file lock may occur during Npcap installation causing it to fail.

Npcap Issues

Npcap is a pcap tool used for Windows Agent only. Ten seconds after the agent service starts, it will attempt to install or upgrade Npcap to the supported version. If Npcap service fails to install or upgrade, the agent will retry the installation within the next 30 minutes. After 3 failed attempts, the agent will attempt to rollback Npcap to a previous supported version if available. After, the agent will no longer try to install Npcap. You can check *C:\Program Files\Cisco Tetration\Logs\TetUpdate.exe.log* and *C:\Program Files\Cisco Tetration\Logs\npcap_install.log* to identify the error.

Npcap will not upgrade (manually or via agent)

- Npcap will sometimes not uninstall correctly if a process is currently using the Npcap libraries. To check for this run the following command:

```
PS C:\Program Files\Npcap> .\NPFInstall.exe -check_dll
WindowsSensor.exe, Wireshark.exe, dumpcap.exe
```

If you see processes listed, they must be stopped before the Npcap upgrade can continue. If no processes are using Npcap the above command will simply show *<NULL>*

Npcap will not install

- Check CA certificates installed on the system: Certificate Issues for NPCAP installer
- Check Windows Installer issues: Windows Installer Issues

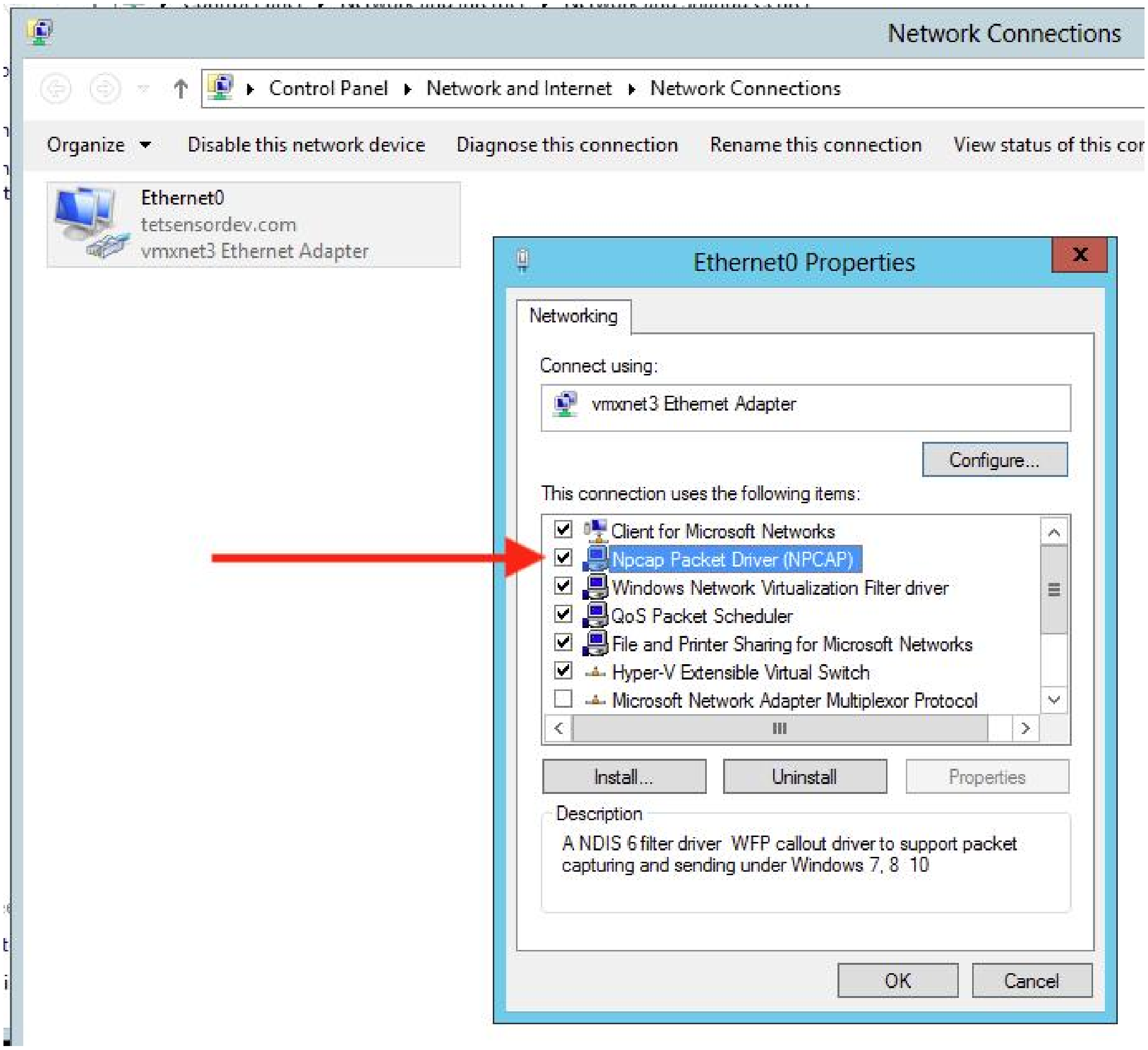
- Verify no other user on the system is making changes to the network interfaces. This can cause a COM lock preventing NDIS driver binding.

Verify if Npcap is fully installed

Procedure

Step 1 Check **Control Panel** > **Programs** and **Features** to see if Npcap is listed as an installed application

Step 2 Make sure the Npcap Packet Driver has a binding to the NIC in question (checkmark is present)



Connect using:

vmxnet3 Ethernet Adapter

This connection uses the following items:

- ☑ Client for Microsoft Networks
- ☑ Npcap Packet Driver (NPCAP)
- ☑ Windows Network Virtualization Filter driver
- ☑ QoS Packet Scheduler
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ Hyper-V Extensible Virtual Switch
- ☐ Microsoft Network Adapter Multiplexor Protocol

Description

A NDIS 6 filter driver WFP callout driver to support packet capturing and sending under Windows 7, 8 10

Step 3 Check if the network driver is installed

```
C:\Windows\system32>pnputil -e | findstr Nmap
Driver package provider : Nmap Project
```

Step 4 Check if the driver service is installed and RUNNING

```
C:\Windows\system32>sc query npcap
SERVICE_NAME: npcap
         TYPE : 1 KERNEL_DRIVER
         STATE : 4 RUNNING
```

Step 5 Check if the registry entry is there (used by the agent to verify Npcap exists already)

```
C:\Windows\system32>reg query HKLM\software\wow6432node\npcap
HKEY_LOCAL_MACHINE\software\wow6432node\npcap
          AdminOnly REG_DWORD 0x1
          WinPcapCompatible REG_DWORD 0x0
         (Default) REG_SZ C:\Program Files\Npcap
```

Step 6 Check if the installed Npcap program files are all there

```
C:\Windows\system32>dir "c:\program files\npcap"
 Directory of c:\program files\npcap
04/29/2020 02:42 PM <DIR> .
04/29/2020 02:42 PM <DIR> ..
01/22/2019 08:16 AM 868 CheckStatus.bat
11/29/2016 03:43 PM 1,034 DiagReport.bat
12/04/2018 11:12 PM 8,908 DiagReport.ps1
01/09/2019 09:22 PM 2,959 FixInstall.bat
04/29/2020 02:42 PM 134,240 install.log
01/11/2019 08:52 AM 9,920 LICENSE
03/14/2019 08:59 PM 10,434 npcap.cat
03/14/2019 08:57 PM 8,657 npcap.inf
03/14/2019 09:00 PM 74,040 npcap.sys
03/14/2019 08:57 PM 2,404 npcap_wfp.inf
03/14/2019 09:00 PM 270,648 NPFInstall.exe
04/29/2020 02:42 PM 107,783 NPFInstall.log
03/14/2019 09:01 PM 175,024 Uninstall.exe
         13 File(s) 806,919 bytes
          2 Dir(s) 264,417,628,160 bytes free
```

Step 7 Check to see if the .sys driver file is in the Windows driver folder

```
C:\Windows\system32>dir "C:\Windows\System32\Drivers\npcap.sys"
Directory of C:\Windows\System32\Drivers
03/14/2019 09:00 PM 74,040 npcap.sys
                  1 File(s) 74,040 bytes
```

Network Connectivity issues during NPCAP installation or upgrade

Applicable to Windows 2016 Only

If you have a 3rd party LWF (Light Weight Filter) driver (e.g. netmon) or a teaming adapter is configured in your setup, and NPCAP is installed during agent deployment, you might experience

RDP is reconnected

NetBios service is restarted

Similar network connectivity issues

This is due to a BUG in Windows 2016 OS

NIC teaming compatibility issues with NPCAP

Teaming NIC functionality is based on underneath Physical NICs (Intel, Broadcom, Realtek, MS virtual adapter etc) and Teaming driver configuration (switch based, loadbalancing or failover, algorithm to distribute the packets across multiple NICs).

Some NPCAP versions have compatibility issues with Teaming NICs, especially during binding to the underneath Teaming NICs.

The current Secure Workload Sensor software is tested using Microsoft supported NIC teaming.

```
NIC type : Intel(R) 82574L Gigabit Network Connection
Teaming Mode : Switch Independent
Load Balancing Mode: Address Hash
OS : Windows 2012 , Windows 2012 R2, Windows 2016, Windows 2019
NPCAP version: 1.55
```

.

Note Windows 2008R2 does not support Microsoft supported NIC teaming.

VDI instance VM does not report network flows

The TetSensor service occasionally does not capture the network flows on cloned VMs when NPCAP service is running. This can happen when the agent is installed without the **nostart** flag using MSI installer or without **goldenImage** flag using PowerShell Installer on a VM template or golden image.

In this case, Secure Workload agent services start running on the VM template. NPCAP is installed and bound to the Network stack on the VM template. When a new VM is cloned from the VM template, NPCAP is not properly bound to the Network stack on the new cloned VM. As a result, NPCAP fails to capture the network flows.

Resolution

Procedure

Step 1 Run command **cmd.exe** with **Admin** privileges.

Step 2 Run command **sc stop tetsensor** to stop TetSensor Service.

Step 3 Run command **sc stop tetenforcer** to stop TetEnforcer Service.

Step 4 Run **C:\Program Files\Npcap\NPFInstall.exe -check_dll** to make sure that no other application is using NPCAP.

Step 5 Stop the processes using NPCAP.

Step 6 Run **C:\Program Files\Npcap\NPFInstall.exe -r** to restart the bindings.

Step 7 Run command **sc start tetsensor** to start TetSensor Service.

Step 8 Run command **sc start tetenforcer** to start TetEnforcer Service.

Network Performance with NPCAP

It is observed that Network performance will be affected when Windows TetSensor service is running. Windows Tet- Sensor service (tetsen.exe) captures the network flows using NPCAP. NPCAP implementation to capture the network flows and the network flows to the tetsen.exe affects the network performance.

Compare the Network Performance after installing tetsensor, Client : Windows 2016

NPCAP 1.55

TetSensor Config : Conversation Mode with Enforcement mode WFP

Server : Windows 2016

NPCAP 1.55

TetSensor Config : Conversation Mode with Enforcement mode WFP

Run cmd : iperf3.exe -c <server_ip> -t 40

Table 11: 121071: Network Performance with NPCAP 155

Setup	Network Performance
No TetSensor Installed NO NPCAP	[ID] Interval Transfer Bandwidth [4] 0.00-40.00 sec 18.2 GBytes 3.90 Gbits/sec sender [4] 0.00-40.00 sec 18.2 GBytes 3.90 Gbits/sec receiver
TetSensor Installed NPCAP Installed	[ID] Interval Transfer Bandwidth [4] 0.00-40.00 sec 17.3 GBytes 3.72 Gbits/sec sender [4] 0.00-40.00 sec 17.3 GBytes 3.72 Gbits/sec receiver

Network Performance with NPCAP 0.9990

Compare the Network Performance after installing tetsensor, Client : Windows 2016

NPCAP 0.9990

TetSensor Config : Conversation Mode with Enforcement mode WFP

Server : Windows 2016

NPCAP 0.9990

TetSensor Config : Conversation Mode with Enforcement mode WFP

Run cmd : iperf3.exe -c <server_ip> -t 40 .. table:: Network Performance with NPCAP 0.9990

class longtable

Setup	Network Performance
TetSensor Installed NPCAP Installed	[ID] Interval Transfer Bandwidth [4] 0.00-40.00 sec 16.3 GBytes 3.50 Gbits/sec sender [4] 0.00-40.00 sec 16.3 GBytes 3.50 Gbits/sec receiver

Note Performance may vary based on Windows NPCAP version installed, Windows OS, and network Configuration.

OS Performance and/or stability Issues

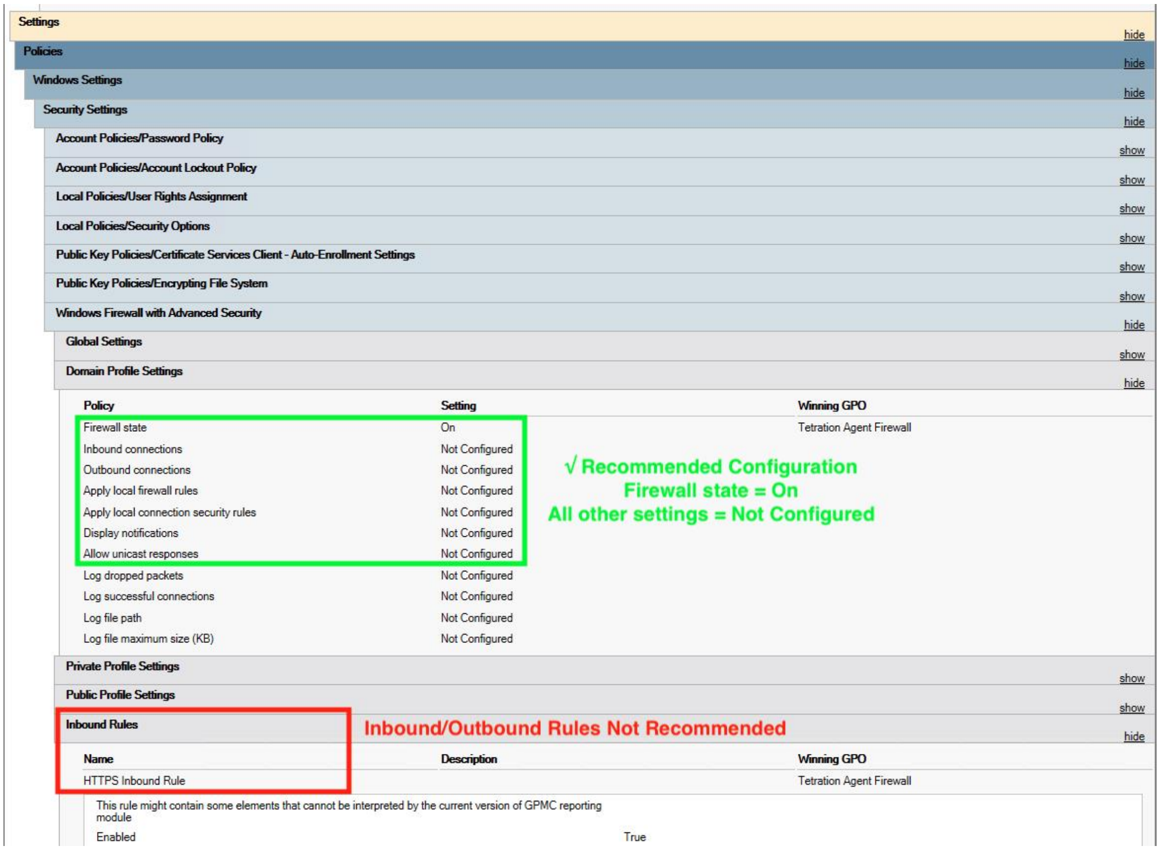
OS may experience unknown performance or stability issues if the installed NPCAP version or NPCAP configuration is not supported by the Secure Workload Software.

Supported NPCAP Version: : 0.991 and 1.55

GPO Configurations

Agents that enforce policy require only the Firewall to be enabled with either a local setting or GPO. All other GPO settings should not be set and left as "Not Configured."

- To check if a GPO setting is blocking enforcement you can check the *C:\Program Files\Cisco Tetration\Logs\TetEnf.exe.log* log and search for the following error examples:
- **Rules conflicting with "Preserve Rules=No" setting:** "There are firewall rules set in the Group Policy. Secure Workload agent does not have permission to remove these"
- **Firewall set to off:** "GPO has disabled firewall for DomainProfile"
- **Default Action is set:** "Group Policy has conflicting default inbound action for DomainProfile"
- To check what GPO policies are being applied to the host, run *gpresult.exe /H gpreport.html* and open the generated HTML report. In the example below *Secure Workload Agent Firewall* is applying a Inbound rule which will conflict with Enforcement if "Preserve Rules" is set to "No."



Settings hide

Policies hide

Windows Settings hide

Security Settings hide

Account Policies/Password Policy show

Account Policies/Account Lockout Policy show

Local Policies/User Rights Assignment show

Local Policies/Security Options show

Public Key Policies/Certificate Services Client - Auto-Enrollment Settings show

Public Key Policies/Encrypting File System show

Windows Firewall with Advanced Security hide

Global Settings show

Domain Profile Settings hide

Policy	Setting	Winning GPO
Firewall state	On	Tetration Agent Firewall
Inbound connections	Not Configured	
Outbound connections	Not Configured	
Apply local firewall rules	Not Configured	
Apply local connection security rules	Not Configured	
Display notifications	Not Configured	
Allow unicast responses	Not Configured	
Log dropped packets	Not Configured	
Log successful connections	Not Configured	
Log file path	Not Configured	
Log file maximum size (KB)	Not Configured	

√ Recommended Configuration
Firewall state = On
All other settings = Not Configured

Private Profile Settings show

Public Profile Settings show

Inbound Rules hide

Inbound/Outbound Rules Not Recommended

Name	Description	Winning GPO
HTTPS Inbound Rule		Tetration Agent Firewall

This rule might contain some elements that cannot be interpreted by the current version of GPMC reporting module

Enabled	True

Agent To Cluster Communications

The Secure Workload Agent maintains connections to the cluster over multiple channels. Depending on the type of Agent, the number of connections varies.

Types of connections

- **WSS:** Persistent socket connection over port 443 to the cluster
- **Check in:** A HTTPS call to the cluster every 15-20 minutes to check for current configurations, check for updates and to update the active state of the agent to the cluster. This also reports upgrade failures.
- **Flow export:** Persistent SSL connection over port 443 (TaaS) or 5640 (On-premise) to send flow metadata to the cluster
- **Enforcement:** Persistent SSL connection over port 443 (Taas) or 5660 (On-premise) to pull in enforcement policies and report enforcement state

Checking the connection state

The Teration UI will report either an inactive agent (no longer checking-in), no exported flows (on Agent Workload Profile page under Stats), or failed enforcement. Depending on the error, you can check different logs on the workload to help determine the source of the issue.

Inactive Agent

Windows Log: *C:\Program Files\Cisco Tetration\Logs\TetUpdate.exe.log*

Linux Log: */usr/local/tet/logs/check_conf_update.log*

An HTTP response code of 304 is expected and means there is no configuration change. Error code = 2 is expected as well. Any other HTTP response code will indicate a issue talking to the WSS service on the Secure Workload cluster.

```
Tue 06/09/2020 17:25:25.08 check_conf_update: "curl did not return 200 code, it's 304,
↪ exiting"
Tue 06/09/2020 17:25:25.08 check_conf_update: "error code after running check_conf_
↪update = 2"
```

- **304** Expected, no config change. Successful check-in
- **401** Registration is not successful, missing Activation Key (TaaS)
- **403** Agent already registered to the cluster with same UUID
- **000** Indicates connection issue with SSL. Either curl could not reach the WSS server or there is a issue with the certificate. See SSL troubleshooting: SSL Troubleshooting

No exported flows

Windows Log: *C:\Program Files\Cisco Tetration\Logs\TetSen.exe.log*

Linux Log: */usr/local/tet/logs/tet-sensor.log*

The following indicates a successful connection to WSS

```
cfgserver.go:261] config server: StateConnected, wss://<config_server_ip>:443/wss/
↪<sensor_id>/forensic, proxy:
```

The following indicates a successful connection to the Collectors

```
collector.go:258] next collector: StateConnected, ssl://<collector_ip>>:5640
```

If there are errors connecting to either WSS or the Collectors, check your firewall configuration or verify if any SSL decryption is occurring between the agent and Secure Workload. See: SSL Troubleshooting

Failed to enforce policy

Windows Log: *C:\Program Files\Cisco Tetration\Logs\TetEnf.exe.log*

Linux Log: */usr/local/tet/logs/tet-enforcer.log*

```
ssl_client.cpp:341] Successfully connected to EFE server
```

If there are errors connecting to the EFE server, check your firewall configuration or verify if any SSL decryption is occurring between the agent and Secure Workload. See: SSL Troubleshooting

SSL Troubleshooting

Agent Communications Overview

Secure Workload agents use TLS to secure the TCP connections to the Secure Workload Cloud SaaS servers. These connections are broken down into three distinctive channels.

- Agent -> Cisco Secure Workload SaaS control channel over port TCP/443 (TLS) (sensorVIP)

  This is a low volume control channel that allows the agent to register with Secure Workload and also handles configuration pushes and software upgrade notifications.

- Agent -> Cisco Secure Workload SaaS flow data over TCP/443 (TLS) (collector)

  Flow data is the extracted flow metadata information; the data will be sent to 1 set of 16 IP addresses at a time. The second set of IP addresses is for standby. This is around 1 – 5% of actual server traffic.

- Agent ->Cisco Secure Workload SaaS enforcement data over TCP/443 (TLS) (efe)

  The enforcement data channel is a low volume control channel that is used to push the policies to the sensors and also gather enforcement statistics.

The sensor validates the TLS certificate from the Secure Workload Cloud control, data and enforcement servers against a local CA that is installed with the agent. No other CAs are used, so any other certificate sent to the agent will result in a verification failure and the agent will not connect. This will result in the agent not registering, checking-in, sending flows or receiving enforcement policies.

Configuring IP traffic for Agent Communications

A typical configuration for most will be to have a perimeter firewall and possibly a proxy between the agents (workflows) and Secure Workload TaaS.

Note Secure Workload gathers your gateway/NAT IP information during the on-boarding and automatically adds the information at the time of tenant creation. If you add new IP addresses or change IP addresses in the portal, the changes require review and approval by Secure Workload staff.

In addition to adding your gateway/NAT IP addresses in the TaaS portal, there might be more changes required to your network to allow the traffic outbound and unmodified:

Allow outbound port 443 over TLS/HTTPS on the perimeter firewall

Configure proxy bypass and SSL/TLS bypass on the web proxy, if a decrypting web proxy is being used.

Note If you are using a transparent web proxy at the data center, you must route the specific SaaS IP address and configure the bypass rules. Sensors are connections that cannot do automatic HTTPS redirection.

The list of IPs the agents communicates with is available on the TaaS portal. The IPs to add to your firewall outbound configuration and proxy bypass are labeled collector-n, efe-n (only if enforcement is being deployed), and sensorVIP. There are typically 17 to 33 IPs to add for agent communication, but there could more or less depending on your TaaS configuration.

Note Ensure that the outbound firewall rules allow traffic to flow to the destination metadata collector IPs.

Note You can now edit the outbound gateway IP addresses on the user interface. This functionality allows the allowed metadata traffic originating from your workloads to their destination.

Troubleshooting SSL/TLS Connections

As discussed in the previous section, it is important to configure your explicit or transparent web proxy to bypass SSL/TLS decryption for agent communications. If the bypass is not configured, these proxies might attempt to decrypt

SSL/TLS traffic by sending its own certificate to the agent. Because the agent only uses its local CA to validate the certificate, these proxy certificates will cause connection failures.

Symptoms include agent failing to register to the cluster, agent not checking-in, agent not sending flows, and/or agent not receiving enforcement configuration (if enforcement is enabled).

Note Troubleshooting steps below are assuming default installation paths were used. Windows: C:Program FilesCisco Tetration Linux: /usr/local/tet. If you installed your agents in a different location, substitute that location in the instructions.

SSL/TLS Connection issues are reported in the agent logs. To verify if there are SSL errors in the logs, run the following commands for the associated issue being observed.

Registration, check-in

Linux

```
grep "NSS error" /usr/local/tet/log/check_conf_update.log
```

Windows (PowerShell)

```
get-content "C:\Program Files\Cisco Tetration\logs\TetUpdate.exe.log" | select-
↪string -pattern "curl failed SSL peer certificate"
```

Flows

Most of the SSL/TLS connection issues seen are during the initial connection and registration of the agent. Sending flows relies on the registration to be complete before attempting to connect. SSL/TLS errors seen here would be the result of the sensorVIP IPs being allowed but not the collector IPs.

Linux

```
grep "SSL connect error" /usr/local/tet/log/tet-sensor.log
```

Windows (PowerShell)

```
get-content "C:\Program Files\Cisco Tetration\logs\WindowsSensor*.log" | select-
↪string -pattern "Certificate verification error"
```

Enforcement

Linux

```
grep "Unable to validate the signing cert" /usr/local/tet/log/tet-enforcer.log
```

Windows (PowerShell)

```
get-content "C:\Program Files\Cisco Tetration\logs\WindowsSensor*.log" | select-
↪string -pattern "Handshake failed"
```

If an SSL error is seen in the log checks above you can verify what certificate is being sent to the Agents with the following commands.

Explicit Proxy - where a proxy is configured in user.cfg

Linux

```
curl -v -x http://<proxy_address>:<port> https://<sensorVIP>:443
```

Windows (PowerShell)

```
cd "C:\Program Files\Cisco Tetration"
.\curl.exe -kv -x http://<proxy_address>:<port> https://<sensorVIP>:443
```

Transparent Proxy - No user.cfg proxy configuration required. It's a proxy configured between all HTTP(S) traffic from agent to the internet.

Linux

```
openssl s_client -connect <sensorVIP from TaaS Portal>:443 -CAfile /usr/local/tet/
↪cert/ca.cert
```

Windows (PowerShell)

```
cd C:\Program Files\Cisco Tetration
.\openssl.exe s_client -connect <sensorVIP from TaaS Portal>:443 -CAfile cert\ca.cert
```

You are looking for the following in the openssl s_client respose

```
Verify return code: 0 (ok)
```

If you see an error, examine the certificate. An example certificate (chain) should include only the following cert (CN IP is an example):

Certificate chain

```
0 s:/C=US/ST=CA/L=San Jose/O=Cisco Systems, Inc./OU=Tetration, Insieme BU/CN=129.146.
↪155.109
i:/C=US/ST=CA/L=San Jose/O=Cisco Systems, Inc./OU=Tetration Analytics/CN=Customer CA
```

If you see additional certificates, then there is possibly a Web decrypting proxy between the agent and Secure Workload. Contact your security or network group and verify if the proxy bypass is configured using the listed IPs from the Configuring IP traffic for Agent Communications section.

Windows sensor installation script fails on Windows 2016 servers: Error message that might appear “The underlying connection was closed: An unexpected error occurred on a receive.” Possible reason might be the SSL/TLS versions set in PowerShell.

To check the SSL/TLS versions running, run the following command:

```
[Net.ServicePointManager]::SecurityProtocol
```

If the output from the above command is:

```
Ssl3, Tls
```

Then use the below command to change the allowed protocols and retry the installation:

```
[Net.ServicePointManager]::SecurityProtocol = [System.Net.SecurityProtocolType]'Ssl3,
↪Tls,Tls11,Tls12'
```

Agent operations

Q: I have installed the agents successfully, but I didn’t see it on UI Sensor Monitoring page.

A: An agent is required to register with backend server running within cluster before it could start operating. When an agent is not shown on UI page, most likely it’s because the registration has failed. There are a few things we could check to see why a registration failed:

- Check if the connection between the agent and the backend server is working properly
- Check if the curl request could be sent to backend server properly
- Check HAProxy access and backend server logs to see if the registration request made it to the server
- Check the error return from curl request in the log file

Q: The agent is installed and I could find in on UI page. However, the “SW Ver” column shows “initializing” instead of a version string.

A: After the initial agent is installed and registered with the backend server, it would take another 30 minutes for the agent to report its version.

Q: The agent is upgraded properly, but the “SW Ver” fields still show the old version after a long time (like several hours).

A: After the agent is upgraded successfully, it will try to send a curl request to report its current running version and check for new version in the same request. It is possible that the request couldn’t make it to the backend, due to several reason:

- The request is timed out, couldn’t get the response in time
- The network is facing problem, agent couldn’t connect to backend servers

Q: I have an agent running on RHEL/CentOS-6.x and it is working properly. I am planning to upgrade the OS to RHEL/CentOS-7.x. Would the agent still work after the upgrade?

A: currently we do not support the scenario in which the OS has been upgraded, especially upgrading the major releases. In order to have the agent work after OS upgrade, do the following steps:

- Uninstall the existing agent software
- Clean up all files, including certs
- Go to UI, delete the agent entry
- Upgrade the OS to the desired version
- Install the agent software on the new OS

Q: I have an agent running on RHEL/CentOS-6.x and it is working properly. I am planning to rename the host. Would the agent still work after rename/reboot?

A: An agent identity is calculated based on the host’s uniqueness, including hostname and bios-uuid. Changing hostname changes the host’s indentify. It is recommended to do the following:

- Uninstall the existing agent software
- Clean up all files, including certs
- Go to UI, delete the old agent entry

- Rename the host and reboot
- Install the agent software again

Q: On Windows host, firewall deviation was caused by adding/deleting/modifying a rule. How do I find the rule?

A: On deviation detection, agent logs the last 15 seconds of firewall events to “C:\Windows\System32\config\systemprofile\AppData\Roaming\tet\firewall_events”. Rule that caused deviation will be found in the latest file created as policy_dev_<policy id>_<timestamp>.txt

Q: I have installed the agent on a Windows host successfully. Why do I not see any reported flows from the sensor?

A: Npcap is required to collect flows on a Windows host. Ten seconds after the agent is installed successfully, it will install Npcap. If the sensor does not report flows after several minutes, check if the agent and the backend server is connected and if Npcap is installed properly on the Npcap Issues.

Q: I have installed the agent on Windows host, 2008 R2, successfully. Why does the system clock drift when tetsensor service is running?

A: This is a known problem with Go and Windows 2008 R2. For more information, see Golang and Win2008 R2.

The process, tet-main.exe, running as a part of tetsensor service, is built using Go Version 1.15. That is why the system clock drifts when the tetsensor service is running.

This issue occurs when Windows 2008 R2 workload is configured to use the external NTP server or Domain Controller as NTP server.

The possible work around :

1. Periodially force NTP to sync the clock: w32tm /resync /force
2. Disable tet-main.exe manually.
   - Run cmd.exe with “administrator” privilege.
   - Run regedit.exe
   - Go to “HKEY_LOCAL_MACHINE\SYSTEM\ControlSet001\Services\TetSensor”
   - Double click on “ImagePath”
   - Edit value, remove tet-main.exe

     before “C:\Program Files\Cisco Tetration\TetSenEngine.exe” TetSensor TetSen.exe “-f sensor_config” tet-main.exe ” ” TetUpdate.exe

     after “C:\Program Files\Cisco Tetration\TetSenEngine.exe” TetSensor TetSen.exe “-f sensor_config” TetUpdate.exe
   - Restart tetsensor service

Note Disable tet-main.exe after every time agent is upgraded.

3. Remove external NTP server configuration:

- Run command : w32tm /config /update /manualpeerlist: /syncfromflags:manual /reliable:yes
- Restart Windows Time Service, W32Time

For more details about this issue, refer CSCwb8009 for more details.

CHAPTER 3

External Orchestrators

External orchestrators can be used to gather existing metadata describing your workloads from systems on your network. Some external orchestrators can also enforce segmentation policy.

For deployments where an authorized system of record exists with labels for workloads, we provide a way for automatically importing the labels through external orchestrator integrations. Any modifications in the system of record will be learnt automatically by Secure Workload and used for updating labels in your inventory. For detailed information about the power and uses of labels, see Workload Labels.

Currently supported external orchestrators:

Table 12: Currently supported external orchestrators

Type	Description/ When to use
VMware vCenter	To import virtual machine data, such as host name, IP address, and labels, from a vCenter server to Secure Workload. The generated labels can be used to create Secure Workload scopes and enforcement policies.
Amazon Web Services	(You cannot create new AWS orchestrators; instead, create AWS connectors. See AWS Connector. Any existing AWS orchestrators are read-only). To import data of EC2 server instances, such as host name, IP address, and labels, from the given AWS account to Secure Workload. The generated labels are useful to create Secure Workload scopes and policies.
Kubernetes/OpenShift	To import Kubernetes' entities, such as nodes, pods, services, and labels. These labels can be used within Secure Workload to define scopes and policies.
DNS	To import A/AAAA and CNAME records from a DNS server via zone transfer. This produces DNS names as labels, which are useful in defining Secure Workload scopes and policies.

Type	Description/ When to use
Infoblox	To import networks, hosts, and A/AAAA records with extensible attributes from an Infoblox appliance with IPAM/DNS enabled. The imported extensible attributes can be used as labels in Secure Workload scopes and policies.
F5 BIG-IP	To read virtual server configurations from the given F5 load balancer and generate labels for the provided services, which can be used to define enforcement policies in Secure Workload. The policy enforcement feature will translate them into F5 policy rules via F5 REST API.
Citrix Netscaler	To read virtual server configurations from the given Netscaler load balancer and generate labels for the provided services, which can be used to define enforcement policies in Secure Workload. The policy enforcement feature will translate them into Netscaler ACLs via its REST API.
Secure Firewall Management Center *(BETA)*	To deploy policies to all Secure Firewall Threat Defense (formerly known as Firepower Threat Defense or FTD) devices registered to the given Secure Firewall Management Center using REST API.

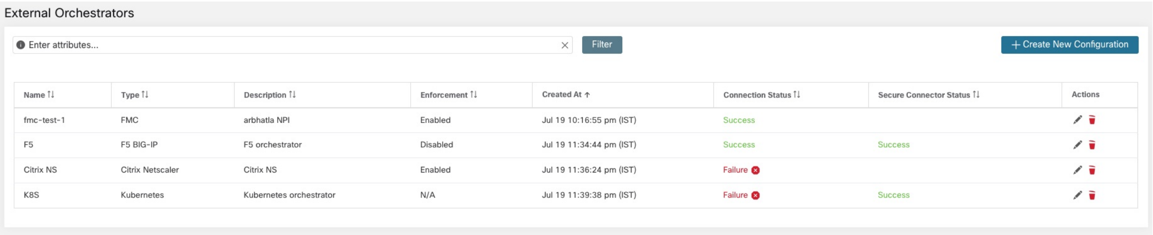
Navigate to the External Orchestrators Page

The main page for external orchestrators can be reached by selecting **Manage** > **Workloads** > **External Orchestrators** from the menu bar on the left.

List External Orchestrators

The External Orchestrators page shows the existing external orchestrators and provides functions to modify and delete them as well as to create new external orchestrators:

Figure 29: External orchestrator's main page



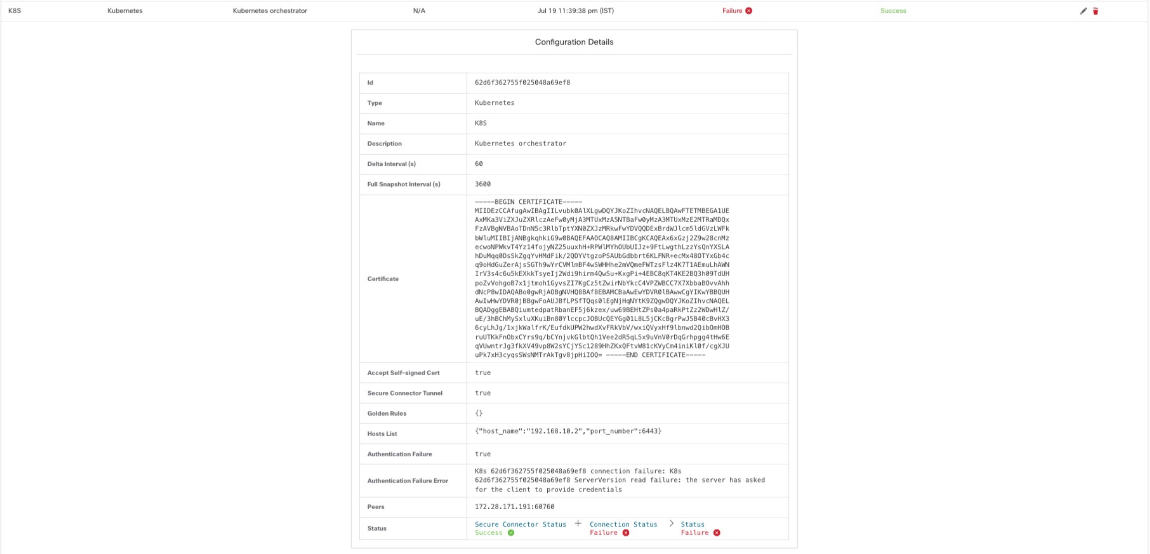
External Orchestrators

Name ↑↓	Type ↑↓	Description ↑↓	Enforcement ↑↓	Created At ↑	Connection Status ↑↓	Secure Connector Status ↑↓	Actions
fmc-test-1	FMC	arbhatla NPI	Enabled	Jul 19 10:16:55 pm (IST)	Success		✎ 🗑
F5	F5 BIG-IP	F5 orchestrator	Disabled	Jul 19 11:34:44 pm (IST)	Success	Success	✎ 🗑
Citrix NS	Citrix Netscaler	Citrix NS	Enabled	Jul 19 11:36:24 pm (IST)	Failure ✖		✎ 🗑
K8S	Kubernetes	Kubernetes orchestrator	N/A	Jul 19 11:39:38 pm (IST)	Failure ✖	Success	✎ 🗑

Each row shows a short version of the external orchestrator with its *Name*, *Type*, *Description*, *Enforcement*, *Created at*, *Connection Status*, and *Secure Connector Status*. The Connection Status tells if a connection to the given external data source could be made successfully. The *Secure Connector Status* displays the status of the Secure Connector tunnel- Success or Failure. If the tunnel is not enabled then N/A is displayed.

The Secure Connector tunnel can be enabled while creating an external orchestrator configuration. If Secure Connector tunnel is enabled, the external orchestrator 'Connection Status' is dependent on both the authentication status and secure connector status. If Secure Connector tunnel is not enabled, the external orchestrator 'Connection Status' is only dependent on the authentication status. Irrespective of the status- Success or Failure, you can click the respective row to get more details. For more details on the Secure Connector client metrics, click the **Status** row or in the left pane, navigate to **Manage** > **Workloads** > **Secure Connector**.

Figure 30: Example External Orchestrator Authentication Failure



K8S	Kubernetes	Kubernetes orchestrator	N/A	Jul 19 11:39:38 pm (IST)	Failure ✖	Success	✎ 🗑

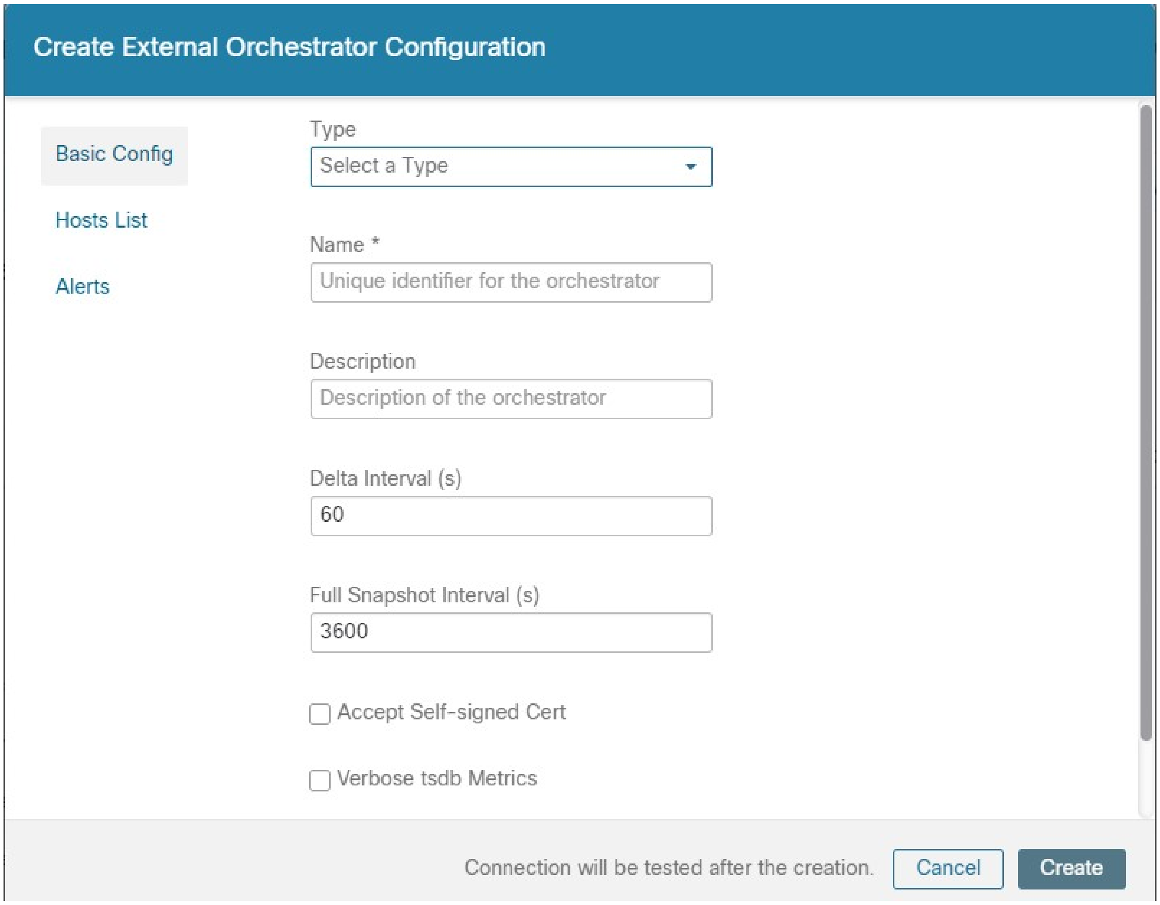
Configuration Details

Id	62d6f362755f025048a69ef8
Type	Kubernetes
Name	K8S
Description	Kubernetes orchestrator
Delta Interval (s)	60
Full Snapshot Interval (s)	3600
Certificate	-----BEGIN CERTIFICATE----- MIIDEzCCAfugAwIBAgIILvubk0AlXLgwDQYJKoZIhvcNAQELBQAwFTETMBEGA1UE AxMKa3ViZXJuZXRlczAeFw0yMjA3MTUxMzA5NTBaFw0yMzA3MTUxMzE2MTRaMDQx FzAVBgNVBAoTDnN5c3RlbTptYXN0ZXJzMRkwFwYDVQQDExBrdWJlcm5ldGVzLWFk bWluMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAx6xGzj2Z9w28cnMz ecwoNPWkvT4Yz14fojyNZ25uuxhH+RPWlMYhOUbUIJz+9FtLwgthLzzYsQnYXSLA hDuMqq0DsSkZgqYvHMdFik/2QDYVtgzoPSAUbGdbbrt6KLFNR+ecMx48OTYxGb4c q9oHdGuZerAjsSGTh9wYrCVMlmBF4wSWHHhe2mVQmeFWTzsFlz4K7T1AEmuLhAWN IrV3s4c6u5kEXkkTsyeIj2Wdi9hirm4QwSu+KxgPi+4EBC8qKT4KE2BQ3h09TdUH poZvVohgoB7x1jtmoh1GyvsZI7KgCz5tZwirNbYkcC4VPZWBCC7X7XbbaBOvvAhh dNcP8wIDAQABo0gwRjAOBgNVHQ8BAf8EBAMCBaAwEwYDVR0lBAwwCgYIKwYBBQUH AwIwHwYDVR0jBBgwFoAUJBfLPSfTQqs0lEgNjHqNYtK9ZQgwDQYJKoZIhvcNAQEL BQADggEBABQiumtedpatRbanEF5j6kzex/uw69BEHtZPs0a4paRkPtZz2WDwHlZ/ uE/3hBChMySxluXKuiBn80YlccpcJOBUcQEYGg01L8L5jCKcBgrPwJ5B40cBvHX3 6cyLhJg/1xjkWalfrK/EufdkUPW2hwdXvFRkVbV/wxiQVyxHf9lbnwd2QibOmHOB ruUTKkFnObxCYrs9q/bCYnjvkGlbtQh1Vee2dR5qL5x9uVnV0rDqGrhpgg4tHw6E qVUwntrJg3fkXV49vp8W2sYCjYSc1289HhZKxQFtvW81cKVyCm4iniKl0f/cgXJU uPk7xH3cyqsSWsNMTrAkTgv8jpHiIOQ= -----END CERTIFICATE-----
Accept Self-signed Cert	true
Secure Connector Tunnel	true
Golden Rules	{}
Hosts List	{"host_name":"192.168.10.2","port_number":6443}
Authentication Failure	true
Authentication Failure Error	K8s 62d6f362755f025048a69ef8 connection failure: K8s 62d6f362755f025048a69ef8 ServerVersion read failure: the server has asked for the client to provide credentials
Peers	172.28.171.191:60760
Status	Secure Connector Status Success ✓ + Connection Status Failure ✖ > Status Failure ✖

Create External Orchestrator

A new external orchestrator can be created by clicking the **Create New Configuration** button in the external orchestrators main page. This leads to a modal dialog, where you can enter a name and choose an external orchestrator type. The picture below shows the basic configuration page:

Figure 31: Create External Orchestrator Configuration



Create External Orchestrator Configuration

Type: Select a Type

Name *: Unique identifier for the orchestrator

Description: Description of the orchestrator

Delta Interval (s): 60

Full Snapshot Interval (s): 3600

□ Accept Self-signed Cert

□ Verbose tsdb Metrics

Connection will be tested after the creation.

The following table describes the common fields for external orchestrators. Depending on the selected type the *Basic Config* page requires additional parameters to be given. These will be covered by the respective section of the individual external orchestrators below.

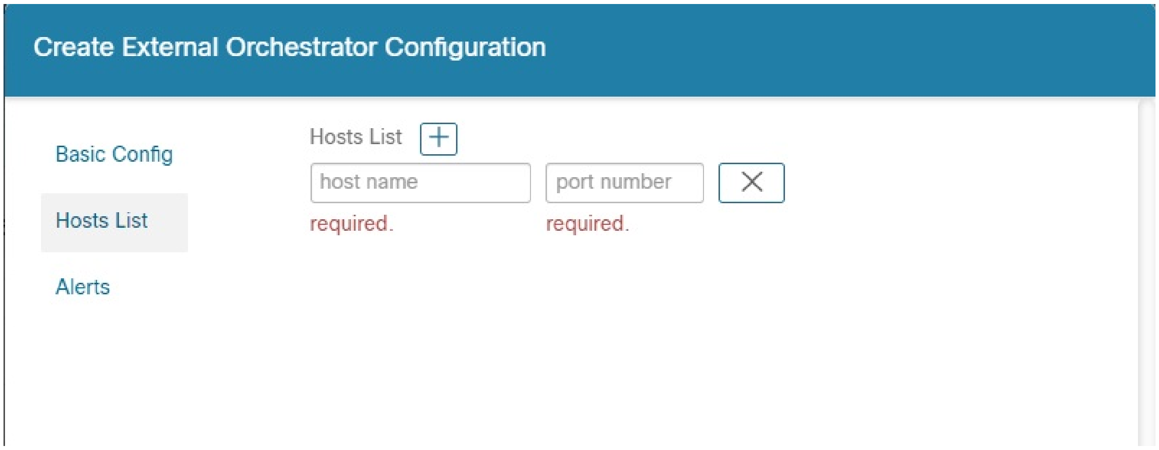
Common Field	Required	Description
Type	Yes	Select an external orchestrator from the list.
Name	Yes	Name of the external orchestrator, which must be unique for the active tenant.

Common Field	Required	Description
Description	No	Description of the external orchestrator.
Full Snapshot Interval(s)	Yes	Interval in seconds the external orchestrator will try to import the full snapshot of configuration from the selected *Type*.
Accept Self-signed Cert	No	Check this option to accept self-signed server certificates for the HTTPS connection used by Secure Workload to retrieve configuration data from the selected *Type*. Default is not to allow self-signed server certificates.
Secure Connector Tunnel	No	Check this option to set connections to the Secure Workload cluster to be tunneled through a Secure Connector tunnel.

Note The fields *Delta interval* and *Verbose TSDB Metrics* as shown in the picture above are optional and applicable only for certain external orchestrators, which are explained in the respective description below.

Except for the external orchestrator type *AWS*, the *Hosts List* must be given. It specifies the network address(es) of the external data source from which the external orchestrator will fetch data and generate labels. This can be done by clicking on the tab *Hosts List* on the left hand side, which is shown in the following picture:

Figure 32: External Orchestrator's Hosts List

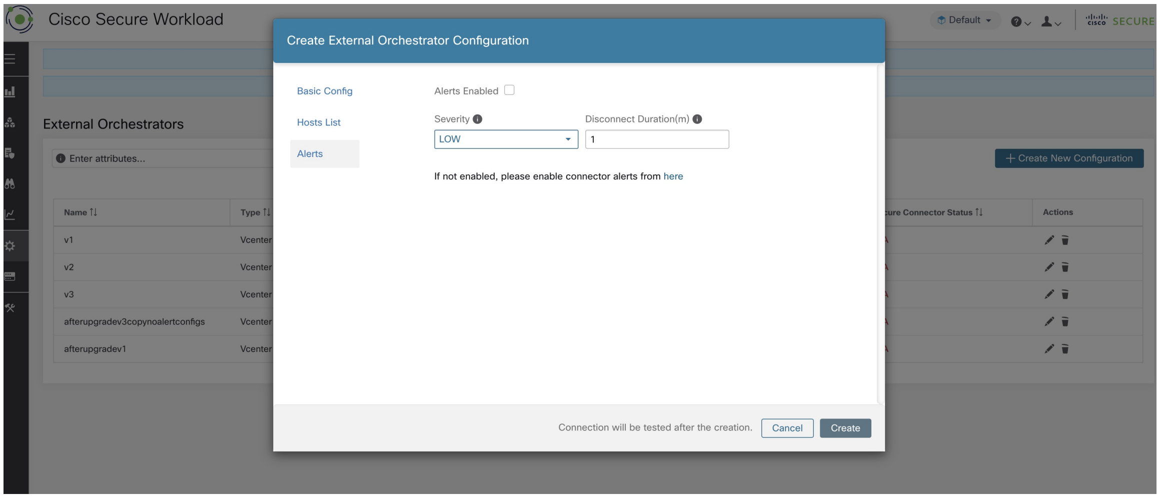


Create External Orchestrator Configuration

In order to add new host list entry click the plus sign. Each row must contain a valid DNS host name, IPv4 or IPv6 address and a port number. Depending on the chosen external orchestrator type, you can enter multiple hosts for high availability or redundancy purposes. For more information, see the description for the chosen external orchestrator.

To set the alert for the external orchestrator, this can be done by clicking on the *Alert* tab on the left hand side, which is shown in the following picture:

Figure 33: External Orchestrator's Alerts



Create External Orchestrator Configuration

Alerts Enabled ☐

Severity: LOW

Disconnect Duration(m): 1

If not enabled, please enable connector alerts from here

Connection will be tested after the creation.

For each external orchestrator, configuring *alerts* requires additional parameters to be given. These will be covered by the respective section of the individual external orchestrators below.

To enable alerts for this external orchestrator, check the *Alert enabled* check box.

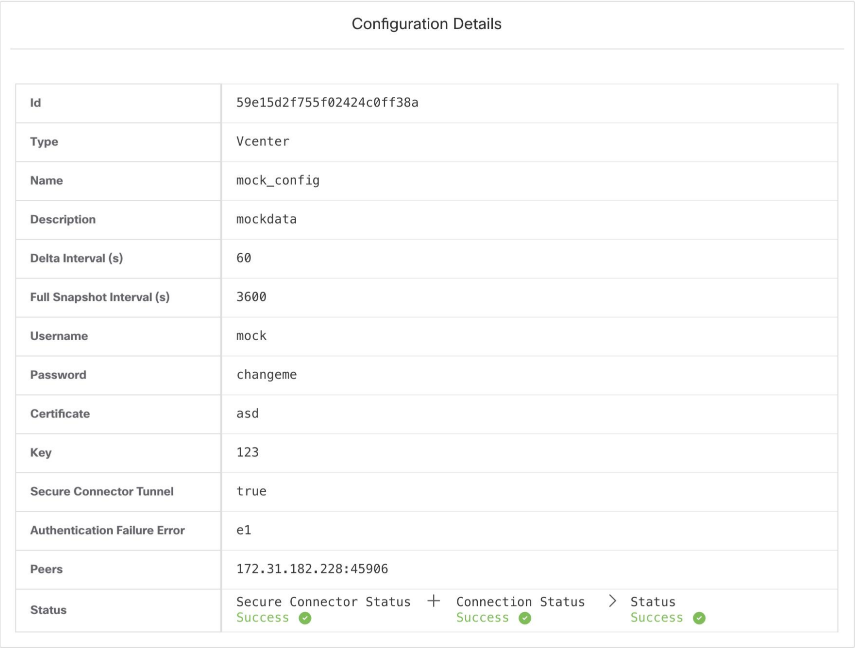
Note Make sure that Connector Alerts are also enabled from **Manage** > **Workloads** > **Alert Configs** page.

Select the *Alert Severity* level and *Disconnect Duration* in minutes for configuring external orchestrator alert.

Field	Description
Severity	Select severity level of this rule: **LOW**, **MEDIUM**, **HIGH**, **CRITICAL** or **IMMEDIATE ACTION**
Disconnect Duration(m)	The amount of time that a connection is disconnected.

Click the **Create** button to create the new external orchestrator, whose configuration details can be viewed by clicking on the respective row in the list view:

Figure 34: External Orchestrator's Configuration Details



Configuration Details

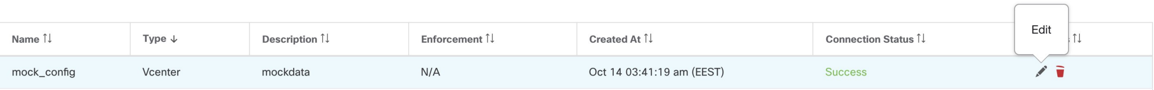
Id	59e15d2f755f02424c0ff38a
Type	Vcenter
Name	mock_config
Description	mockdata
Delta Interval (s)	60
Full Snapshot Interval (s)	3600
Username	mock
Password	changeme
Certificate	asd
Key	123
Secure Connector Tunnel	true
Authentication Failure Error	e1
Peers	172.31.182.228:45906
Status	Secure Connector Status + Connection Status > Status Success ✓ Success ✓ Success ✓

Note Since the first full snapshot pull from an external orchestrator is an asynchronous operation, expect about one minute for the connection status field to be updated.

Edit External Orchestrator

Click the pencil button on the right hand side of an external orchestrator row as shown below to open a modal dialog similar to the one for creating an external orchestrator, where the configuration can be modified.

Figure 35: Edit External Orchestrator



Name ↑↓	Type ↓	Description ↑↓	Enforcement ↑↓	Created At ↑↓	Connection Status ↑↓	Edit ↑↓
mock_config	Vcenter	mockdata	N/A	Oct 14 03:41:19 am (EEST)	Success	✎ 🗑

Note

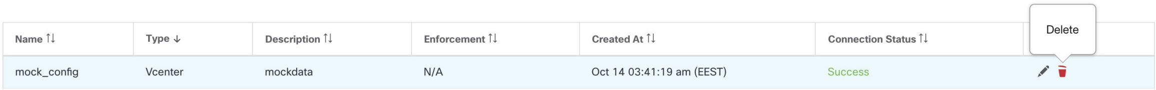
- The **Type** field is not editable.
- If a configuration uses keys/certificates for authentication, the keys and certificates have to be provided every time the configuration is updated.
- Since the configuration changes of an external orchestrator is an asynchronous operation, expect about one minute for the connection status field to be updated and to confirm the correctness of entered changes.

Click the **Update** button to save the changes made to the configuration.

Delete External Orchestrator

Caution Deleting an external orchestrator also deletes labels provided by that orchestrator, which will impact policies. In order to delete an external orchestrator click the trash bin button as shown below:

Figure 36: Delete External Orchestrator



Name ↑↓	Type ↓	Description ↑↓	Enforcement ↑↓	Created At ↑↓	Connection Status ↑↓	
mock_config	Vcenter	mockdata	N/A	Oct 14 03:41:19 am (EEST)	Success	

Orchestrator generated labels

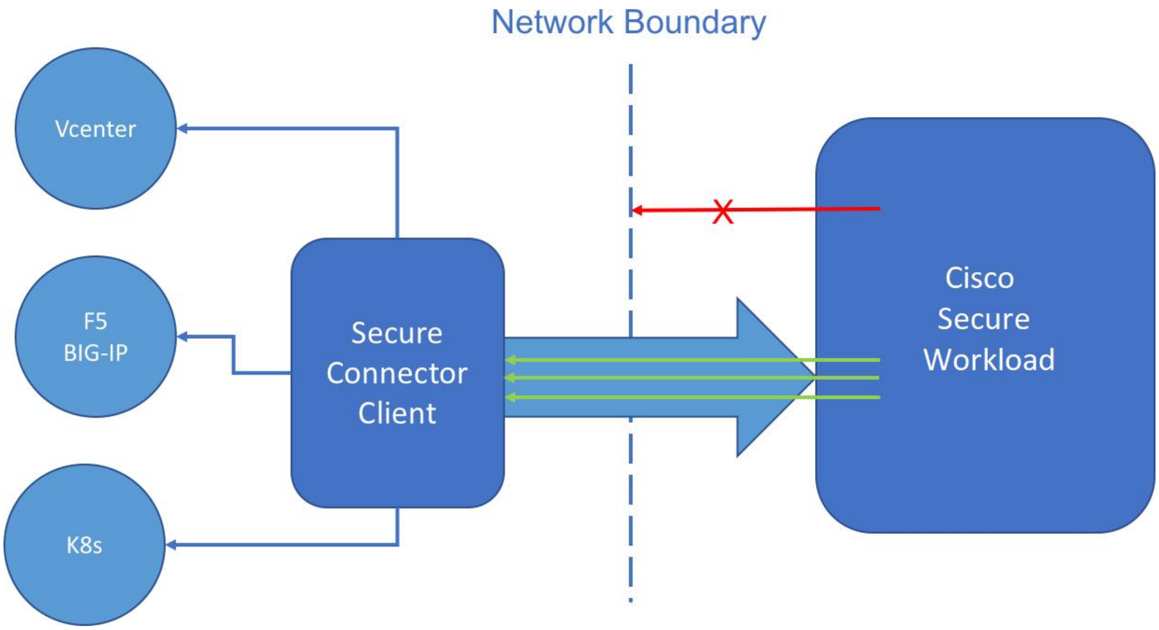
Secure Workload adds the following labels to all the AWS instances.

Key	Value
orchestrator_system/orch_type	aws
orchestrator_system/cluster_name	*<Name of kubernetes cluster>*
orchestrator_system/name	*<Name of the connector>*
orchestrator_system/cluster_id	*<UUID of the orchestrator's configuration in |product|>*

Secure Connector

In order for Secure Workload to import user tags or enforce policies on external orchestrators (see External Orchestrators), Secure Workload needs to establish outgoing connections to the orchestrator API servers (vCenter, Kubernetes, F5 BIG-IP, etc.). Sometimes it is not possible to allow direct incoming connections to the orchestrators from the Secure Workload cluster. Secure Connector solves this issue by establishing an outgoing connection from the same network as the orchestrator to the Secure Workload cluster. This connection is used as a reverse tunnel to pass requests from the cluster back to the orchestrator API server.

Figure 37: Secure Connector



For each root scope, only one tunnel may be active at any time. Attempts to start additional tunnels will be rejected with an error message indicating that one is already active. The active tunnel can be used to connect to multiple orchestrators that are reachable from the network in which the client is running. A per-orchestrator configuration is used to indicate whether connections to that orchestrator should go through the Secure Connector tunnel.

All communication between the Secure Connector client and the Secure Workload cluster is mutually authenticated and encrypted using TLS.

For improved security, customers are advised to install the Secure Connector client on an isolated appropriately secured machine. The machine should have firewall rules to allow outgoing connections only to the Secure Workload cluster and any external orchestrator API servers Secure Workload should be allowed to access.

To configure orchestrators to use the Secure Connector tunnel, see instructions for configuring the external orchestrator for your product.

For more details on OpenAPI endpoints for the Secure connector, see Secure Connector API endpoints

Technical details

To bootstrap the tunnel, the Secure Connector client creates a public/private key pair and signs its public key certificate remotely by the server. A cryptograhic single-use time-limited token is used to secure this remote signing process and identify the root scope to which the client belongs. On the server side, each root scope has a unique certificate that the client uses to authenticate the server. These certificates are periodically rotated to ensure the continued secrecy of communication.

The Secure Connector client is internally constructed of a tunnel client and a SOCKS5 server. After the tunnel is started, the client waits for incoming tunneled connections from the Secure Workload Cluster. Incoming connections are handled by the SOCKS5 server and forwarded to the destination host.

Requirements for Secure Connector Client

The following are the requirements for the Secure Connector client:

- RHEL or CentOS 7 (x86_64)
- 2 CPU cores
- 4 GB RAM
- Sufficient network bandwidth for handling data from the on-premises orchestrators that use the Secure Connector.
- Outgoing connectivity to the Secure Workload cluster on port 443 (direct or through HTTP(S) proxy).
- Outgoing connectivity to internal Orchestrator API servers (direct).

Secure Connector Client Deployment

Proxy Support

The Secure Connector client supports connecting to the Secure Workload cluster through an HTTP(S) proxy. If needed, the proxy server must be configured by setting the HTTPS_PROXY environment variable for the client. To set the variable, add the following line in the *[Service]* section of the systemd service file located at */etc/systemd/system/tetration- secure-connector.service*. This setting will not persist across re-installations. For a sticky configuration, the line can be added in a new file at */etc/systemd/system/tetration-secure-connector.service.d/10-https-proxy.conf*. For either configurations to take effect, reload the systemd config by running *systemctl daemon-reload*.

```
[Service]
Environment="HTTPS_PROXY=<Proxy Server Address>"
```

Deployment Overview

The Secure Connector creates a reverse tunnel from the Secure Workload cluster to your internal network in order to reach your orchestrator API servers.

Starting the Secure Connector client requires downloading Secure Connector RPM and generating a one-time registration token.

1. Download Latest Secure Connector Client RPM on a supported platform.
2. Generate Registration Token.
3. Copy the Token and Start the Client on the host to start the client.

Deploy the Secure Connector Client

Download Latest Secure Connector Client RPM

Procedure

Step 1 In the navigation pane, click **Manage** > **Workloads** > **Secure Connector**.

Step 2 Click **Download Latest RPM**.

Step 3 Copy the RPM package to the Linux host for deployment, and then execute the following command with root privileges: `rpm -ivh <rpm_filename>`

Generate Registration Token

Procedure

Step 1 Click **Manage** > **Workloads** > **Secure Connector**.

Step 2 Click **Generate Registration Token**.

Copy the Token and Start the Client

After generating a registration token on the **Secure Connector** page, you will have a *registration.token* file that contains the single-use limited-time token for bootstrapping the client. Stop the Secure Connector client on the host and copy the token file where you have installed the Secure Connector client package.

1. To stop the client, run the following command: `systemctl stop tetration-secure-connector`
2. Copy the *registration.token* file to the `/etc/tetration/cert/` folder.
3. To restart the client, run the following command: `systemctl start tetration-secure-connector`

[Optional] Deploy Specific Version of Secure Connector Client

Procedure

Step 1 Download a specific version of Secure Connector Client RPM.

a) In the navigation pane, click **Manage** > **Workloads** > **Agents**.

b) Click the **Installer** tab.

c) Click **Manual Install using classic packaged installers**, then click **Next**.

The Secure Connector Client packages have the agent type as *Secure Connector*.

d) Find the appropriate version (if multiple are available on the cluster) and click **Download**.

e) Copy the RPM package to the Linux host for deployment, and then execute the following command with root privileges: `rpm -ivh <rpm_filename>`.

Step 2 Retrieve a new token using the API.

Secure Connector tokens can also be retrieved through OpenAPI (Get Token). The following Python and Bash snippets can be used to retrieve a new token. Note that the API key used must have the *external_integration* capability and must have write access to the specified root scope. See OpenAPI Authentication for information on installing the Secure Workload OpenAPI client for python and creating a new API key.

- **Python snippet for token retrieval**

```
    from tetpyclient import RestClient
    from urllib import quote

    API_ENDPOINT = "https://<UI_VIP_OR_DNS_FOR_TETRATION_DASHBOARD>"
    ROOT_SCOPE_NAME = r"""<ROOT_SCOPE_NAME>"""
    API_CREDENTIALS_FILE = "<API_CREDENTIALS_JSON_FILE>"
    OUTPUT_TOKEN_FILE = "registration.token"

    if __name__ == "__main__":
      client = RestClient(API_ENDPOINT,
                          credentials_file=API_CREDENTIALS_FILE)  # Add (verify=False) to
skip certificate verification
      escaped_root_scope_name = quote(ROOT_SCOPE_NAME, safe='')
      resp = client.get('/secureconnector/name/{}/token'.format(escaped_root_scope_name))
      if resp.status_code != 200:
        print 'Error ({}): {}'.format(resp.status_code, resp.content)
        exit(1)
      else:
        with open(OUTPUT_TOKEN_FILE, 'w') as f:
          f.write(resp.content)
```

- **BASH snippet for token retrieval**

```
   #!/bin/bash
   HOST="https://<UI_VIP_OR_DNS_FOR_TETRATION_DASHBOARD>"
   API_KEY="<API_KEY>"
   API_SECRET="<API_SECRET>"
   ROOTSCOPE_NAME="<ROOT_SCOPE_NAME>" # if the name contains spaces or special characters,
 it should be url-encoded
   TOKEN_FILE="registration.token"
   INSECURE=1 # Set to 0 if you want curl to verify the identity of the cluster

   METHOD="GET"
   URI="/openapi/v1/secureconnector/name/$ROOTSCOPE_NAME/token"
   CHK_SUM=""
   CONTENT_TYPE=""
   TS=$(date -u "+%Y-%m-%dT%H:%M:%S+0000")
   CURL_ARGS="-v"
   if [ $INSECURE -eq 1 ]; then
       CURL_ARGS=$CURL_ARGS" -k"
   fi

   MSG=$(echo -n -e "$METHOD\n$URI\n$CHK_SUM\n$CONTENT_TYPE\n$TS\n")
   SIG=$(echo "$MSG"| openssl dgst -sha256 -hmac $API_SECRET -binary | openssl enc -base64)

   REQ=$(echo -n "curl $CURL_ARGS $HOST$URI -w '%{http_code}' -H 'Timestamp: $TS' -H 'Id:
 $API_KEY' -H 'Authorization: $SIG' -o $TOKEN_FILE")
   status_code=$(sh -c "$REQ")
   if [ $status_code -ne 200 ]; then
       echo "Failed to get token. Status: " $status_code
   else
       echo "Token retrieved successfully"
   fi
```

Step 3 Copy the token and start the client. For detailed instructions, see Copy the Token and Start the Client, on page 141.

Verify Secure Connector Client State

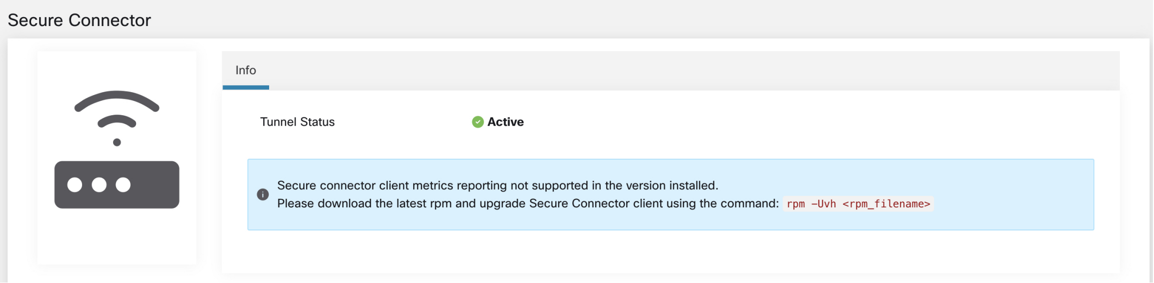
- To check if the Secure Connector client is installed, query the RPM database for the *tet-secureconnector-client-site* package by running the following command: `rpm -q tet-secureconnector-client-site`
- To check the state of the installed client, you can check the status of the *tetration-secure- connector* systemd service by running the following command: `systemctl status tetration-secure-connector`

Secure Connector Client Status

On the **External Orchestrators** page, the status of the configured external orchestrators and Secure Connector tunnel is displayed. If Secure Connector is enabled while configuring the external orchestrators, you can view the Secure Connector client metrics on the **Secure Connector** page.

However, if the Secure Connector tunnel status is **Active** but the client metrics are not visible, it implies an older version of Secure Connector is installed. A message to upgrade the Secure Connector Client version is displayed as shown:

Figure 38: Secure Connector Client upgrade message



Secure Connector

Info

Tunnel Status ✓ Active

Secure connector client metrics reporting not supported in the version installed.
Please download the latest rpm and upgrade Secure Connector client using the command: `rpm -Uvh <rpm_filename>`

Note For instructions on installing the latest Secure Connector RPM, see Download Latest Secure Connector Client RPM

To view the client metrics:

Procedure

Step 1 Under **Configure Details**, click the **Status** row. The **Secure Connector** page is displayed.

Note To access the status of the Secure Connector tunnel, select **Manage** > **Workloads** > **Secure Connector** in the left pane.

Step 2 Select the tabs - **General**, **Interface**, or **Routes** to access more details on the connectivity status between the client and Secure Workload cluster.

Tabs	Description
General	Lists the following information: • Tunnel Status • Hostname • IP Address • HTTP/HTTPS Proxy • Version- Lists the build version. • No. vCPU's • Total Memory (GB) • Uptime- Lists the uptime of the VM where the Secure Connector client is running. • Last Heartbeat Received- Lists the day and timestamp of heartbeat last received from client. • No. of Heartbeat Failures (Last 1 day)- Lists the number of times the connectivity to the Secure Connector client failed in a day. If the client remains to stay inactive, the count is not incremented. The count is reset at the end of day. • Round Trip Latency (ms)
Interface	Lists the interface details of the VM where the Secure Connector client is running.
Routes	The route table lists the destination IP addresses, gateway, genmask, and interface.

Secure Connector Alerts

The alert is generated when Secure Connector stops functioning or if there is no heartbeat in the past one minute.

Step 1: To enable alert, click **Manage** > **Workloads** > **Secure Connector**.

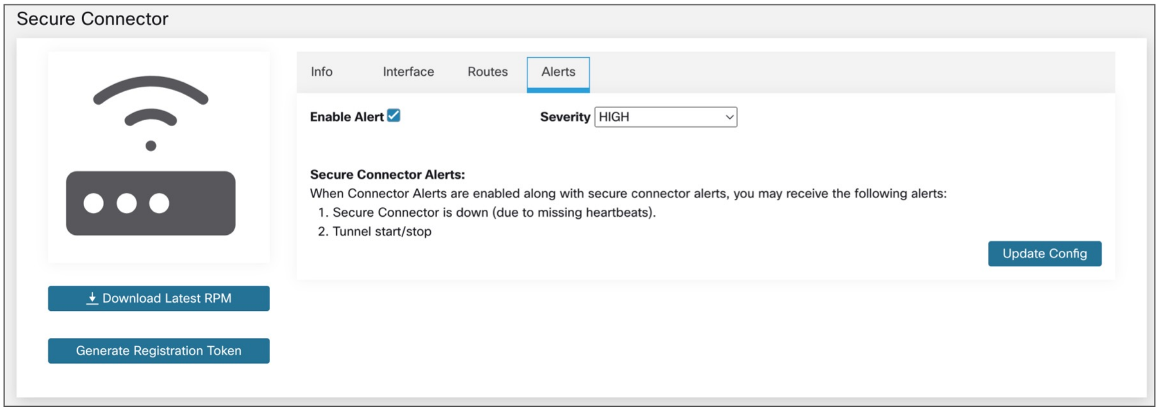
Step 2: Click the **Alerts** tab.

Step 3: Check the **Enable Alert** checkbox.

Step 4: Choose a **Severity** value from the drop-down.

Step 5: Click **Update Config**.

Figure 39: Enable Secure Connector Alerts



Enable Alert ☑ **Severity** HIGH

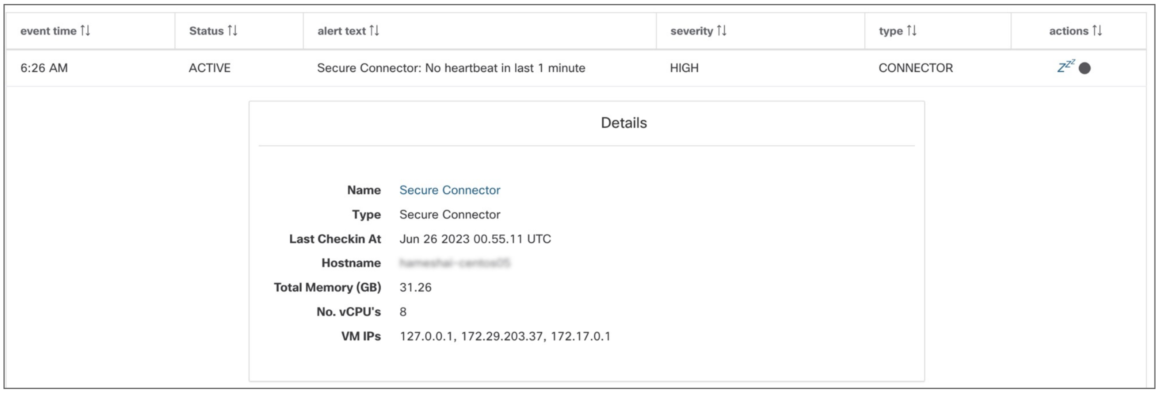
Secure Connector Alerts:
When Connector Alerts are enabled along with secure connector alerts, you may receive the following alerts:
1. Secure Connector is down (due to missing heartbeats).
2. Tunnel start/stop

Note Ensure that the Connectors alerts is enabled in the **Manage** > **Alerts - Configuration** page.

Navigate to **Investigate** > **Alerts** and click on an alert to view more details.

Alert text: Secure Connector: <reason for connection failure>

Figure 40: Secure Connector Alert



event time ↑↓	Status ↑↓	alert text ↑↓	severity ↑↓	type ↑↓	actions ↑↓
6:26 AM	ACTIVE	Secure Connector: No heartbeat in last 1 minute	HIGH	CONNECTOR	zᶻᶻ ●

Details

Name	Secure Connector
Type	Secure Connector
Last Checkin At	Jun 26 2023 00.55.11 UTC
Hostname	[redacted]
Total Memory (GB)	31.26
No. vCPU's	8
VM IPs	127.0.0.1, 172.29.203.37, 172.17.0.1

Table 13: Alert Details

Field	Type	Description
Name	String	Secure Connector name
Type	String	Secure Connector type
Last Checkin At	String	Last known time when there was a heartbeat
Hostname	String	Name of the machine hosting this Secure Connector
Total Memory (GB)	String	RAM in GB

Field	Type	Description
No. vCPU's	String	Number of CPUs
VM IPs	String	List of network interfaces on the Secure Connector client host

Upgrade Secure Connector Client

The Secure Connector client does not support automatic updates. To deploy a new version:

1. Run the following command to uninstall the current version: `rpm -e tet-secureconnector-client-site`
2. Deploy the new version. For detailed instructions, see Deploy the Secure Connector Client, on page 140.

Uninstall Secure Connector Client

The Secure Connector Client can be uninstalled using the following command: `rpm -e tet-secureconnector-client-site`

Amazon Web Services

Note AWS external orchestrator functionality is now part of the new AWS cloud connector feature. If you upgraded to this release, your existing AWS external orchestrators are now read-only; if you need to make changes, create a new AWS connector. For complete information, see AWS Connector.

Secure Workload supports automated ingestion of inventory live from an AWS region. When an external orchestrator configuration is added for type “aws”, the Secure Workload appliance will connect to the AWS endpoint and fetch the metadata for all the instances in running/stopped state.

Prerequisites

- Security tokens (access key and secret key) used should have the right kind of IAM privileges to allow fetching of orchestrator information.

Configuration fields

Attribute	Description
ID	Unique identifier for the orchestrator.
Name	User-specified name of the orchestrator.
Type	Type of orchestrator - (*aws* in this case)

Attribute	Description
Description	A brief description of the orchestrator.
AWS Access Key ID	ACCESS KEY associated with the account for which orchestrator config is being created.
AWS Secret Access key	SECRET KEY associated with the account you create for the orchestrator configuration. **Note** Re-enter the SECRET KEY if you modify the orchestrator configuration.
AWS Region	The Region in which workload has been deployed. If a workload is spread across multiple regions, a separate config is required for every region. See the link below for correct *region* values. :ref:https://docs.aws.amazon.com/general/latest/gr/rande.html.
Accept Self-signed Cert	Is automatically marked true for AWS. User cannot edit it.
Full Snapshot Interval	Full snapshot interval in seconds. Orchestrator Inventory manager will perform a full refresh poll from the orchestrator.
Delta Snapshot Interval	Delta snapshot interval in seconds. Orchestrator Inventory manager will only fetch incremental updates from the orchestrator.
Hosts List	AWS orchestrator type doesn’t require hosts list. The endpoint for AWS will be derived from *AWS Region* field above. This field should be left empty.
Verbose TSDB metrics	If enabled, tsdb metrics for each individual orchestrator will be reported. Else an aggregation of all orchestrator metrics will be reported.
Secure Connector Tunnel	Tunnel connections to this orchestrator’s hosts through the Secure Connector tunnel.

Workflow

- Configure an AWS orchestrator filled with the configuration fields above.

Orchestrator generated labels

Secure Workload adds the following labels to all the AWS instances.

Key	Value
orchestrator_system/orch_type	aws
orchestrator_system/cluster_name	*<Name of kubernetes cluster>*
orchestrator_system/name	*<Name of the connector>*
orchestrator_system/cluster_id	*<UUID of the orchestrator's configuration in |product|>*

Instance-specific labels

The following labels are instance specific.

Key	Value
orchestrator_system/workload_type	vm
orchestrator_system/machine_id	*<InstanceID assigned by AWS>*
orchestrator_system/machine_name	*<PublicDNS(FQDN) given to this node by AWS>*
orchestrator_'<AWS Tag Key>'	*<AWS Tag Value>*

Troubleshooting

- Confusion between AWS Region and Availability Zone.

  Both these values are interrelated and should not be confused. For example us-west-1 might be the region and availability zone can be either of us-west-1a or us-west-1b etc. While configuring orchestrator, *Region* should be used. Refer to https://docs.aws.amazon.com/general/latest/gr/rande.html for all regions.

- Connectivity/Credentials issue after updating the orchestrator config.

  Customers must re-submit the *AWS Secret Key* every time the config gets updated.

Kubernetes/OpenShift

Note EKS and AKS external orchestrator functionalities are now part of the new AWS and Azure cloud connector features, respectively. If you upgraded to this release, your existing EKS and AKS external orchestrators are now read-only; if you need to make changes, create a new AWS or Azure connector. For complete information, see the relevant topics under Cloud Connectors.

The external orchestrator for plain-vanilla Kubernetes and OpenShift has not changed.

Secure Workload supports automated ingestion of inventory live from a Kubernetes cluster. When an external orchestrator configuration is added for a Kubernetes/OpenShift cluster, Secure Workload connects to the cluster's API server and tracks the status of nodes, pods and services in that cluster. For each object type, Secure Workload imports all Kubernetes labels and labels associated with the object. All values are imported as-is.

In addition to importing the labels defined for Kubernetes/OpenShift objects, Secure Workload also generates labels that facilitate the use of these objects in inventory filters. These additional labels are especially useful in defining scopes and policies.

For more information about all of these labels, see Labels Related to Kubernetes Clusters.

If enforcement is enabled on the Kubernetes nodes (enforcement agents are installed and the configuration profile enables enforcement on these agents), enforcement policies will be installed in both the nodes as well as inside the pod namespaces using the information ingested about the Kubernetes entities via this integration.

About Kubernetes on Cloud Platforms

For the following managed kubernetes services running on supported cloud platforms, this orchestrator's functionality is provided using cloud connectors:

- Elastic Kubernetes Service (EKS) running on Amazon Web Services (AWS)
- Azure Kubernetes Service (AKS) running on Microsoft Azure
- Google Kubernetes Engine (GKE) running on Google Cloud Platform (GCP)

For details about obtaining data from kubernetes clusters on cloud platforms, see the topics under Cloud Connectors.

Requirements and Prerequisites

- For supported Kubernetes and OpenShift versions, see https://www.cisco.com/go/secure-workload/requirements/integrations
- Secure Connector tunnel, if needed for connectivity.

Configuration fields

The following configuration fields pertain to Kubernetes Orchestrator configuration in the Orchestrator Object.

Field	Description
Name	User specified name of the orchestrator.
Description	User specified description of the orchestrator.
Delta Interval	Interval (in seconds) to check the Kubernetes endpoint for changes
Full Snapshot Interval	Interval (in seconds) to perform a full snapshot of Kubernetes data
Username	Username for the orchestration endpoint.
Password	Password for the orchestration endpoint.
Certificate	Client certificate used for authentication.

Field	Description
Key	Key corresponding to client certificate.
Auth Token	Opaque authentication token (bearer token).
CA Certificate	CA Certificate to validate orchestration endpoint.
Accept Self-Signed Cert	Checkbox to disable strictSSL checking of the Kubernetes API server certificate
Verbose TSDB Metrics	Maintain per Kubernetesorchestrator metrics - if set to False, only Secure Workload cluster-wide metrics are maintained.
Secureconnector Tunnel	Tunnel connections to this orchestrator’s hosts through the Secure Connector tunnel
Hosts List	Array of { “host_name”, port_number} pairs that specify how Secure Workload must connect to the orchestrator
K8s manager type	Manager type for the kubernetes cluster(None for Vanilla/Openshift kubernetes deployments)
AWS cluster name	Name of the orchestrator as specified at time of creation of cluster (Pre-existing EKS only)
AWS Access ID	ACCESS KEY associated with the account for which orchestrator config is being created (Pre-existing EKS only)
AWS Secret Access Key	The SECRET KEY associated with the account the orchestrator configuration is created. Re-enter the SECRET KEY every time the config is edited. (Pre-existing EKS only)
AWS Region	The Region in which workload has been deployed. If a workload is spread across multiple regions, a separate config is required for every region. See the link below for correct *region* values. :ref: https://docs.aws.amazon.com/general/latest/gr/rande.html. (Pre-existing EKS only)
AWS Assume Role ARN	Amazon resource number of the roleto assume while connecting to the orchestrator. :ref: https://docs.aws.amazon.com/STS/latest/APIReference/API_AssumeRole.html (Pre-existing EKS only)
Azure Tenant ID	Tenant ID associated with Azure subscription. (Pre-existing AKS only)

Field	Description
Azure Client ID	Globally unique ID associated with the application that needs to authenticate with Azure AD. (Pre-existing AKS only)
Azure Client Secret	Password associated with the service principal for the application that needs to authenticate with Azure AD. (Pre-existing AKS only)

Orchestrator Golden Rules

The golden rules object attributes are described below. These golden rules allow a concise specification of rules necessary for the Kubernetes cluster to stay functional once enforcement is enabled on the Kubernetes cluster nodes.

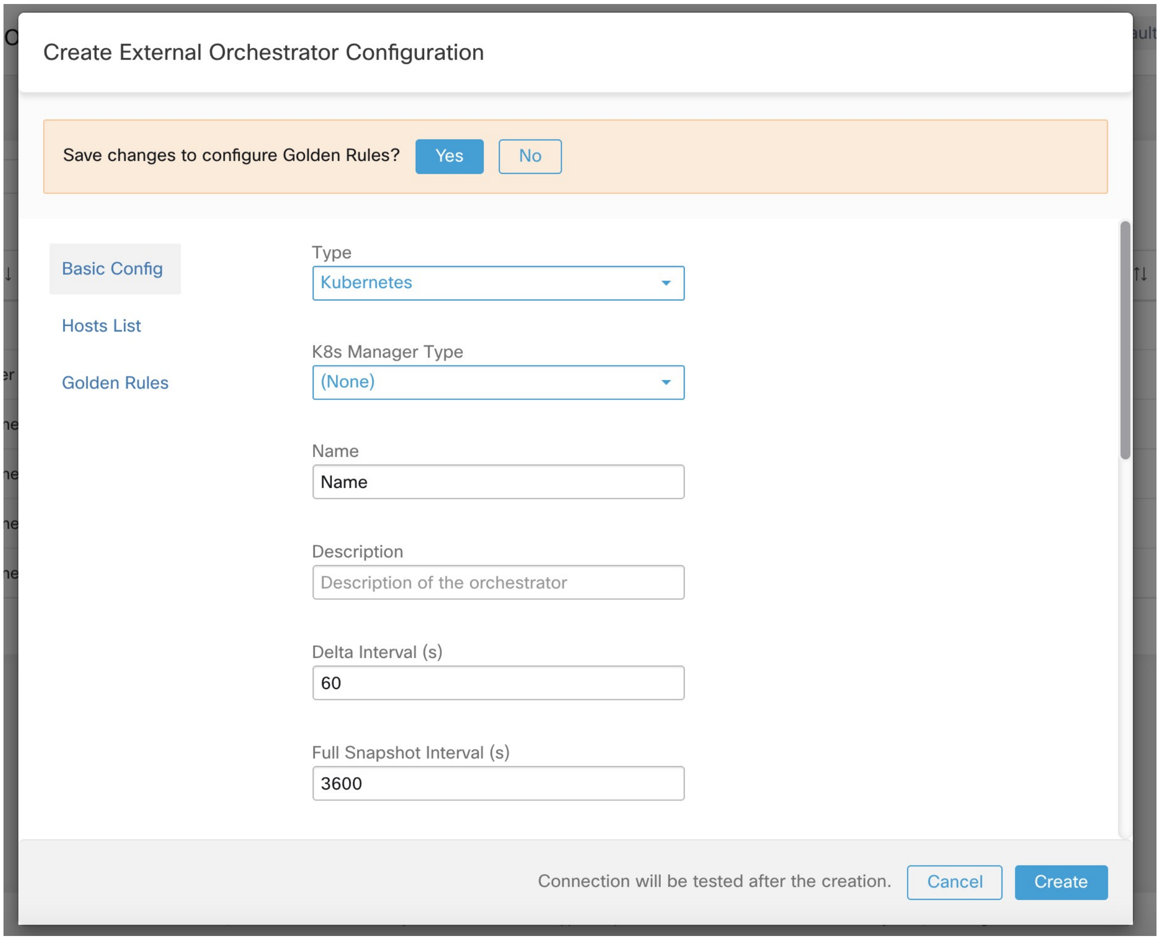
Attribute	Description
Kubelet Port	Kubelet node-local API port
Services	Array of Kubernetes Services objects

The kubelet port is necessary to create policies to allow traffic from the Kubernetes management daemons to kubelets such as for live logs, execs of pods in interactive mode etc. Vital connectivity between the various kubernetes services and daemons is specified as a series of services - each entry in the services array has the following structure

- Description: A string that describes the service
- Addresses: A list of service endpoint addresses of the format <IP>:<port>/<protocol>.
- Consumed By: A list of consumers of the endpoints (allowed values are Pods or Nodes)

Note If **kubernetes** is chosen as the type, Golden Rules configuration will be allowed.

Figure 41: Create Golden Rules Configuration for Kubernetes Type



Create External Orchestrator Configuration

Save changes to configure Golden Rules? Yes No

Type: Kubernetes

K8s Manager Type: (None)

Name: Name

Description: Description of the orchestrator

Delta Interval (s): 60

Full Snapshot Interval (s): 3600

Connection will be tested after the creation.

Workflow

- Configure Secure Connector tunnel, if needed, for connectivity from the Secure Workload cluster to a Kubernetes API server (or servers).
- Configure a Kubernetes orchestrator filled with the configuration fields above.
- Configure the Golden Rules for the Kubernetes orchestrator.

Kubernetes Role-Based Access Control (RBAC) Resource Considerations

The Kubernetes client attempts to GET/LIST/WATCH the following resources. It is highly recommended NOT to configure the admin key/cert or an admin service account.

The provided Kubernetes authentication credentials should have a minimum set of privileges to the following resources:

Resources	Kubernetes Verbs
endpoints	[get list watch]
namespaces	[get list watch]
nodes	[get list watch]
pods	[get list watch]
services	[get list watch]
ingresses	[get list watch]
replicationcontrollers	[get list watch]
replicasets	[get list watch]
deployments	[get list watch]
daemonsets	[get list watch]
statefulsets	[get list watch]
jobs	[get list watch]
cronjobs	[get list watch]

Essentially, you can create a special service account on your Kubernetes server with these minimal privileges. An example sequence of kubectl commands is below that will facilitate the creation of this serviceaccount. Note the use of the clusterrole (not role) and clusterrolebindings (not rolebindings) - these are cluster-wide roles and not per namespace. Using a role/rolebinding will not work as Secure Workload attempts to retrieve data from all namespaces.

```
$ kubectl create serviceaccount csw.read.only
```

Create the clusterrole.

A sample clusterrole.yaml with minimal privileges is provided below

```
    kind: ClusterRole
    apiVersion: rbac.authorization.k8s.io/v1
    metadata:
      name: csw.read.only
    rules:
      - apiGroups:
        - ""
        resources:
          - nodes
          - services
          - endpoints
          - namespaces
          - pods
          - replicationcontrollers
          - ingresses
        verbs:
          - get
          - list
          - watch
      - apiGroups:
        - extensions
        - networking.k8s.io
        resources:
          - ingresses
        verbs:
          - get
          - list
          - watch
      - apiGroups:
        - apps
        resources:
          - replicasets
          - deployments
          - statefulsets
          - daemonsets
        verbs:
          - get
          - list
          - watch
      - apiGroups:
        - batch
        resources:
          - jobs
          - cronjobs
        verbs:
          - get
          - list
          - watch

    $ kubectl create -f clusterrole.yaml
```

Note API groups for these different resources are susceptible to change across Kubernetes versions. The sample above should work for Kubernetes versions 1.20-1.24 and might require some tweaks for other versions.

Create the cluster role binding

```
$ kubectl create clusterrolebinding csw.read.only --clusterrole=csw.read.
˓→only --serviceaccount=default:csw.read.only
```

To retrieve the authtoken secret from the serviceaccount (used in the Auth Token field in the GUI) and decode from base64, you can retrieve the name of the secret by listing the serviceaccount with yaml output.

```
$ kubectl get serviceaccount -o yaml csw.read.only
apiVersion: v1
kind: ServiceAccount
metadata:
  creationTimestamp: 2020-xx-xxT19:59:57Z
  name: csw.read.only
  namespace: default
  resourceVersion: "991"
  selfLink: /api/v1/namespaces/default/serviceaccounts/e2e.minimal
  uid: ce23da52-a11d-11ea-a990-525400d58002
secrets:
- name: csw.read.only-token-vmvmz
```

Listing the secret in yaml output mode will yield the token but in Base64 format (which is standard Kubernetes procedure for secret data). Secure Workload does not accept the token in this format, you must decode it from Base64.

```
$ kubectl get secret -o yaml csw.read.only-token-vmvmz
apiVersion: v1
data:
  ca.crt: ...
  namespace: ZGVmYXVsdA==
  token: ZXlKaGJHY2lPaUpTVX....HRfZ2JwMVZR
kind: Secret
metadata:
  annotations:
    kubernetes.io/service-account.name: csw.read.only
    kubernetes.io/service-account.uid: ce23da52-a11d-11ea-a990-525400d58002
  creationTimestamp: 2020-05-28T19:59:57Z
  name: csw.read.only-token-vmvmz
  namespace: default
  resourceVersion: "990"
  selfLink: /api/v1/namespaces/default/secrets/csw.read.only-token-vmvmz
  uid: ce24f40c-a11d-11ea-a990-525400d58002
type: kubernetes.io/service-account-token
```

To list the secret and output only the `.data.token` field and decode from base 64 encoding in one command, the following command that use the `--template` option is helpful.

```
  $ kubectl get secret csw.read.only-token-vmvmz --template "{{ .data.token }}" | base64
-d
```

This authtoken can be used for configuring a Kubernetes orchestrator in the Secure Workload UI instead of username/password or key/cert.

See EKS specific RBAC considerations.

Orchestrator-generated labels

See Labels Related to Kubernetes Clusters.

Troubleshooting

- Client key/certificate Credentials parsing/mismatch

  These must be supplied in PEM format and be the correct entry from the kubectl.conf file. We have encountered customers pasting CA certs into client cert fields, as well as keys and certs not matching each other.

- gcloud credentials instead of GKE credentials

  Customers using GKE under the gcloud CLI mistakenly provide the gcloud credentials when the GKE cluster credentials are needed.

- Kubernetes cluster version unsupported

  Using an incompatible version of Kubernetes may result in failures. Verify that the Kubernetes version is in the supported versions list.

- Credentials have insufficient privileges

  verify that the authtoken or user or client key/cert used has all the privileges listed in the table above.

- Kubernetes inventory keeps flipping around

The hosts_list field specifies a pool of API servers for the same Kubernetes cluster - you cannot use this to configure multiple Kubernetes clusters. Secure Workload will probe for aliveness and randomly select one of these endpoints to connect to and retrieve the Kubernetes inventory information. No load balancing is performed here, nor is there a guarantee of evenly distributing load across these endpoints. If these are different clusters, the Kubernetes inventory will keep flipping between them, depending on which cluster's API server we connect to.

- Multiple authorization methods

  Multiple authorization methods may be filled in during configuration (username/password, authtoken, client key/certificate) and will be used in the client connection established with the API server. The standard Kubernetes rules for valid simultaneous authorization methods apply here.

- SSL Certificate validation fails

  If the Kubernetes API endpoint is behind a NAT or load balancer, then the DN in the SSL certificate generated on the kube control plane nodes may mismatch with the IP address configured in Secure Workload. This will cause an SSL validation failure even if the CA certificate is provided and is valid. The Insecure knob bypasses strict server SSL certificate validation and will help workaround this issue but can lead to MITM issues. The correct fix for this is to change the CA certificate to provide SAN (Subject Alternative Name) entries for all DNS/IP entries that can be used to connect to the Kubernetes cluster.

VMware vCenter

vCenter integration allows user to fetch bare metal and VM attributes from configured vCenter.

When an external orchestrator configuration is added for type "vCenter", Secure Workload fetches bare metal and VM attributes for all the bare metals and VM's controlled by that vCenter instance. Secure Workload will import the following attributes of a bare metal/VM:- a) Hostname b) IP addresses c) BIOS UUID d) Categories/Labels.

A new inventory will be created in Secure Workload with the above bare metal/VM attributes, if the inventory is not present in the appliance. If the inventory is already present in the appliance (created by Secure Workload visibility sensor running on the bare metal/VM), the existing inventory will be labelled with the fetched bare metal/VM Categories/Labels list.

Prerequisites

- Secure Connector Tunnel, if needed for connectivity.
- vCenter version supported is 6.5+

Configuration fields

Beside the common configuration fields as described in *Create External Orchestrator* the following fields can be configured:

- **Hosts List** is an array of hostname/ip and port pairs pointing to the vCenter server from which bare metal/VM attributes will be fetched.

Workflow

- First, the user must verify that the vCenter server is reachable on that IP/Port from the Secure Workload cluster.
- For TaaS or in cases where the vCenter server is not directly reachable, the user must configure a secure connector tunnel to provide connectivity.

Orchestrator generated labels

Secure Workload adds the following labels to all the VM's learnt from vCenter server.

Key	Value
orchestrator_system/orch_type	vCenter
orchestrator_system/cluster_name	*<Name given to this cluster's configuration>*
orchestrator_system/cluster_id	*<UUID of the cluster's configuration in |product|>*

Instance-specific labels

The following labels are instance specific.

Table 14: The following labels are instance specific.

Key	Value
orchestrator_system/workload_type	vm
orchestrator_system/machine_id	*BIOS UUID of bare metal/VM*
orchestrator_system/machine_name	*Hostname of the bare metal/VM*
orchestrator_'<Category Name>'	*<Tag Value>*

Caveats

- When an external orchestrator configuration is added for vCenter, Secure Workload software will connect to the vCenter server specified in the hosts list. After the connection to the server is successful, Secure Workload software will import hostnames, IP addresses and Category/Labels for all the bare metals and Virtual Machines present in the vCenter server. In order to import hostnames and IP addresses of the bare metals and VM's, VM tools must be installed on all the bare metals and VM's. If VM tools is not installed for a given bare metal/Virtual Machine, Secure Workload software will not display Category/Labels for that particular bare metal/VM.
- Secure Workload software doesn't import Custom attributes of the bare metal/VM.
- It is recommended to set **Delta** interval timer to more than 10 min so as to reduce the load on the vCenter server. Any change in the inventory/labels on the vCenter server will have a propagation delay of at least 10 min, once the above mentioned timer is modified.

Troubleshooting

- Connectivity Issues

  In case, Secure Workload appliance is not able to connect/reach the vCenter server, **Connection Status** tab of the External orchestrator will display the failure status along with the appropriate error if any.

- Secure Workload software health check.

  Check the **MAINTENANCE/Service Status** page to see if any service is down. Check if **OrchestratorInventoryManager** is up and running.

DNS

The DNS Integration allows Secure Workload to annotate known inventory with DNS information such as hostnames from CNAME and A/AAAA records.

When an external orchestrator configuration is added for type “dns”, the Secure Workload appliance will attempt to connect to the DNS server(s) and perform a zone transfer download of DNS records. These records (only A/AAAA and CNAME records) will be parsed and used to enrich inventory in the Secure Workload pipelines (as belonging to the Tenant under which the orchestrator is configured) with a single multi-value label called “orchestrator_system/dns_name”, whose value will be the DNS entries that point (directly or indirectly) to that IP address.

Prerequisites

- Secure Connector Tunnel, if needed for connectivity
- Supported DNS Servers: BIND9, servers supporting AXFR (RFC 5936), Microsoft Windows Server 2016

Configuration fields

- **DNS zones** is an array of strings, each of which represents a DNS zone to be transferred from the DNS server. All dns zones must have a trailing period (“.”) character.
- **Hosts List** is an array of hostname/ip and port pairs pointing to the DNS server(s) from which to fetch the DNS records. Multiple DNS servers may be configured here for HA purposes only. High Availability behavior across multiple DNS servers specified in the hosts_list is “first healthy server” and will favor the earlier entries in the hosts_list. Zones cannot be split across the DNS servers.

Workflow

- First, the user must verify that the DNS server is reachable on that IP/Port from the Secure Workload cluster.
- For TaaS or in cases where the DNS server is not directly reachable, the user must configure a secure connector tunnel to provide connectivity.

- Configure the correct DNS Zone Transfers ACLs/configuration on the DNS server. Refer to the documentation for the particular DNS server software for more information.

Generated labels

orchestrator_system/dns_name -> a multi-value field whose values are all the CNAME and A/AAAA hostnames pointing to that IP.

Caveats

- The DNS orchestrator feed is a *metadata feed* - IP addresses learnt from a DNS zone transfer will not create inventory items in Secure Workload, rather, labels for an existing IP address will be updated with the new DNS metadata. DNS data for unknown IPs is silently discarded. In order to annotate DNS metadata to IPs not learnt from any sensor or via any other orchestrator integrations, IPs must be uploaded via the CMDB bulk upload mechanism to create inventory entries for them. Subnets learnt from CMDB uploads do not create inventory entries.
- Only CNAME and A/AAAA records from the DNS server are processed. CNAME records will be processed to their ultimate IPv4/IPv6 records via the A/AAAA records they point to. Only a single level of deferencing is supported (i.e. chains of CNAME -> CNAME -> A/AAAA or longer are not deferenced) as long as the CNAME points to an A/AAAA record from that same orchestrator. CNAME deferencing across different DNS orchestrators is not supported.

Troubleshooting

- Connectivity Issues

  Secure Workload will attempt to connect to the provided ip/hostname and port number using a TCP connection originating from one of the Secure Workload appliance servers or from the cloud in the case of TaaS or from the VM hosting the Secure Workload Secure Connector VPN tunnel service. In order to correctly establish this connection, firewalls must be configured to permit this traffic.
- DNS AXFR Privilege Issues

  In addition, most DNS servers (BIND9 or Windows DNS or Infoblox) require additional configuration when client IPs attempt DNS zone transfers (AXFR requests as per the DNS protocol opcodes) as these are more resource intensive and privileged as compared to simple DNS requests to resolve individual DNS records. These errors typically show up as AXFR refused with reason code 5 (REFUSED).

  Thus, any manual testing to establish that the DNS server is configured correctly must not depend on succesful hostname lookups but rather they must test AXFR requests specifically (using a tool such as dig).

  Any failure to perform an AXFR zone transfer from the DNS server will be reported in the “authentication_failure_error” field by Secure Workload appliance.

  Also, note that Secure Workload will attempt zone transfers from all configured DNS zones and all must succeed in order for the DNS data to be injected into the Secure Workload label database.
- Inventory Hostname fields are not populated by DNS Field ‘hostname’ is always learnt from the Secure Workload sensor. If the inventory was uploaded via CMDB upload and not from the sensor, it may be

missing the hostname. All data from the DNS orchestrator workflow only shows up under the “orchestrator_system/dns_name” label and will never populate the hostname field.

Behavior of Full/Delta polling for DNS Orchestrators

Default Full Snapshot Interval is 24 hours

Default Delta Snapshot Interval is 60 minutes

These are also the minimum allowed values for these timers.

DNS Records may rarely change. So, for optimal fetching behaviour, at every delta snapshot interval, Secure Workload will check if the serial numbers of any of the DNS zones has changed from the previous interval. If no zones have changed, no action is needed.

If any zones have changed, we will perform a zone transfer from all configured DNS zones (not just the single zone that has changed).

Every full snapshot interval, Secure Workload will perform zone transfer downloads from all zones and inject into the label database regardless of whether the zone serial numbers have changed.

Unsupported Features

Warning

- DNAME aliasing and lookups are not supported.
- Incremental Zone Transfers (IXFR) are not supported.

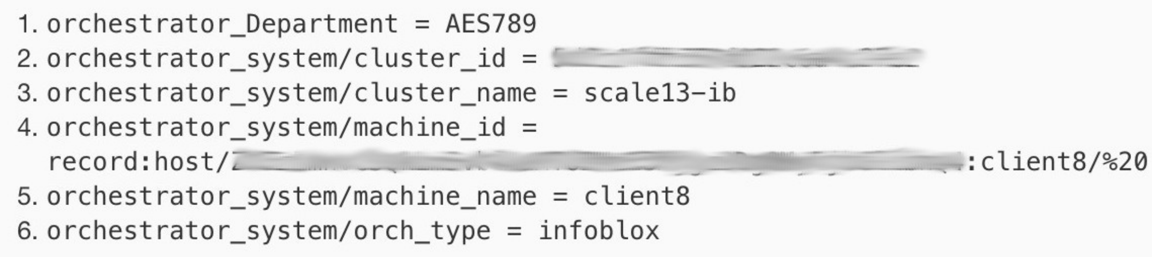
Infoblox

The Infoblox integration allows Secure Workload to import Infoblox subnets, hosts (*record:host*) and A/AAAA records into Secure Workload inventory database. The extensible attribute names and values are imported as is and can be used as Secure Workload labels to define scopes and enforcement policies.

Note Only Infoblox objects with extensible attributes are considered, ie. those without any extensible attributes attached will be excluded from the import.

Below picture shows an example of generated labels for a host object imported from Infoblox with the extensible attribute *Department*:

Figure 42: Example Infoblox labels



```
1. orchestrator_Department = AES789
2. orchestrator_system/cluster_id = [redacted]
3. orchestrator_system/cluster_name = scale13-ib
4. orchestrator_system/machine_id =
   record:host/[redacted]:client8/%20
5. orchestrator_system/machine_name = client8
6. orchestrator_system/orch_type = infoblox
```

Prerequisites

- Infoblox REST API endpoint supporting WAPI version 2.6, 2.6.1, 2.7, 2.7.1 (recommended)

Configuration fields

Beside the common configuration fields as described in *Create External Orchestrator* the following fields can be configured:

Common Field	Required	Description
Hosts List	Yes	The hosts list denotes one Infoblox grid, ie. more than one grid members with REST API access can be added, and the external orchestrator will switch over to the next one in the list in case of connection errors. If you want to import labels from another Infoblox grid, create a new external orchestrator for it.

Note For Infoblox external orchestrator, IPv4 and IPv6 (dual stack mode) addresses are supported. However, do note that dual stack support is a BETA feature.

Workflow

- First, the user must verify that the Infoblox REST API endpoint is reachable from the Secure Workload cluster.
- For TaaS or in cases, where the Infoblox server is not directly reachable, the user must configure a Secure Connector tunnel to provide connectivity.
- Create an external orchestrator with type *Infoblox*. Depending on the volume of Infoblox data, ie. the number of subnets, hosts and A/AAAA records it can take up to one hour for the first full snapshot is available in Secure Workload.

- While creating infoblox config, the user has an option to deselect any of the record types(subnet, host, A/AAAA records).

Orchestrator generated labels

Secure Workload adds the following system labels to all objects retrieved from Infoblox.

Key	Value
orchestrator_system/orch_type	infoblox
orchestrator_system/cluster_id	<UUID of the external orchestrator in Secure Workload
orchestrator_system/cluster_name	<Name given to this external orchestrator>
orchestrator_system/machine_id	<Infoblox object reference/identifier>
orchestrator_system/machine_name	<Infoblox host (DNS) name>

Generated labels

All Infoblox extensible attributes will be imported as Secure Workload labels with the prefix *orchestrator_*. For instance, a host with an extensible attribute called *Department* can be addressed in Secure Workload inventory search as *orchestrator_Department*.

Key	Value
orchestrator_<extensible attribute>	<value(s) of the extensible attribute as retrieved from Infoblox>

Caveats

- The maximal number of subnets that can be imported from Infoblox is 50000.
- The maximal number of hosts and A/AAAA records that can be imported from Infoblox is 400000 in total.

Troubleshooting

- Connectivity issue Secure Workload will attempt to connect to the provided IP/hostname and port number using an HTTPS connection originating from one of the Secure Workload appliance servers or from the cloud in the case of TaaS or from the VM hosting the Secure Workload Secure Connector tunnel service. In order to correctly establish this connection, firewalls must be configured to permit this traffic. Also, make sure the given credentials are correct and have privileges to send REST API requests to the Infoblox appliance.

- Not all expected objects are imported Secure Workload imports only subnets, hosts and A/AAAA records with attached extensible attributes. Note there is a limit number objects that can be imported from Infoblox, see *Caveats*.
- Could not find subnets in inventory It is not possible to use inventory search to find Infoblox subnets as Secure Workload inventory by design includes only IP addresses, ie. hosts and A/AAAA records.
- Could not find a host or A/AAAA record Secure Workload imports all extensible attributes as retrieved from Infoblox. Remember to add the prefix *orchestrator_* to the extensible attribute name in eg. inventory search. Note subnets extensible attributes, if not marked as inherited in Infoblox, are not part of hosts and hence not searchable in Secure Workload.

F5 BIG-IP

The F5 BIG-IP integration allows Secure Workload to import the *Virtual Servers* from an F5 BIG-IP load balancer appliance and to derive service inventories. A service inventory corresponds to an F5 BIG-IP virtual server, whose service is characterized by the *VIP* (virtual IP address), protocol and port. Once imported into Secure Workload this service inventory will have labels such as *service_name*, which can be used in inventory search as well as to create Secure Workload scopes and policies.

A big benefit of this feature is the enforcement of policies in that the *external orchestrator for F5 BIG-IP* translates Secure Workload policies to security rules assigned to the virtual server and deploys them to the F5 BIG-IP load balancer via its REST API.

Prerequisites

- Secure Connector Tunnel, if needed for connectivity
- F5 BIG-IP REST API endpoint version 12.1.1

Configuration fields

Beside the common configuration fields as described in *Create External Orchestrator* the following fields can be configured:

Field	Required	Description
Hosts List	Yes	This specifies the REST API endpoint for F5 BIG-IP load balancer. If High Availability is configured for F5 BIG-IP, enter the standby member node so that in case of a failover, the external orchestrator switches over to the current node. If you want to import labels from another F5 BIG-IP load balancer, you need to create a new external orchestrator.

Field	Required	Description
Enable Enforcement	No	Default value is false (unchecked). If checked, this allows Secure Workload *policy enforcement* to deploy security policy rules to the corresponding F5 BIG-IP load balancer. Note the given credentials must have write access for the F5 BIG-IP REST API.
Route Domain	No	Default value is 0 (zero). The route domain specifies which virtual server are to be considered by the external orchestrator. This is determined by the list of partitions assigned to the given route domain, and only the virtual servers defined in those partitions will be imported in Secure Workload.

Workflow

- First, the user must verify that the F5 BIG-IP REST API endpoint is reachable from Secure Workload.
- For TaaS or in cases, where the F5 BIG-IP appliance is not directly reachable, the user must configure a Secure Connector tunnel to provide connectivity.
- Create an external orchestrator with type *F5 BIG-IP*.
- Depending on the *delta interval* value it might take up to 60 seconds (default delta interval) for the first full snapshot of F5 BIG-IP virtual servers to complete. Thereafter the generated labels can be used to create Secure Workload scopes and enforcement policies.

Orchestrator generated labels

Secure Workload adds the following system labels for an external orchestrator for *F5 BIG-IP*:

Key	Value
orchestrator_system/orch_type	f5
orchestrator_system/cluster_id	<UUID of the external orchestrator>
orchestrator_system/cluster_name	<Name given to this external orchestrator>
orchestrator_system/workload_type	service
orchestrator_system/namespace	<Partition the virtual server belongs to>
orchestrator_system/service_name	<Name of the F5 BIG-IP virtual server>

Generated labels

For each virtual server the external orchestrator will generate the following labels:

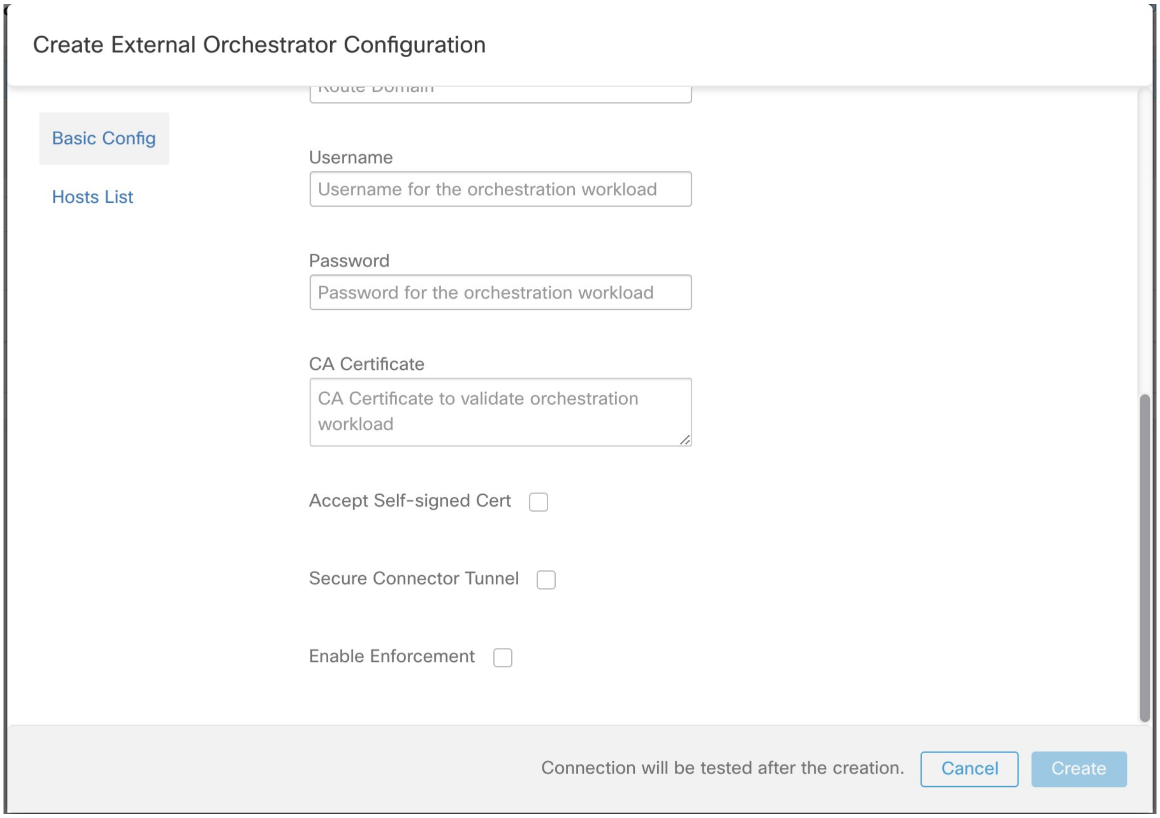
Key	Value
orchestrator_annotation/snat_address	<Virtual servers SNAT address>

Policy enforcement for F5 BIG-IP

This feature enables Secure Workload to translate logical policies with provider groups that match labelled *F5 BIG-IP* virtual servers into *F5 BIG-IP* security policy rules and deploys them to the load balancer appliance using its REST API. As mentioned above any assignment of existing security policy to the respective *F5 BIG-IP* virtual server will be replaced by a new assignment pointing to Secure Workload generated security policy. Existing security policies will not be changed or removed from the *F5 BIG-IP* policy list.

By default, enforcement is not enabled in the external orchestrator configuration:

Figure 43: Configuration Option "Enable Enforcement"



Create External Orchestrator Configuration

Username

Username for the orchestration workload

Password

Password for the orchestration workload

CA Certificate

CA Certificate to validate orchestration workload

Accept Self-signed Cert □

Secure Connector Tunnel □

Enable Enforcement □

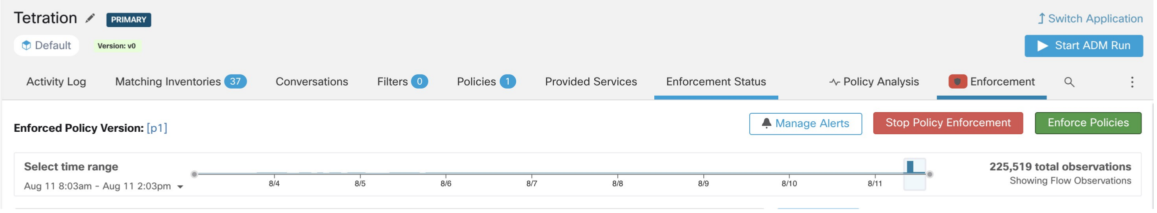
Connection will be tested after the creation.

This option can be modified any time as needed.

Enabling enforcement does not deploy policies to the load balancer appliance unless and until you enable enforcement in a workspace that includes at least one policy that applies to the load balancer, or due to any updates of inventories.

However, disabling enforcement for the orchestrator will cause all deployed security policy rules being removed from the *F5 BIG-IP* load balancer immediately.

Figure 44: Workspace Policy Enforcement



Note

- The orchestrator for *F5 BIG-IP* also detects any deviation of security policy rules and replaces it with Secure Workload policies, ie. any policy changes towards the virtual servers should be done with Secure Workload only.
- When policy enforcement is stopped or the external orchestrator is deleted, the security policy for virtual servers will become empty as all Secure Workload policies will be removed from *F5 BIG-IP* load balancer.

The OpenAPI Policy enforcement status for external orchestrator can be used to retrieve the status of Secure Workload policy enforcement to the load balancer appliance associated with the external orchestrator. This helps to verify if the deployment of security policy rules to the *F5 BIG-IP* appliance has succeeded or failed.

Policy enforcement for F5 ingress controller

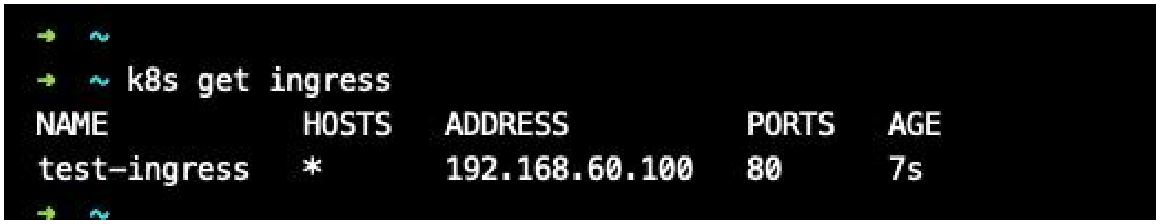
Secure Workload will enforce policies both at the *F5 BIG-IP* load balancer and at the backend pods when the pods are exposed to the external clients using Kubernetes ingress object.

Following are the steps to enforce policy using F5 ingress controller.

Procedure

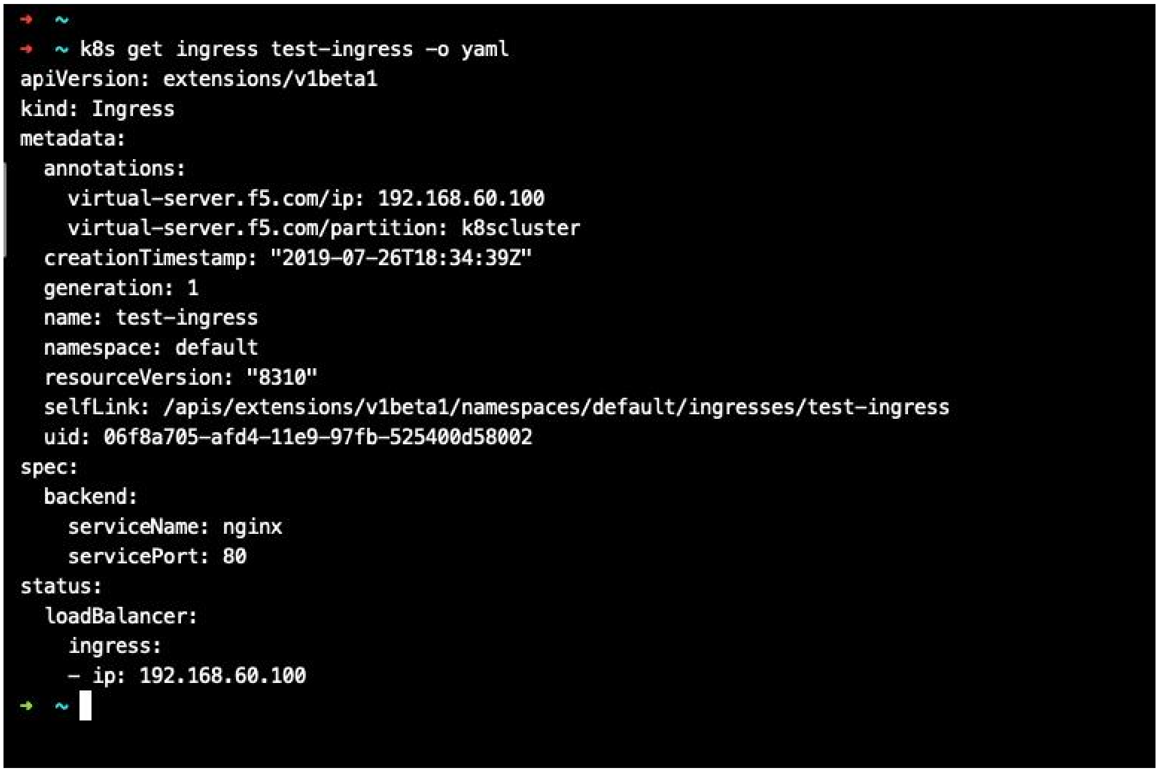
Step 1 Create an external orchestrator for *F5 BIG-IP* load balancer as described above.

Step 2 Create an external orchestrator for Kubernetes/OpenShift as described here.



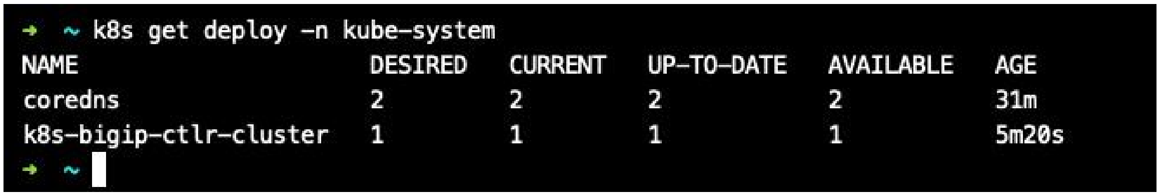
```
➜  ~
➜  ~ k8s get ingress
NAME           HOSTS   ADDRESS          PORTS   AGE
test-ingress   *       192.168.60.100   80      7s
➜  ~
```

Step 3 Create an ingress object in the Kubernetes cluster. A snapshot of the yaml file used to create ingress object is provided in the following picture.



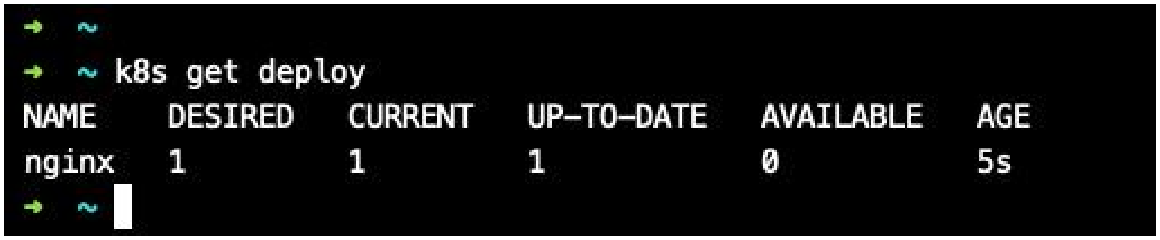
```
➜  ~
➜  ~ k8s get ingress test-ingress -o yaml
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  annotations:
    virtual-server.f5.com/ip: 192.168.60.100
    virtual-server.f5.com/partition: k8scluster
  creationTimestamp: "2019-07-26T18:34:39Z"
  generation: 1
  name: test-ingress
  namespace: default
  resourceVersion: "8310"
  selfLink: /apis/extensions/v1beta1/namespaces/default/ingresses/test-ingress
  uid: 06f8a705-afd4-11e9-97fb-525400d58002
spec:
  backend:
    serviceName: nginx
    servicePort: 80
status:
  loadBalancer:
    ingress:
    - ip: 192.168.60.100
➜  ~
```

Step 4 Deploy F5 ingress controller pod in the Kubernetes cluster.



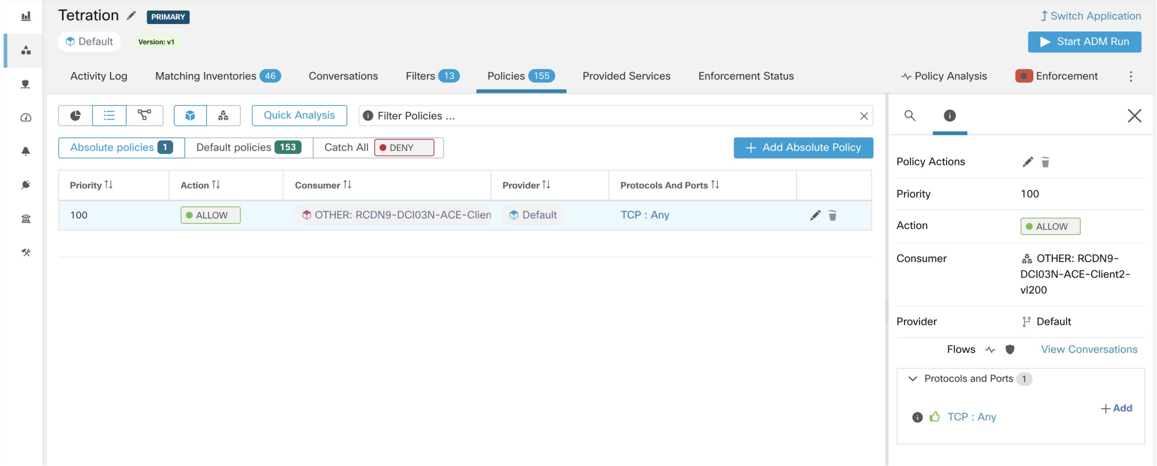
```
➜  ~ k8s get deploy -n kube-system
NAME                    DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
coredns                 2         2         2            2           31m
k8s-bigip-ctlr-cluster  1         1         1            1           5m20s
➜  ~
```

Step 5 reate a backend service which will be accessed by the consumers outside the cluster. In the example provided below we have created a *nginx* service.



```
➜  ~
➜  ~ k8s get deploy
NAME    DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
nginx   1         1         1            0           5s
➜  ~
```

Step 6 Create a policy between external consumer and backend service. Enforce the policy using *Policy Enforcement* tab.



Priority	Action	Consumer	Provider	Protocols And Ports
100	ALLOW	OTHER: RCDN9-DCI03N-ACE-Clien	Default	TCP : Any

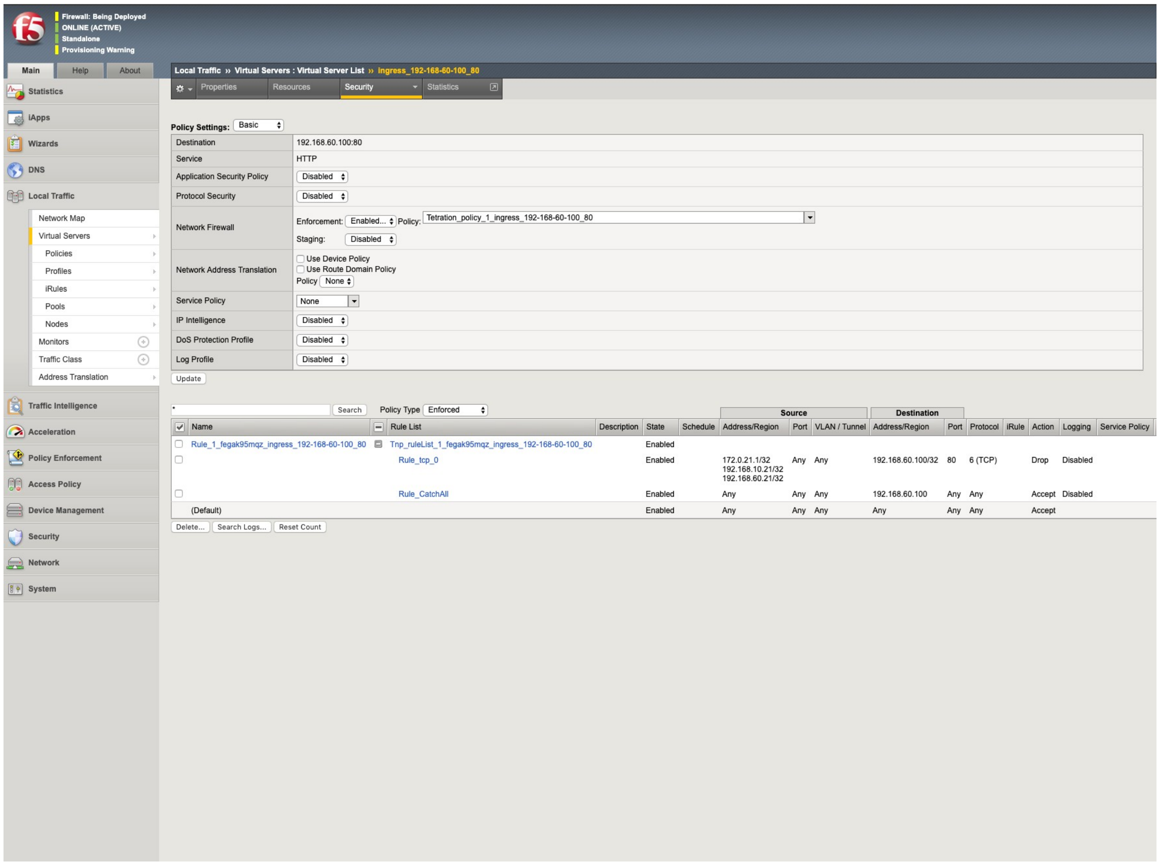
Policy Actions	
Priority	100
Action	ALLOW
Consumer	OTHER: RCDN9-DCI03N-ACE-Client2-vl200
Provider	Default
Flows	View Conversations

Protocols and Ports 1

TCP : Any

+ Add

Step 7 Check the policies on *F5 BIG-IP* load balancer and backend pods. In case of F5 load balancer Secure Workload will apply the appropriate allow/drop rule where the source will be the consumer specified in step 6 and the destination will be VIP [VIP for the ingress virtual service for F5]. In case of backend pods, Secure Workload will apply the appropriate allow/drop rule where the source will the SNIP [in case SNAT pool is enabled] or F5 IP [auto map enabled] and destination will be backend pod IP.



Policy Settings: Basic

Destination	192.168.60.100:80
Service	HTTP
Application Security Policy	Disabled
Protocol Security	Disabled
Network Firewall	Enforcement: Enabled... Policy: Tetration_policy_1_ingress_192-168-60-100_80 Staging: Disabled
Network Address Translation	□ Use Device Policy □ Use Route Domain Policy Policy None
Service Policy	None
IP Intelligence	Disabled
DoS Protection Profile	Disabled
Log Profile	Disabled

Update

* Search Policy Type Enforced

							Source			Destination						
☑	Name	Rule List	Description	State	Schedule	Address/Region	Port	VLAN / Tunnel	Address/Region	Port	Protocol	iRule	Action	Logging	Service Policy
□	Rule_1_fegak95mqz_ingress_192-168-60-100_80	Tnp_ruleList_1_fegak95mqz_ingress_192-168-60-100_80		Enabled											
□		Rule_tcp_0		Enabled		172.0.21.1/32 192.168.10.21/32 192.168.60.21/32	Any	Any	192.168.60.100/32	80	6 (TCP)		Drop	Disabled	
□		Rule_CatchAll		Enabled		Any	Any	Any	192.168.60.100	Any	Any		Accept	Disabled	
	(Default)			Enabled		Any	Any	Any	Any	Any	Any		Accept		

Delete... Search Logs... Reset Count

Caveats

- During deployment phase of *F5 BIG-IP* HA mode, enable the *configuration sync* option. This ensures the external orchestrator can fetch the latest list of virtual servers from the currently connected host.
- In case of *F5 BIG-IP* HA deployment mode, if *Auto-Map* is configured instead of SNAT pool for Address translation, ensure that the *Primary BIG-IP* is configured with the floating *Self IP* address.
- Only VIP specified as a single address is supported, ie. VIP given as a subnet is not supported.

Troubleshooting

- Connectivity issue Secure Workload will attempt to connect to the provided IP/hostname and port number using an HTTPS connection originating from one of the Secure Workload appliance servers or from the cloud in the case of *TaaS* or from the VM hosting the Secure Workload Secure Connector tunnel service. In order to correctly establish this connection, firewalls must be configured to permit this traffic. Also, make sure the given credentials are correct and have privileges with read and write access to send REST API requests to the *F5 BIG-IP* appliance.
- Security rules not found In case no security rules for a defined virtual server are found, after policy enforcement was performed, make sure the corresponding virtual server is enabled, ie. its availability/status must be *available*/*enabled*.

Citrix Netscaler

The Citrix Netscaler integration allows Secure Workload to import the *Load Balancing Virtual Servers* from a Netscaler load balancer appliance and to derive service inventories. A service inventory corresponds to a Netscaler service provided by a virtual server and has labels such as *service_name*, which can be used in inventory search and to create Secure Workload scopes and policies.

A big benefit of this feature is the enforcement of policies in that the *external orchestrator for Citrix Netscaler* translates Secure Workload policies to Netscaler ACLs rules and deploys them to the Netscaler load balancer via its REST API.

Prerequisites

- Secure Connector Tunnel, if needed for connectivity
- Netscaler REST API endpoint version 12.0.57.19

Configuration fields

Beside the common configuration fields as described in *Create External Orchestrator* the following fields can be configured:

Common Field	Required	Description
Hosts List	Yes	This specifies the REST API endpoint for Citrix Netscaler load balancer. If High Availability is configured on Citrix Netscaler, enter another member node so that in case of a failover, the external orchestrator switches over to the current node. If you want to import labels from another Citrix Netscaler load balancer, create a new external orchestrator.
Enable Enforcement	No	Default value is false (unchecked). If checked, this allows Secure Workload *policy enforcement* to deploy ACL rules to the corresponding Citrix Netscaler load balancer. Note the given credentials must have write access for the Citrix Netscaler REST API.

Workflow

- First, the user must verify that the Netscaler REST API endpoint is reachable from the Secure Workload cluster.
- For TaaS or in cases, where the Netscaler appliance is not directly reachable, the user must configure a Secure Connector tunnel to provide connectivity.
- Create an external orchestrator with type *Citrix Netscaler*.
- Depending on the *delta interval* value it might take up to 60 seconds (default delta interval) for the first full snapshot of Netscaler virtual servers to complete. Thereafter the generated labels can be used to create Secure Workload scopes and enforcement policies.
- Enforce policies from Secure Workload to deploy Netscaler ACL rules.

Orchestrator generated labels

Secure Workload adds the following system labels for an external orchestrator for *Citrix Netscaler*:

Key	Value
orchestrator_system/orch_type	nsbalancer
orchestrator_system/cluster_id	<UUID of the external orchestrator>
orchestrator_system/cluster_name	<Name given to this external orchestrator>
orchestrator_system/workload_type	service

Key	Value
orchestrator_system/service_name	<Name of the load balancing virtual server>

Generated labels

For each load balancing virtual server the external orchestrator will generate the following labels:

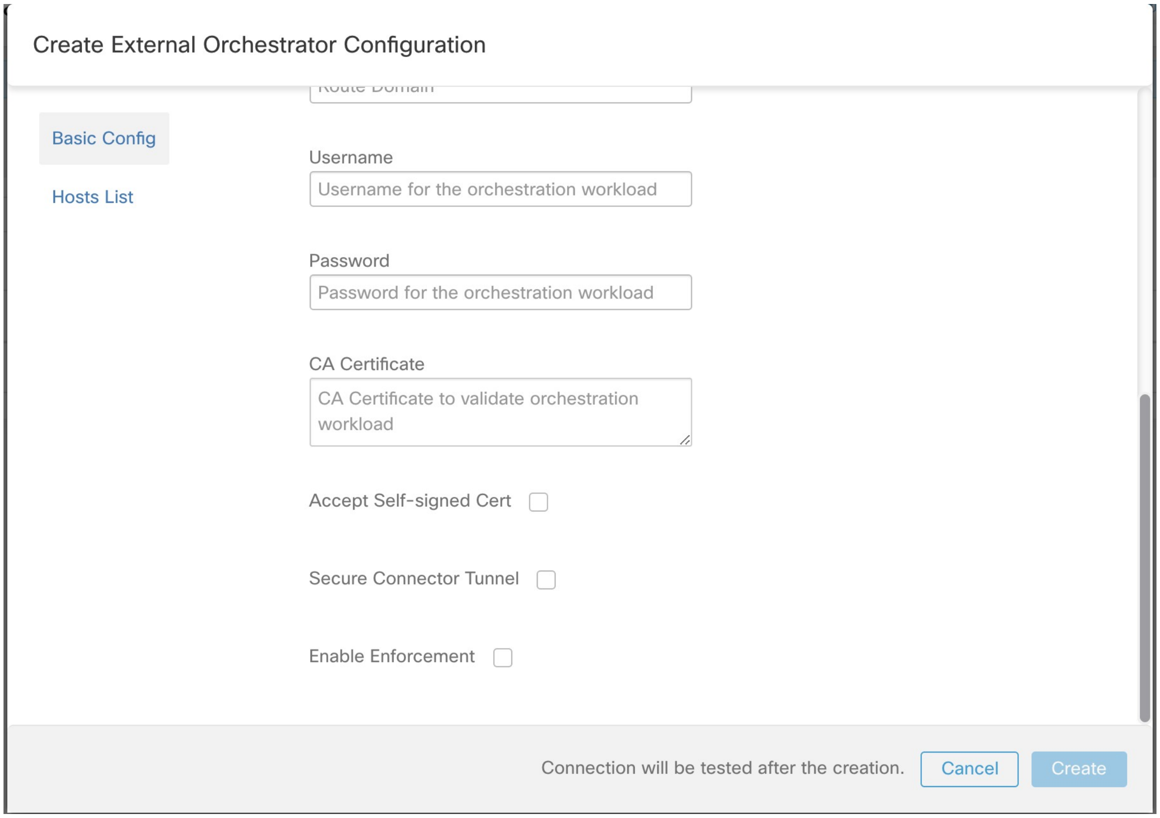
Key	Value
orchestrator_annotation/snat_address	<Virtual servers SNAT address>

Policy enforcement for Citrix Netscaler

This feature enables Secure Workload to translate logical policies with provider groups that match labelled *Citrix Netscaler* virtual servers into *Citrix Netscaler* ACL rules and deploys them to the load balancer appliance using its REST API. As mentioned above all existing ACL rules will be replaced by Secure Workload generated policy rules.

By default, the field *Enable Enforcement* is not checked, ie. disabled, in the dialog *Create Orchestrator* as shown in the picture below:

Figure 45: Configuration Option "Enable Enforcement"



Create External Orchestrator Configuration

Route Domain

Basic Config

Hosts List

Username: Username for the orchestration workload

Password: Password for the orchestration workload

CA Certificate: CA Certificate to validate orchestration workload

Accept Self-signed Cert □

Secure Connector Tunnel □

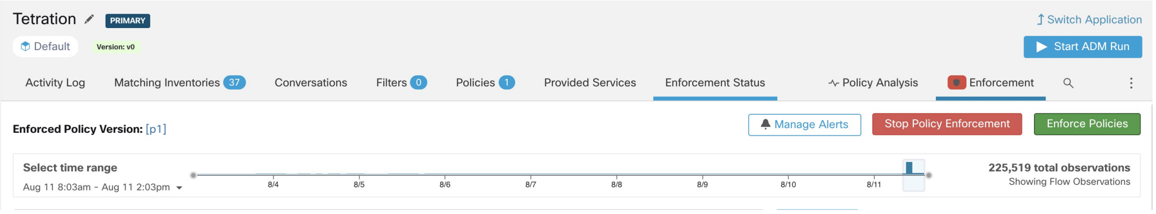
Enable Enforcement □

Connection will be tested after the creation.

Just click on the designated check box to enable enforcement for the orchestrator. This option can be modified any time as needed.

Enable enforcement for the orchestrator, regardless whether it is done by creating or editing the orchestrators configuration, will not deploy the current logical policies to the load balancer appliance immediately. This task is performed as part of the workspace policy enforcement to be triggered by the user as shown in the following picture or due to any updates of inventories. However, disable enforcement for the orchestrator will cause all deployed ACL rules being removed from the *Citrix Netscaler* load balancer immediately.

Figure 46: Workspace Policy Enforcement



Note

- The orchestrator for *Citrix Netscaler* also detects any deviation of ACL rules and replaces it with Secure Workload policies, ie. any policy changes towards the load balancing virtual servers should be done with Secure Workload only.
- When policy enforcement is stopped or the external orchestrator is deleted, the ACLs will become empty as all Secure Workload policies will be removed from *Citrix Netscaler* load balancer.

The OpenAPI Policy enforcement status for external orchestrator can be used to retrieve the status of Secure Workload policy enforcement to the load balancer appliance associated with the external orchestrator. This helps to verify if the deployment of ACL rules to the *Citrix Netscaler* appliance has succeeded or failed.

Caveats

- If enforcement is enabled, the Secure Workload policies will always be deployed to the global list of ACLs, ie. partition *default*.
- Only VIP specified as a single address is supported, ie. VIP given as an address pattern is not supported.
- Visibility for the detected services (*Citrix Netscaler* virtual servers) is not supported.

Troubleshooting

- Connectivity issue Secure Workload will attempt to connect to the provided IP/hostname and port number using an HTTPS connection originating from one of the Secure Workload appliance servers or from the cloud in the case of *TaaS* or from the VM hosting the Secure Workload Secure Connector tunnel service. In order to correctly establish this connection, firewalls must be configured to permit this traffic. Also, make sure the given credentials are correct and have privileges with read and write access to send REST API requests to the *Citrix Netscaler* appliance.
- ACL rules not found In case no ACL rules are found, after policy enforcement was performed, make sure the corresponding virtual server is enabled, ie. its status must be *up*.

TAXII

The TAXII (Trusted Automated Exchange of Intelligence Information) Integration allows Secure Workload to ingest threat intelligence data feeds from security vendors to annotate network flows and process hashes with STIX (Structured Threat Information Expression) indicators such as malicious IPs, malicious hashes.

When an external orchestrator configuration is added for type “taxii”, the Secure Workload appliance will attempt to connect to the TAXII server(s) and poll STIX data feed collections. The STIX data feeds (only IPs and binary hashes indicators) will be parsed and used to annotate network flows and process hashes in the Secure Workload pipelines (as belonging to the Tenant under which the orchestrator is configured).

Network flows with either provider or consumer addresses matched imported malicious IPs will be tagged with multi-value label “orchestrator_malicious_ip_by_<vendor name>” where <vendor name> is the user orchestrator configuration input TAXII vendor, and the label value is “Yes”.

The ingested STIX binary hash indicators will be used to annotate workload process hashes, which will be displayed (if matched) in the Security Dashboard / Process Hash Score Details and in the Workload Profile / File Hashes.

Prerequisites

- Secure Connector Tunnel, if needed for connectivity
- Supported TAXII Servers: 1.0
- Supported TAXII feeds with STIX verion: 1.x

Configuration fields

Beside the common configuration fields as described in *Create External Orchestrator* the following fields can be configured:

Common Field	Required	Description
Name	Yes	User specified name of the orchestrator.
Description	Yes	User specified description of the orchestrator.
Vendor	Yes	The vendor provides intelligence data feeds.
Full Snapshot Interval	Yes	The interval (in seconds) to perform a full snapshot of the TAXII feed. (Default: 1 day)
Poll Url	Yes	The polling full URL path to poll data.

Common Field	Required	Description
Collection	Yes	The TAXII feed collection name to be polled.
Poll Days	Yes	The number of earlier days threat data to poll from TAXII feed.
Username		Username for authentication.
Password		Password for authentication.
Certificate		Client certificate used for authentication.
Key		Key corresponding to client certificate.
CA Certificate		CA Certificate to validate orchestration endpoint.
Accept Self-Signed Cert		Checkbox to disable strictSSL checking of the TAXII API server cer- tificate
Secureconnector Tunnel		Tunnel connections to this orchestrator's hosts through the Secure Con- nector tunnel.
Hosts List	Yes	The hostname/ip and port pairs pointing to the TAXII server(s).

Workflow

- First, the user must verify that the TAXII server is reachable on that IP/Port from the Secure Workload cluster.
- Configure the correct TAXII server with the poll path and TAXII feed name.

Generated labels

Key	Value
orchestrator_system/orch_type	*TAXII*
orchestrator_system/cluster_id	UUID of the cluster's configuration in Secure Workload.
orchestrator_system/cluster_name	Name given to this cluster's configuration>.

Key	Value
orchestrator_malicious_ip_by_<vendor>	*Yes* if the flow provider/consumer address matches the imported TAXII malicious IPs data.

Caveats

- The TAXII integration is supported only on on-premise Secure Workload.
- Only IPs and hashes indicators from TAXII feeds are ingested.
- Maximum number of ingested IPs is 100K (most recently updated) per TAXII feed.
- Maximum number of ingested hashes is 500K (most recently updated) for all TAXII feeds.
- Only TAXII feeds with STIX version 1.x are supported.

Troubleshooting

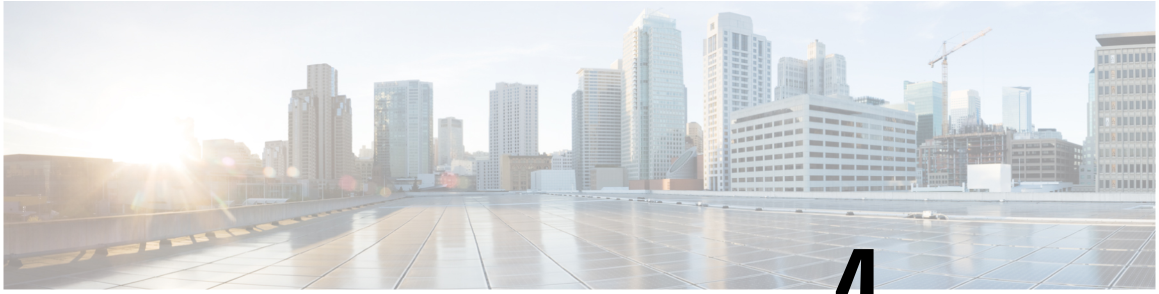
- Connectivity Issues

  The Secure Workload will attempt to connect to the provided poll URL path from one of the Secure Workload appliance servers or from the VM hosting the Secure Workload Secure Connector VPN tunnel service. In order to correctly establish this connection, firewalls must be configured to permit this traffic.

Behavior of Full polling for TAXII Orchestrators

Default Full Snapshot Interval is 24 hours

Every full snapshot interval, Secure Workload will perform pulling TAXII feeds of IPs and hashes up to the above limits into the label database.



CHAPTER 4

Connectors

What are Connectors

Connectors allow Secure Workload to integrate with other resources, for various purposes including:

- Connectors for Flow Ingestion
- Connectors for Inventory Enrichment
- Cloud Connectors
- Connectors for Endpoints
- Connectors for Alert Notifications

Connectors require a virtual appliance. For more information, see Virtual Appliances for Connectors.

Navigating to the Connectors Page

To configure and work with connectors, click **Manage** > **Connectors** in the navigation bar at the left side of the window.

Connectors for Flow Ingestion

Connectors stream flow observations from different Network switches, routers, and other middle-boxes (such as load balancers and firewalls) to Secure Workload for flow ingestion.

Secure Workload supports flow ingestion through NetFlow v9, IPFIX, and custom protocols. In addition to flow observations, middle-box connectors actively stitch client-side and server-side flows to understand which client flows are related to which server flows.

Connector	Description	Deployed on Virtual Appliance
NetFlow	Collect NetFlow V9 and/or IP-FIX telemetry from network devices such as routers and switches.	Secure Workload Ingest
F5 BIG-IP	Collect telemetry from F5 BIG-IP, stitch client, and server side flows, enrich client inventory with user attributes.	Secure Workload Ingest
Citrix NetScaler	Collect telemetry from Citrix ADC, stitch client, and server side flows.	Secure Workload Ingest
Cisco Secure Connector Firewall	Collect telemetry data from Secure Firewall ASA, Secure Firewall Threat Defense, stitch client, and server side flows.	Secure Workload Ingest
Meraki	Collect telemetry data from Meraki firewalls.	Secure Workload Ingest
ERSPAN	Collect ERSPAN telemetry data from network devices which support ERSPAN	Secure Workload Ingest
See also	Cloud Connectors	–

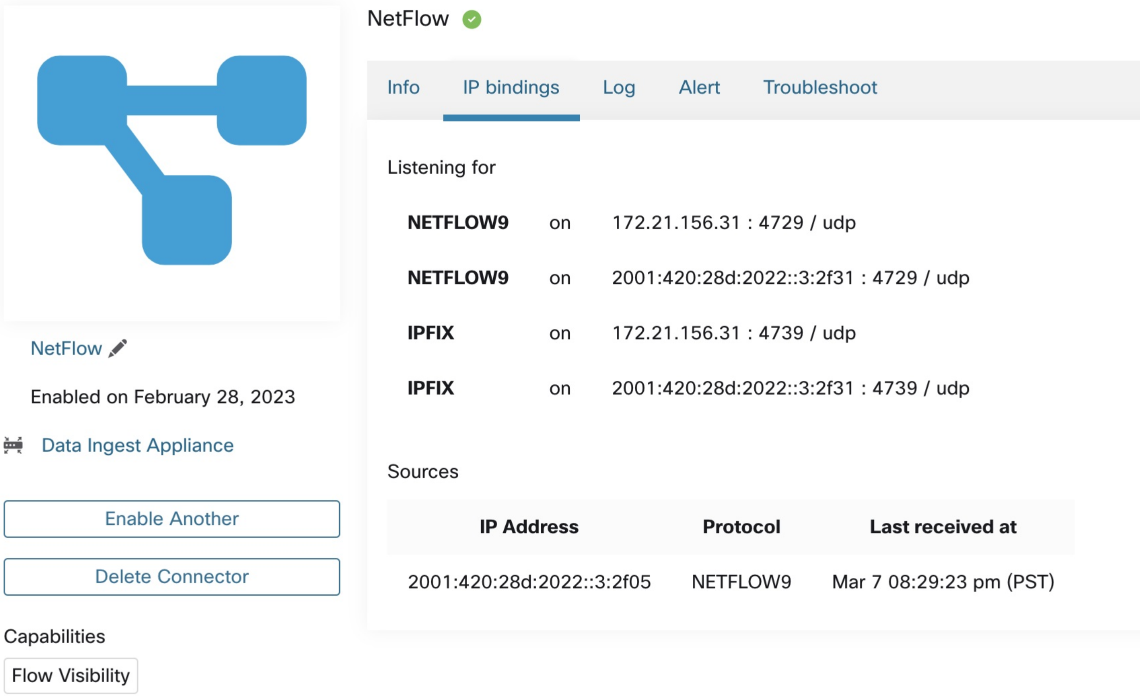
For more information about required virtual appliances, see Virtual Appliances for Connectors.

NetFlow Connector

NetFlow connector allows Secure Workload to ingest flow observations from routers and switches in the network.

This solution enables the hosts to avoid running software agents since the Cisco switches relay NetFlow records to a NetFlow connector hosted in a Secure Workload Ingest appliance for processing.

Figure 47: NetFlow connector



Enabled on February 28, 2023

Listening for

NETFLOW9	on	172.21.156.31 : 4729 / udp
NETFLOW9	on	2001:420:28d:2022::3:2f31 : 4729 / udp
IPFIX	on	172.21.156.31 : 4739 / udp
IPFIX	on	2001:420:28d:2022::3:2f31 : 4739 / udp

Sources

IP Address	Protocol	Last received at
2001:420:28d:2022::3:2f05	NETFLOW9	Mar 7 08:29:23 pm (PST)

What is NetFlow

NetFlow protocol allows routers and switches to aggregate traffic passing through them into flows and export these flows to a flow collector.

The flow collector receives these flow records and stores them in their flow storage for offline querying and analysis. Cisco routers and switches support NetFlow.

Typically, the setup involves the following steps:

1. Enable the NetFlow feature on one or more network devices and configure the flow templates that devices should export.

2. Configure the NetFlow collector endpoint information on the remote network devices. This NetFlow collector is listening on the configured endpoint to receive and process NetFlow flow records.

Flow Ingestion to Secure Workload

NetFlow connector is essentially a NetFlow collector. The connector receives the flow records from the network devices and forwards them to Secure Workload for flow analysis. You can enable a NetFlow connector on a Secure Workload Ingest appliance and run it as a Docker container.

NetFlow connector also registers with Secure Workload as a Secure Workload NetFlow agent. NetFlow connector decapsulates the NetFlow protocol packets (that is, flow records); then processes and reports the flows like a regular Secure Workload agent. Unlike a Deep Visibility Agent, it does not report any process or interface information.

Note NetFlow connector supports NetFlow v9 and IPFIX protocols.

Note Each NetFlow connector should report only flows for one VRF. The connector exports the flows and places them in the VRF based on the Agent VRF configuration in the Secure Workload cluster.

To configure the VRF for the connector, choose **Manage** > **Agents** and click the **Configuration** tab. In this page, under the *Agent Remote VRF Configurations* section, click *Create Config* and provide the details about the connector.

The form requests you to provide: the name of the VRF, the IP subnet of the connector, and the range of port numbers that can potentially send flow records to the cluster.

Rate Limiting

NetFlow connector accepts up to 15000 flows per second. Note that a given NetFlow v9 or IPFIX packet could contain one or more flow and template records. NetFlow connector parses the packets and identifies the flows. If the connector parses more than 15000 flows per second, it drops the additional flow records.

Also note the Secure Workload customer supports the NetFlow connector only if the flow rate is within this acceptable limit.

If the flow rate exceeds 15000 flows per second, we recommend first adjusting the flow rate to fall within the limits, and maintaining this level for at least three days (to rule out issues related to higher incoming flow rate).

If the original issue persists, customer support starts to investigate the issue and identify proper workaround and/or solution.

Supported Information Elements

NetFlow connector *only* supports the following information elements in NetFlow v9 and IPFIX protocols. For more information, see IP Flow Information Export (IPFIX) Entities.

Element ID	Name	Description	Mandatory
1	octetDeltaCount	Number of octets in incoming packets for this flow.	Yes
2	packetDeltaCount	Number of incoming packets for this flow.	Yes
4	protocolIdentifier	The value of the protocol number in the IP packet header.	Yes
6	tcpControlBits	TCP control bits observed for packets of this flow. The agent handles FIN, SYN, RST, PSH, ACK, and URG flags.	No

Element ID	Name	Description	Mandatory
7	sourceTransportPort	The source port identifier in the transport header.	Yes
8	sourceIPv4Address	The IPv4 source address in the IP packet header.	Either 8 or 27
11	destinationTransportPort	The destination port identifier in the transport header.	Yes
12	destinationIPv4Address	The IPv4 destination address in the IP packet header.	Either 12 or 28
27	sourceIPv6Address	The IPv6 source address in the IP packet header.	Either 8 or 27
28	destinationIPv6Address	The IPv6 destination address in the IP packet header.	Either 12 or 28
150	flowStartSeconds	The absolute timestamp of the first packet of the flow (in seconds).	No
151	flowEndSeconds	The absolute timestamp of the last packet of the flow (in seconds).	No
152	flowStartMilliseconds	The absolute timestamp of the first packet of the flow (in milliseconds).	No
153	flowEndMilliseconds	The absolute timestamp of the last packet of the flow (in milliseconds).	No
154	flowStartMicroseconds	The absolute timestamp of the first packet of the flow (in microseconds).	No
155	flowEndMicroseconds	The absolute timestamp of the last packet of the flow (in microseconds).	No
156	flowStartNanoseconds	The absolute timestamp of the first packet of the flow (in nanoseconds).	No

Element ID	Name	Description	Mandatory
157	flowEndNanoseconds	The absolute timestamp of the last packet of the flow (in nanoseconds).	No

How to configure NetFlow on the Switch

The following steps are for a Nexus 9000 switch. The configurations may slightly differ for other Cisco platforms. In any case, refer to the official Cisco configuration guide for the Cisco platform you're configuring.

Procedure

Step 1 Enter global configuration mode.

```
switch# configure terminal
```

Step 2 Enable NetFlow feature.

```
switch(config)# feature netflow
```

Step 3 Configure a flow record.

The following example configuration shows how to generate five tuple information of a flow in a NetFlow record.

```
switch(config)# flow record ipv4-records
switch(config-flow-record)# description IPv4Flow
switch(config-flow-record)# match ipv4 source address
switch(config-flow-record)# match ipv4 destination address
switch(config-flow-record)# match ip protocol
switch(config-flow-record)# match transport source-port
switch(config-flow-record)# match transport destination-port
switch(config-flow-record)# collect transport tcp flags
switch(config-flow-record)# collect counter bytes
switch(config-flow-record)# collect counter packets
```

Step 4 Configure a flow exporter.

The following example configuration specifies the NetFlow protocol version, NetFlow template exchange interval, and NetFlow collector endpoint details. Specify the IP and port on which you enable the NetFlow connector on a Secure Workload Ingest appliance.

```
switch(config)# flow exporter flow-exporter-one
switch(config-flow-exporter)# description NetFlowv9ToNetFlowConnector
switch(config-flow-exporter)# destination 172.26.230.173 use-vrf management
switch(config-flow-exporter)# transport udp 4729
switch(config-flow-exporter)# source mgmt0
switch(config-flow-exporter)# version 9
switch(config-flow-exporter-version-9)# template data timeout 20
```

Step 5 Configure a flow monitor.

Create a flow monitor and associate it with a flow record and flow exporter.

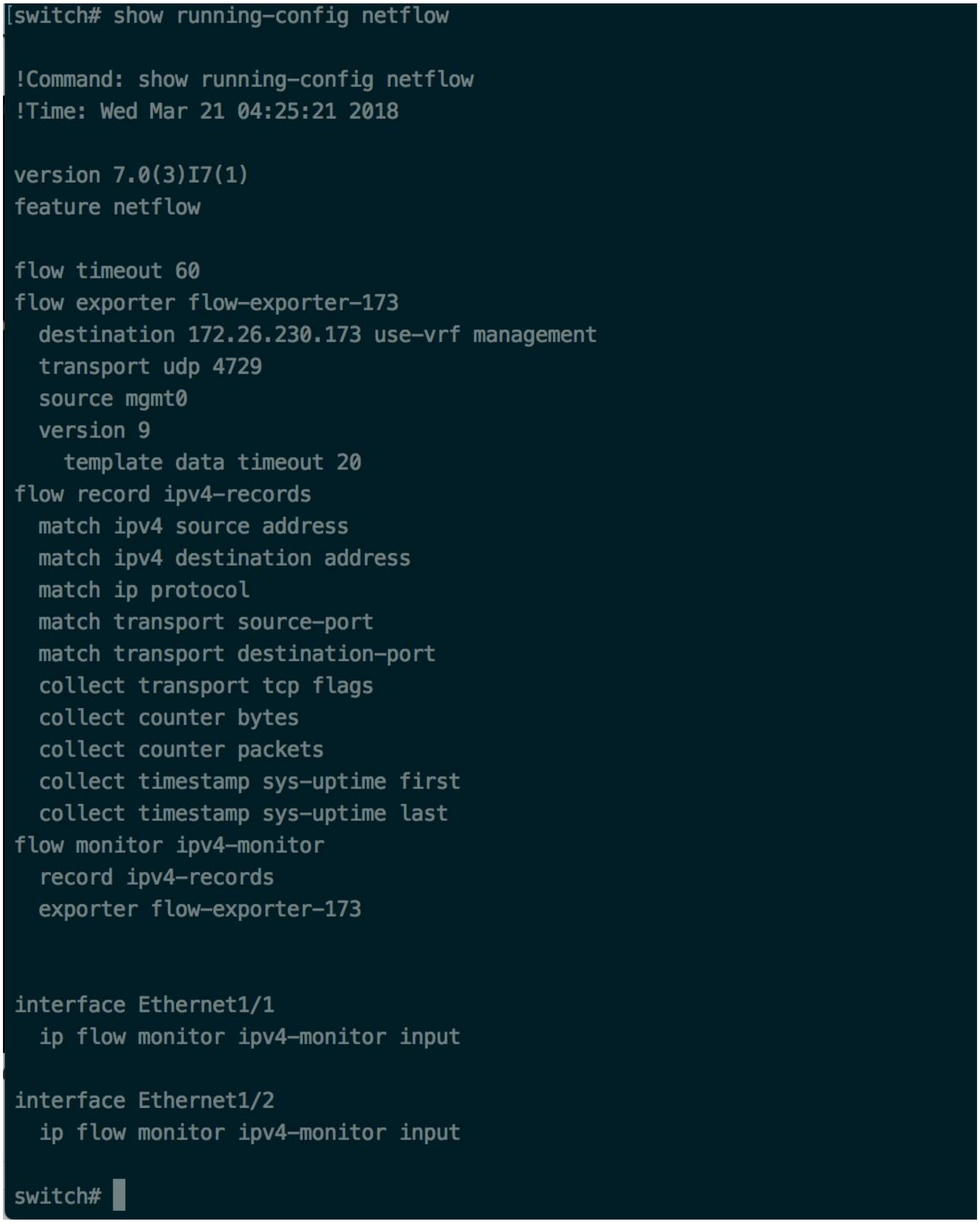
```
switch(config)# flow monitor ipv4-monitor
switch(config-flow-monitor)# description IPv4FlowMonitor
switch(config-flow-monitor)# record ipv4-records
switch(config-flow-monitor)# exporter flow-exporter-one
```

Step 6 Apply the flow monitor to an interface.

```
switch(config)# interface Ethernet 1/1
switch(config-if)# ip flow monitor ipv4-monitor input
```

The above steps configure NetFlow on the Nexus 9000 to export NetFlow v9 protocol packets for ingress traffic going through interface 1/1. It sends the flow records to 172.26.230.173:4729 over a UDP protocol. Each flow record includes five tuple information of the traffic and the byte/packet count of the flow.

Figure 48: Running configuration of NetFlow on Cisco Nexus 9000 Switch



```
[switch# show running-config netflow

!Command: show running-config netflow
!Time: Wed Mar 21 04:25:21 2018

version 7.0(3)I7(1)
feature netflow

flow timeout 60
flow exporter flow-exporter-173
  destination 172.26.230.173 use-vrf management
  transport udp 4729
  source mgmt0
  version 9
    template data timeout 20
flow record ipv4-records
  match ipv4 source address
  match ipv4 destination address
  match ip protocol
  match transport source-port
  match transport destination-port
  collect transport tcp flags
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last
flow monitor ipv4-monitor
  record ipv4-records
  exporter flow-exporter-173


interface Ethernet1/1
  ip flow monitor ipv4-monitor input

interface Ethernet1/2
  ip flow monitor ipv4-monitor input

switch#
```

How to Configure the Connector

For information about required virtual appliances, see Virtual Appliances for Connectors. For NetFlow connectors, IPv4 and IPv6 (dual stack mode) addresses are supported. However, do note that dual stack support is a BETA feature.

The following configurations are allowed on the connector.

- *Log*: For more information, see Log Configuration.

In addition, the listening ports of IPFIX protocol on the connector can be updated on the Docker container in Secure Workload Ingest appliance using an allowed command. This command can be issued on the appliance by providing the connector ID of the connector, type of the port to be update, and the new port information. The connector ID can be found on the connector page in Secure Workload UI. For more information, see update-listening-ports.

Limits

Metric	Limit
Maximum number of NetFlow connectors on single Secure Workload Ingest appliance	3
Maximum number of NetFlow connectors on one Tenant (root scope)	10
Maximum number of NetFlow connectors on Secure Workload	100

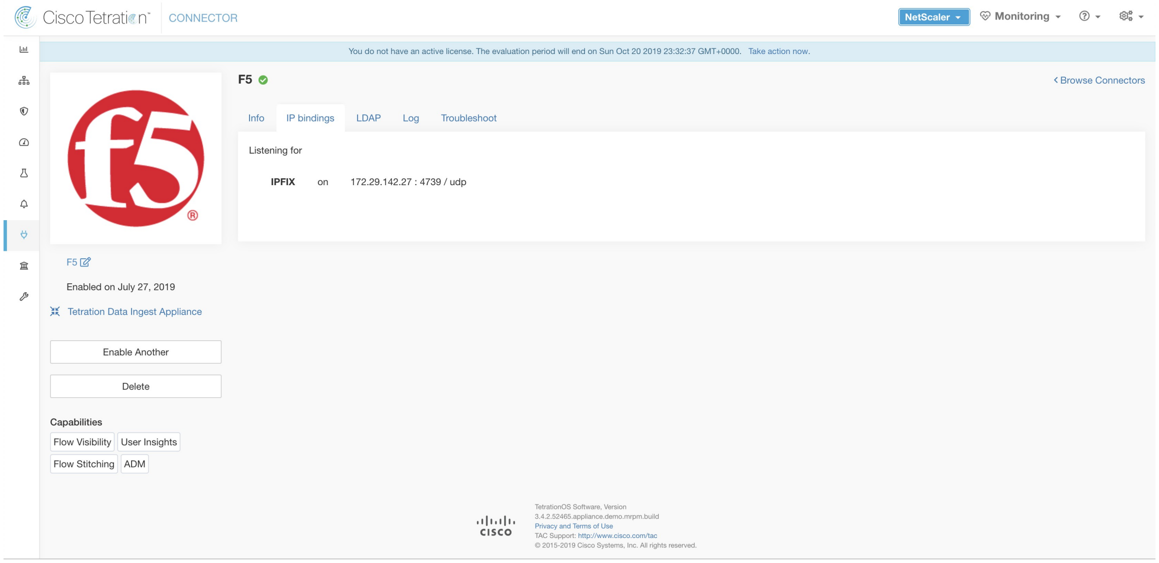
F5 Connector

The F5 connector allows Secure Workload to ingest flow observations from F5 BIG-IP ADCs.

It allows Secure Workload to remotely monitor of flow observations on F5 BIG-IP ADCs, stitching client-side and server-side flows, and annotating users on the client IPs (if user information is available).

Using this solution, the hosts don’t need to run software agents because F5 BIG-IP ADCs configure the export of IPFIX records to the F5 connector for processing.

Figure 49: F5 connector



You do not have an active license. The evaluation period will end on Sun Oct 20 2019 23:32:37 GMT+0000. Take action now.

Listening for

IPFIX on 172.29.142.27 : 4739 / udp

Enabled on July 27, 2019

Tetration Data Ingest Appliance

TetrationOS Software, Version
3.4.2.52465.appliance.demo.mrpm.build
Privacy and Terms of Use
TAC Support: http://www.cisco.com/tac
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What is F5 BIG-IP IPFIX

F5 BIG-IP IPFIX logging collects flow data for traffic going through the F5 BIG-IP and exports IPFIX records to flow collectors.

Typically, the setup involves the following steps:

1. Create the IPFIX Log-Publisher on the F5 BIG-IP appliance.
2. Configure the IPFIX Log-Destination on the F5 BIG-IP appliance. This log-destination listens on the configured endpoint to receive and process flow records.
3. Create an F5 iRule that publishes IPFIX flow records to the log-publisher.
4. Add the F5 iRule to the virtual server of interest.

Note F5 connector supports F5 BIG-IP software version 12.1.2 and above.

Flow Ingestion to Secure Workload

F5 BIG-IP connector is essentially an IPFIX collector. The connector receives the flow records from F5 BIG-IP ADCs, stitch the NATed flows, and forwards them to Secure Workload for flow analysis. In addition, if LDAP configuration is provided to the F5 connector, it determines values for configured LDAP attributes of a user associated with the transaction (if F5 authenticates the user before processing the transaction). The attributes are associated to the client IP address where the flow happened.

Note F5 connector supports only the IPFIX protocol.

Note Each F5 connector reports only flows for one VRF. The connector puts the flows it exports into the VRF based on the Agent VRF configuration in the Cisco Secure Workload cluster.

To configure the VRF for the connector, choose **Manage** > **Agents** and click the **Configuration** tab. In this page, under the *Agent Remote VRF Configurations* section, click the *Create Config* and provide the details about the connector. The form requests you to provide: the name of the VRF, the IP subnet of the connector, and the range of port numbers that can potentially send flow records to the cluster.

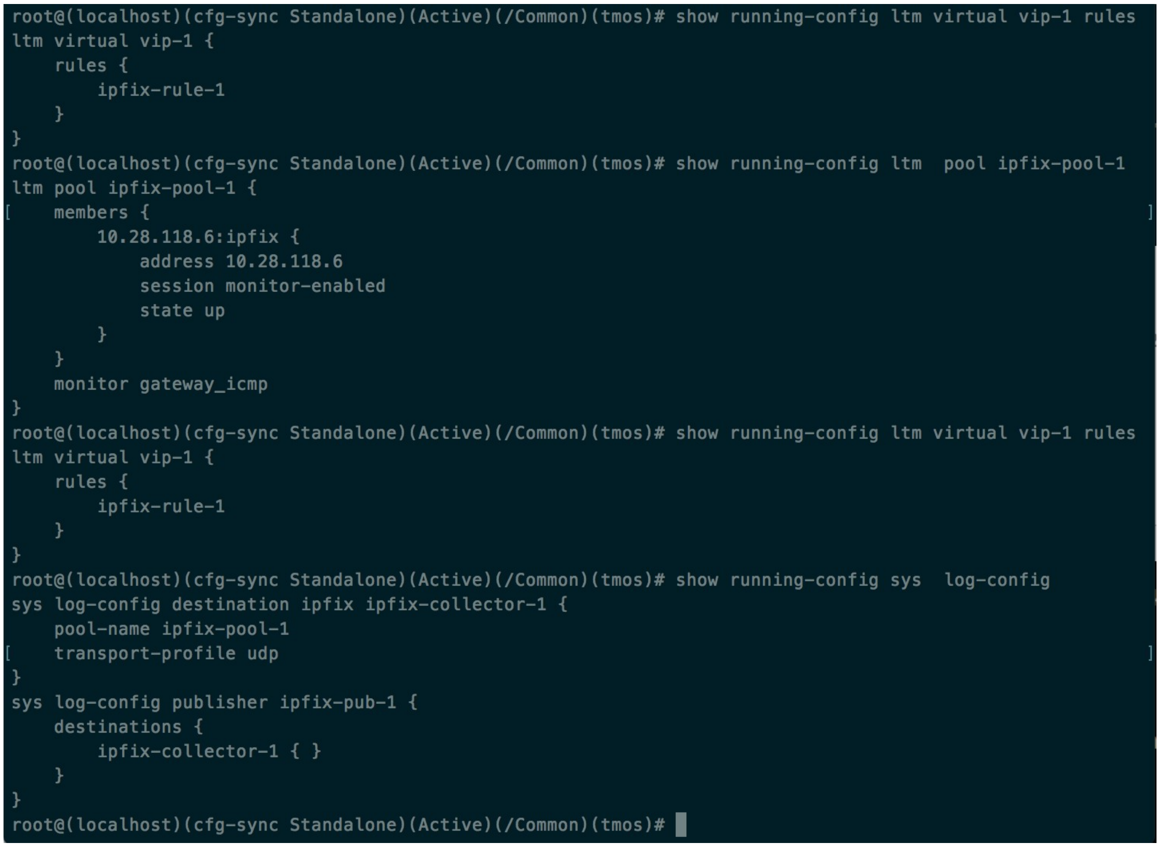
How to configure IPFIX on F5 BIG-IP

The following steps are for F5 BIG-IP load balancer. (Ref: Configuring F5 BIG-IP for IPFIX)

Purpose	Description
1. Create a pool of IPFIX collectors.	On a F5 BIG-IP appliance, create the pool of IPFIX collectors. These are the IP addresses associated with F5 connectors on a Secure Workload Ingest appliance. F5 connectors run in Docker containers on the VM listen on port 4739 for IPFIX packets.
2. Create a log-destination.	The log destination configuration on a F5 BIG-IP appliance specifies the actual pool of IPFIX collectors that are used.
3. Create a log-publisher.	A log publisher specifies where F5 BIG-IP sends the IPFIX messages. The publisher is bound with a log-destination.
4. Add a F5 and Secure Workload approved iRule.	Secure Workload and F5 developed iRules that will export flow records to F5 connectors. These iRules will export complete information about a given transaction: including all the endpoints, byte and packet counts, flow start and end time (in milliseconds). F5 connectors will create 4 independent flows and match each flow with its related flow.
5. Add the iRule to the virtual server.	In the iRule settings of a virtual server, add the Secure Workload, approved iRule to the virtual server.

The above steps configures IPFIX on F5 BIG-IP load balancer to export IPFIX protocol packets for traffic going through the appliance. Here is a sample config of F5.

Figure 50: Running configuration of IPFIX on F5 BIG-IP load balancer



```
root@(localhost)(cfg-sync Standalone)(Active)(/Common)(tmos)# show running-config ltm virtual vip-1 rules
ltm virtual vip-1 {
    rules {
        ipfix-rule-1
    }
}
root@(localhost)(cfg-sync Standalone)(Active)(/Common)(tmos)# show running-config ltm  pool ipfix-pool-1
ltm pool ipfix-pool-1 {
    members {
        10.28.118.6:ipfix {
            address 10.28.118.6
            session monitor-enabled
            state up
        }
    }
    monitor gateway_icmp
}
root@(localhost)(cfg-sync Standalone)(Active)(/Common)(tmos)# show running-config ltm virtual vip-1 rules
ltm virtual vip-1 {
    rules {
        ipfix-rule-1
    }
}
root@(localhost)(cfg-sync Standalone)(Active)(/Common)(tmos)# show running-config sys  log-config
sys log-config destination ipfix ipfix-collector-1 {
    pool-name ipfix-pool-1
    transport-profile udp
}
sys log-config publisher ipfix-pub-1 {
    destinations {
        ipfix-collector-1 { }
    }
}
root@(localhost)(cfg-sync Standalone)(Active)(/Common)(tmos)#
```

In the example above, flow records will be published to *ipfix-pub-1*. *ipfix-pub-1* is configured with log-destination *ipfix-collector-1* which sends the IPFIX messages to IPFIX pool *ipfix-pool-1*. *ipfix-pool-1* has 10.28.118.6 as one of the IPFIX collectors. The virtual server *vip-1* is configured with IPFIX iRule *ipfix-rule-1* which specifies the IPFIX template and how the template gets filled and sent.

- F5 and Secure Workload approved iRule for TCP virtual server. For more information, see L4 iRule for TCP virtual server.
- F5 and Secure Workload approved iRule for UDP virtual server. For more information, see L4 iRule for UDP virtual server.
- F5 and Secure Workload approved iRule for HTTPS virtual server. For more information, see iRule for HTTPS virtual server.

Note Before using the iRule downloaded from this guide, update the **log-publisher** to point to the log-publisher configured in the F5 connector where you add the iRule.

Note F5 has published a GitHub repository, f5-tetration to help you to start with flow-stitching. The iRules for publishing IPFIX records to the F5 connector for various protocol types are available at: f5-tetration/irules.

Visit the site for the latest iRule definitions. In addition, F5 also develops a script to:

1. Install the correct iRule for the virtual servers.
2. Add a pool of IPFIX collector endpoints (where F5 connectors listen for IPFIX records).
3. Configure the log-collector and log-publisher.
4. Bind the correct iRule to the virtual servers.

This tool minimizes manual configuration and user error while enabling flow-stitching use-case. The script is available at f5-tetration/scripts.

How to Configure the Connector

For information about required virtual appliances, see Virtual Appliances for Connectors.

The following configurations are allowed on the connector.

- LDAP: LDAP configuration supports discovery of LDAP attributes and provide a workflow to pick the attribute that corresponds to username and a list of up to 6 attributes to fetch for each user. For more information, see Discovery.
- *Log*: For more information, see Log Configuration.

In addition, the listening ports of IPFIX protocol on the connector can be updated on the Docker container in Secure Workload Ingest appliance using a command that is allowed to be run on the container. This command can be issued on the appliance by providing the connector ID of the connector, type of the port to be update, and the new port information. The connector ID can be found on the connector page in Secure Workload UI. For more information, see update-listening-ports.

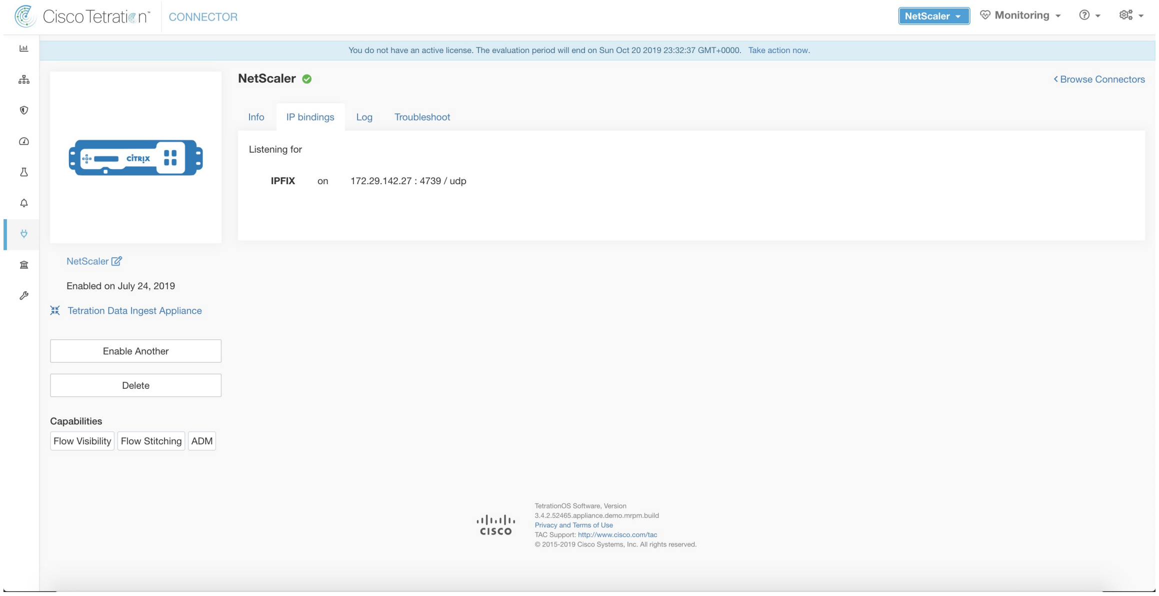
Limits

Metric	Limit
Maximum number of F5 connectors on one Secure Workload Ingest appliance	3
Maximum number of F5 connectors on one Tenant (rootscope)	10
Maximum number of F5 connectors on Secure Workload	100

NetScaler Connector

NetScaler connector allows Secure Workload to ingest flow observations from Citrix ADCs (Citrix NetScalers). It allows Secure Workload to remotely monitor flow observations on Citrix ADCs and stitch client-side and server-side flows. Using this solution, the hosts do not need to run software agents, because Citrix ADCs will be configured to export IPFIX records to NetScaler connector for processing.

Figure 51: NetScaler connector



You do not have an active license. The evaluation period will end on Sun Oct 20 2019 23:32:37 GMT+0000. Take action now.

NetScaler

Listening for

IPFIX on 172.29.142.27 : 4739 / udp

NetScaler

Enabled on July 24, 2019

Tetration Data Ingest Appliance

Capabilities

Flow Visibility | Flow Stitching | ADM

TetrationOS Software, Version 3.4.2.52465.appliance.demo.mrpm.build
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TAC Support: http://www.cisco.com/tac
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What is Citrix NetScaler AppFlow

Citrix NetScaler AppFlow collects flow data for traffic going through the NetScaler and exports IPFIX records to flow collectors. Citrix AppFlow protocol uses IPFIX to export the flows to flow collectors. Citrix AppFlow is supported in Citrix NetScaler load balancers.

Typically, the setup involves the following steps:

1. Enable AppFlow feature on one or more Citrix NetScaler instances.
2. Configure the AppFlow collector endpoint information on the remote network devices. This AppFlow collector will be listening on configured endpoint to receive and process flow records.
3. Configure AppFlow actions and policies to export flow records to AppFlow collectors.

Note NetScaler connector supports Citrix ADC software version 11.1.51.26 and above.

Flow Ingestion to Secure Workload

NetScaler connector is essentially a Citrix AppFlow (IPFIX) collector. The connector receives the flow records from Citrix ADCs, stitch the NATed flows and forwards them to Secure Workload for flow analysis. A NetScaler connector can be enabled on a Cisco Secure Workload Ingest appliance and runs as a Docker container. NetScaler connector also registers with Secure Workload as a Secure Workload NetScaler agent.

Note NetScaler connector supports only IPFIX protocol.

Note

Each NetScaler connector should report only flows for one VRF. The flows exported by the connector is put in the VRF based on the Agent VRF configuration in the Secure Workload cluster. To configure the VRF for the connector, go to: **Manage** > **Agents** and click the Configuration tab. In this page, under *Agent Remote VRF Configurations* section, click *Create Config* and provide the details about the connector. The form requests the user to provide: the name of the VRF, IP subnet of the connector, and range of port numbers that can potentially send flow records to the cluster.

How to configure AppFlow on NetScaler

The following steps are for NetScaler load balancer. (Ref: Configuring AppFlow)

Procedure

Step 1 Enable AppFlow on NetScaler.

```
enable ns feature appflow
```

Step 2 Add AppFlow collector endpoints.

The collector receives the AppFlow records from NetScaler. Specify the IP and port of NetScaler connector enabled on a Secure Workload Ingest appliance as an AppFlow collector.

```
add appflow collector c1 -IPAddress 172.26.230.173 -port 4739
```

Step 3 Configure an AppFlow action.

This lists the collectors that will get AppFlow records if the associated AppFlow policy matches.

```
add appflow action a1 -collectors c1
```

Step 4 Configure an AppFlow policy.

This is a rule that has to match for an AppFlow record to be generated.

```
add appflow policy p1 CLIENT.TCP.DSTPORT(22) a1
add appflow policy p2 HTTP.REQ.URL.SUFFIX.EQ("jpeg") a1
```

Step 5 Bind AppFlow policy to Virtual Server.

Traffic hitting the IP of the virtual server (VIP) will be evaluated for AppFlow policy matches. On a match, a flow record is generated and sent to all collectors listed in the associated AppFlow action.

```
bind lb vserver lb1 -policyname p1 -priority 10
```

Step 6 Optionally, bind AppFlow policy globally (for all virtual servers).

An AppFlow policy could also be bound globally to all virtual servers. This policy applies to all traffic that flows through Citrix ADC.

```
bind appflow global p2 1 NEXT -type REQ_DEFAULT
```

Step 7 Optionally, template refresh interval.

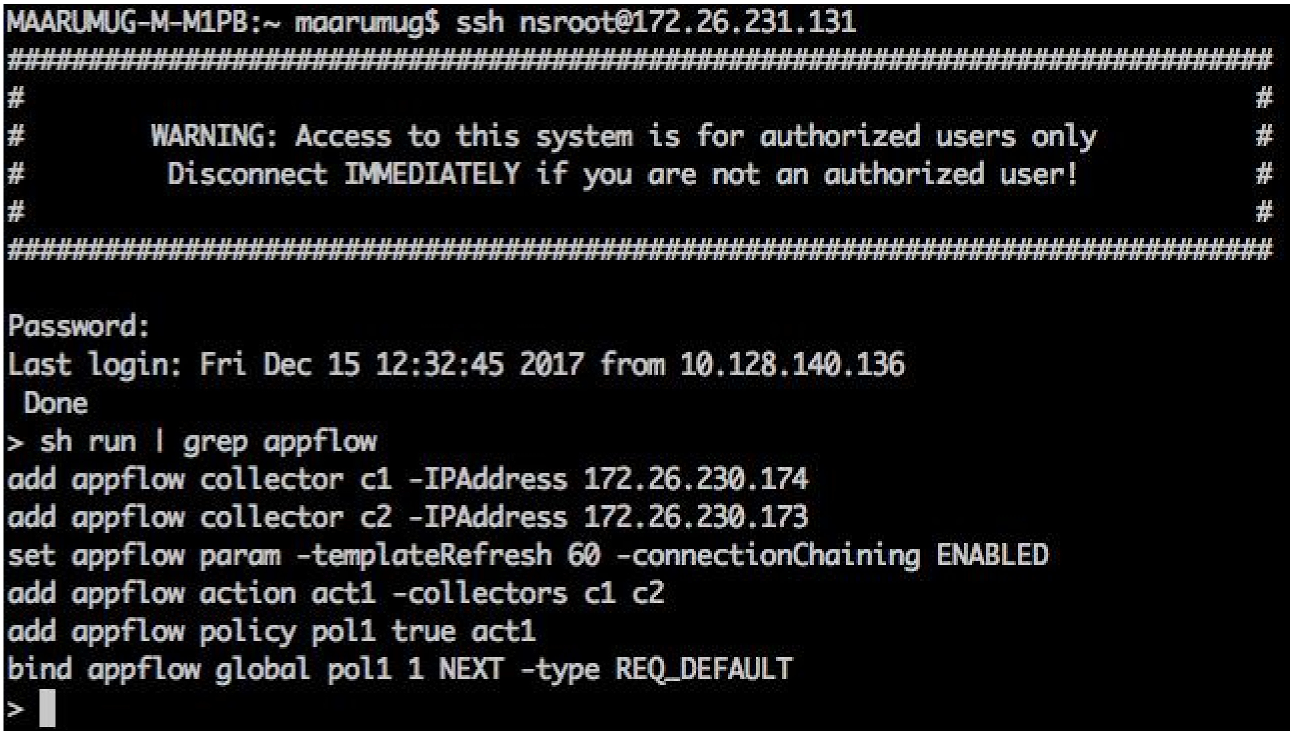
Default value for template refresh is 60 seconds.

```
set appflow param -templatereferesh 60
```

The above steps configures AppFlow on Citrix NetScaler load balancer to export IPFIX protocol packets for traffic going through NetScaler. The flow records will be sent to either 172.26.230.173:4739 (for traffic going through vserver lb1) and to 172.26.230.184:4739 (for all traffic going through the NetScaler). Each flow record includes 5 tuple information of the traffic and the byte/packet count of the flow.

The following screenshot shows a running configuration of AppFlow on a Citrix NetScaler load balancer.

Figure 52: Running configuration of AppFlow on Citrix NetScaler load balancer



```
MAARUMUG-M-M1PB:~ maarumug$ ssh nsroot@172.26.231.131
###############################################################################
#                                                                             #
#        WARNING: Access to this system is for authorized users only          #
#         Disconnect IMMEDIATELY if you are not an authorized user!           #
#                                                                             #
###############################################################################

Password:
Last login: Fri Dec 15 12:32:45 2017 from 10.128.140.136
 Done
> sh run | grep appflow
add appflow collector c1 -IPAddress 172.26.230.174
add appflow collector c2 -IPAddress 172.26.230.173
set appflow param -templateRefresh 60 -connectionChaining ENABLED
add appflow action act1 -collectors c1 c2
add appflow policy pol1 true act1
bind appflow global pol1 1 NEXT -type REQ_DEFAULT
> 
```

How to Configure the Connector

For information about required virtual appliances, see Virtual Appliances for Connectors. The following configurations are allowed on the connector.

- *Log*: . For more information, see Log Configuration.

In addition, the listening ports of IPFIX protocol on the connector can be updated on the Docker container in Secure Workload Ingest appliance using a an allowed command. This command can be issued on the appliance by providing the connector ID of the connector, type of the port to be update, and the new port information. The connector ID can be found on the connector page in Secure Workload UI. . For more information, see update-listening-ports.

Limits

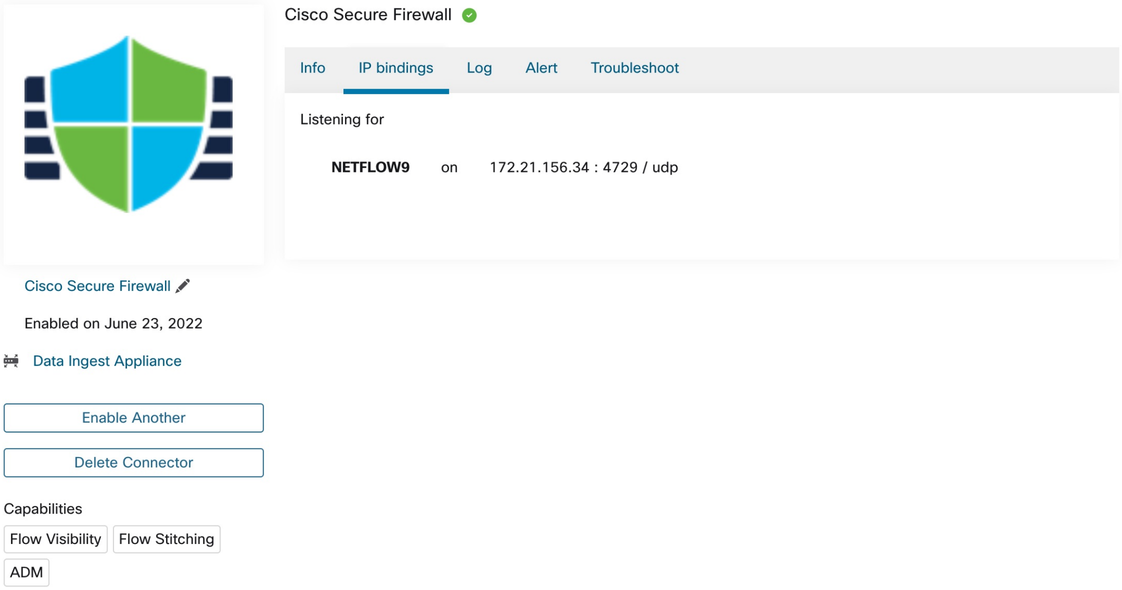
Table 15: Limits

Metric	Limit
Maximum number of NetScaler connectors on one Secure Workload Ingest appliance	3
Maximum number of NetScaler connectors on one Tenant (rootscope)	10
Maximum number of NetScaler connectors on Secure Workload	100

Cisco Secure Firewall Connector

Secure Firewall Connector (formerly known as ASA Connector) allows Secure Workload to ingest flow observations from Secure Firewall ASA (formerly known as Cisco ASA) and Secure Firewall Threat Defense (formerly known as Firepower Threat Defense or FTD). Using this solution, the hosts do not need to run software agents, because the Cisco switches will relay NetFlow Secure Event Logging (NSEL) records to Secure Firewall Connector hosted in a Secure Workload Ingest appliance for processing.

Figure 53: Secure Firewall Connector



Cisco Secure Firewall

Listening for

NETFLOW9 on 172.21.156.34 : 4729 / udp

Cisco Secure Firewall

Enabled on June 23, 2022

Data Ingest Appliance

Capabilities

Cisco Secure Firewall ASA NetFlow Secure Event Logging (NSEL) provides a stateful, IP flow monitoring that exports significant events in a flow to a NetFlow collector. When an event causes a state change on a flow, an NSEL event is triggered that sends the flow observation along with the event that caused the state change to the NetFlow collector. The flow collector receives these flow records and stores them in their flow storage for offline querying and analysis.

Typically, the setup involves the following steps:

1. Enable NSEL feature on Secure Firewall ASA and/or Secure Firewall Threat Defense.
2. Configure the Secure Firewall connector endpoint information on Secure Firewall ASA and/or Secure Firewall Threat Defense. Secure Firewall connector will be listening on configured endpoint to receive and process NSEL records.

Flow Ingestion to Secure Workload

Secure Firewall connector is essentially a NetFlow collector. The connector receives the NSEL records from Secure Firewall ASA and Secure Firewall Threat Defense, and forwards them to Secure Workload for flow analysis. Secure Firewall connector can be enabled on a Secure Workload Ingest appliance and runs as a Docker container.

Secure Firewall connector also registers with Secure Workload as a Secure Workload agent. Secure Firewall connector decapsulates the NSEL protocol packets (i.e., flow records); then processes and reports the flows like a regular Secure Workload agent. Unlike a Deep Visibility Agent, it does not report any process or interface information.

Note Secure Firewall connector supports NetFlow v9 protocol.

Note Each Secure Firewall connector should report only flows for one VRF. The flows exported by the connector is put in the VRF based on the Agent VRF configuration in Secure Workload cluster. To configure the VRF for the connector, go to: **Manage** > **Agents** and click the **Configuration** tab. In this page, under *Agent Remote VRF Configurations* section, click *Create Config* and provide the details about the connector. The form requests the user to provide: the name of the VRF, IP subnet of the connector, and range of port numbers that can potentially send flow records to the cluster.

Handling NSEL Events

The following table shows how various NSEL events are handled by Secure Firewall connector. For more information about these elements, see IP Flow Information Export (IPFIX) Entities document.

Flow Event Element ID: 233 Element Name: *NF_F_FW_EVENT*	Extended Flow Event Element ID: 33002 Element Name: *NF_F_FW_EXT_EVENT*	Action on Secure Firewall connector
0 (default, ignore this value)	Don’t care	No op
1 (Flow created)	Don’t care	Send flow to Secure Workload
2 (Flow deleted)	> 2000 (indicates the termination reason)	Send flow to Secure Workload

Flow Event Element ID: 233 Element Name: ***NF_F_FW_EVENT***	Extended Flow Event Element ID: 33002 Element Name: ***NF_F_FW_EXT_EVENT***	Action on Secure Firewall connector
3 (Flow denied)	1001 (denied by ingress ACL)	Send flow with disposition marked as rejected to Secure Workload
	1002 (denied by egress ACL)	
	1003 (denied connection by ASA interface or denied ICMP(v6) to device)	
	1004 (first packet on TCP is not SYN)	
4 (Flow alert)	Don't care	No op
5 (Flow updated)	Don't care	Send flow to Secure Workload

Based on the NSEL record, Secure Firewall connector sends flow observation to Secure Workload. NSEL flow records are bidirectional. So, Secure Firewall connector sends 2 flows: forward flow and reverse flow to Secure Workload.

Here are the details about flow observation sent by Secure Firewall connector to Secure Workload.

Forward Flow observation

Field	NSEL Element ID	NSEL Element Name
Protocol	4	*NF_F_PROTOCOL*
Source Address	8	*NF_F_SRC_ADDR_IPV4*
	27	*NF_F_SRC_ADDR_IPV6*
Source Port	7	*NF_F_SRC_PORT*
Destination Address	12	*NF_F_DST_ADDR_IPV4*
	28	*NF_F_DST_ADDR_IPV6*
Destination Port	11	*NF_F_DST_PORT*
Flow Start Time	152	*NF_F_FLOW_CREATE_TIME_MSEC*
Byte Count	231	*NF_F_FWD_FLOW_DELTA_BYTES*
Packet Count	298	*NF_F_FWD_FLOW_DELTA_PACKETS*

Reverse Flow Information

Field	NSEL Element ID	NSEL Element Name
Protocol	4	*NF_F_PROTOCOL*

Field	NSEL Element ID	NSEL Element Name
Source Address	12	*NF_F_DST_ADDR_IPV4*
	28	*NF_F_DST_ADDR_IPV6*
Source Port	11	*NF_F_DST_PORT*
Destination Address	8	*NF_F_SRC_ADDR_IPV4*
	27	*NF_F_SRC_ADDR_IPV6*
Destination Port	7	*NF_F_SRC_PORT*
Flow Start Time	152	*NF_F_FLOW_CREATE_TIME_MSEC*
Byte Count	232	*NF_F_REV_FLOW_DELTA_BYTES*
Packet Count	299	*NF_F_REV_FLOW_DELTA_PACKETS*

NAT

If the client to ASA flow is NATed, NSEL flow records indicate the NATed IP/port on the server side. Secure Firewall connector uses this information to stitch server to ASA and ASA to client flows.

Here is the NATed flow record in the forward direction.

Field	NSEL Element ID	NSEL Element Name
Protocol	4	*NF_F_PROTOCOL*
Source Address	225	*NF_F_XLATE_SRC_ADDR_IPV4*
	281	*NF_F_XLATE_SRC_ADDR_IPV6*
Source Port	227	*NF_F_XLATE_SRC_PORT*
Destination Address	226	*NF_F_XLATE_DST_ADDR_IPV4*
	282	*NF_F_XLATE_DST_ADDR_IPV6*
Destination Port	228	*NF_F_XLATE_DST_PORT*
Flow Start Time	152	*NF_F_FLOW_CREATE_TIME_MSEC*
Byte Count	231	*NF_F_FWD_FLOW_DELTA_BYTES*
Packet Count	298	*NF_F_FWD_FLOW_DELTA_PACKETS*

The forward flow will be marked as related to the NATed flow record in the forward direction (and vice versa)

Here is the NATed flow record in the reverse direction

Field	NSEL Element ID	NSEL Element Name
Protocol	4	*NF_F_PROTOCOL*

Field	NSEL Element ID	NSEL Element Name
Source Address	226	*NF_F_XLATE_DST_ADDR_IPV4*
	282	*NF_F_XLATE_DST_ADDR_IPV6*
Source Port	228	*NF_F_XLATE_DST_PORT*
Destination Address	225	*NF_F_XLATE_SRC_ADDR_IPV4*
	281	*NF_F_XLATE_SRC_ADDR_IPV6*
Destination Port	227	*NF_F_XLATE_SRC_PORT*
Flow Start Time	152	*NF_F_FLOW_CREATE_TIME_MSEC*
Byte Count	232	*NF_F_REV_FLOW_DELTA_BYTES*
Packet Count	299	*NF_F_REV_FLOW_DELTA_PACKETS*

The reverse flow will be marked as related to the NATed flow record in the reverse direction (and vice versa).

Note Only NSEL element IDs listed in this section are supported by Secure Firewall connector.

TCP Flags Heuristics

The NSEL records do not have TCP flags information. The Secure Firewall connector uses the following heuristics to set the TCP flags so that the flows can be further analyzed by automatic policy discovery:

- If there are at least one forward packets, adds `SYN` to the forward flow TCP flags.
- If there are at least two forward packets and one reverse packet, adds `ACK` to the forward flow TCP flags and `SYN-ACK` to the reverse flow TCP flags.
- If the previous condition holds true and the flow event is Flow deleted, adds `FIN` to both forward and reverse TCP flags.

How to Configure NSEL on Secure Firewall ASA

The following steps are guidelines on how to configure NSEL and export NetFlow packets to a collector (i.e., Secure Firewall connector). For more information, see the official Cisco configuration guide at Cisco Secure Firewall ASA NetFlow Implementation Guide for more details.

Here is an example NSEL configuration.

```
flow-export destination outside 172.29.142.27 4729
flow-export template timeout-rate 1
!
policy-map flow_export_policy
  class class-default
  flow-export event-type flow-create destination 172.29.142.27
  flow-export event-type flow-teardown destination 172.29.142.27
  flow-export event-type flow-denied destination 172.29.142.27
  flow-export event-type flow-update destination 172.29.142.27
  user-statistics accounting
service-policy flow_export_policy global
```

In this example, Secure Firewall ASA appliance is configured to sent NetFlow packets to *172.29.142.27* on port *4729*. In addition, *flow-export* actions are enabled on *flow-create*, *flow-teardown*, *flow-denied*, and *flow-update* events. When these flow events occur on ASA, a NetFlow record is generated and sent to the destination specified in the configuration.

Assuming a Secure Firewall connector is enabled on Secure Workload and listening on *172.29.142.27:4729* in a Secure Workload Ingest appliance, the connector will receive NetFlow packets from Secure Firewall ASA appliance. The connector processes the NetFlow records as discussed in Handling NSEL Eventsand exports flow observations to Secure Workload. In addition, for NATed flows, the connector stitches the related flows (client-side and server-side) flows.

How to Configure the Connector

For information about required virtual appliances, see Virtual Appliances for Connectors. The following configurations are allowed on the connector.

- *Log*: For more information, see Log Configuration.

In addition, the listening ports of IPFIX protocol on the connector can be updated on the Docker container in Secure Workload Ingest appliance using a an allowed command. This command can be issued on the appliance by providing the connector ID of the connector, type of the port to be update, and the new port information. The connector ID can be found on the connector page in Secure Workload UI. For more information, see update-listening-ports.

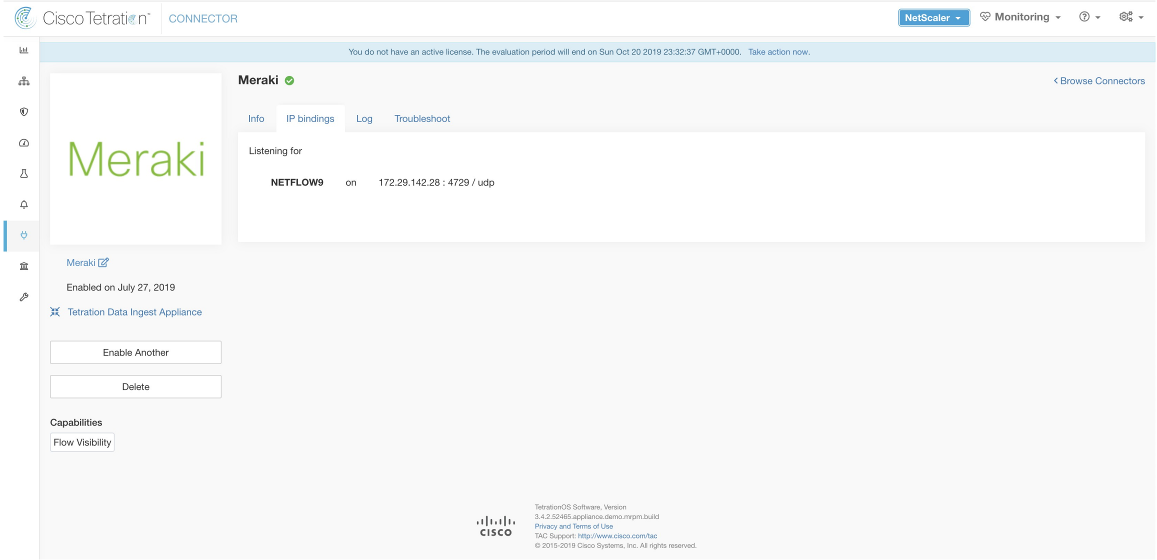
Limits

Metric	Limit
Maximum number of Secure Firewall connectors on one Secure Workload Ingest appliance	1
Maximum number of Secure Firewall connectors on one Tenant (rootscope)	10
Maximum number of Secure Firewall connectors on Secure Workload	100

Meraki Connector

Meraki connector allows Secure Workload to ingest flow observations from Meraki firewalls (included in Meraki MX security appliances and wireless access points). Using this solution, the hosts do not need to run software agents, because the Cisco switches will relay NetFlow records to Meraki connector hosted in a Secure Workload Ingest appliance for processing.

Figure 54: Meraki connector



You do not have an active license. The evaluation period will end on Sun Oct 20 2019 23:32:37 GMT+0000. Take action now.

Meraki

Listening for

NETFLOW9 on 172.29.142.28 : 4729 / udp

Meraki

Enabled on July 27, 2019

Tetration Data Ingest Appliance

Capabilities

Flow Visibility

TetrationOS Software, Version
3.4.2.52465.appliance.demo.mrpm.build
Privacy and Terms of Use
TAC Support: http://www.cisco.com/tac
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What is NetFlow

NetFlow protocol allows network devices such as Meraki Firewall to aggregate traffic that passes through them into flows and export these flows to a flow collector. The flow collector receives these flow records and stores them in their flow storage for offline querying and analysis.

Typically, the setup involves the following steps:

1. Enable NetFlow statistics reporting on Meraki Firewall.
2. Configure the NetFlow collector endpoint information on Meraki Firewall.

Flow Ingestion to Secure Workload

Meraki connector is essentially a NetFlow collector. The connector receives the flow records from the Meraki firewalls that are configured to export NetFlow traffic statistics. It processes the NetFlow records and sends the flow observations reported by Meraki firewalls to Secure Workload for flow analysis. A Meraki connector can be enabled on a Secure Workload Ingest appliance and runs as a Docker container.

Meraki connector also registers with Secure Workload as a Secure Workload Meraki agent. Meraki connector decapsulates the NetFlow protocol packets (i.e., flow records); then processes and reports the flows like a regular Secure Workload agent. Unlike a Deep Visibility Agent, it does not report any process or interface information.

Note Meraki connector supports NetFlow v9 protocol.

Note Each Meraki connector should report only flows for one VRF. The flows exported by the connector is put in the VRF based on the Agent VRF configuration in Secure Workload cluster. To configure the VRF for the connector, go to: **Manage** > **Agents** and click the **Configuration** tab. In this page, under *Agent Remote VRF Configurations* section, click *Create Config* and provide the details about the connector. The form requests the user to provide: the name of the VRF, IP subnet of the connector, and range of port numbers that can potentially send flow records to the cluster.

Handling NetFlow Records

Based on the NetFlow record, Meraki connector sends flow observation to Secure Workload. Meraki NetFlow flow records are bidirectional. So, Meraki connector sends 2 flows: forward flow and reverse flow to Secure Workload.

Here are the details about flow observation sent by Meraki connector to Secure Workload.

Forward Flow observation

Field	Element ID	Element Name
Protocol	4	*protocolIdentifier*
Source Address	8	*sourceIPv4Address*
Source Port	7	*sourceTransportPort*
Destination Address	12	*destinationIPv4Address*
Destination Port	11	*destinationTransportPort*
Byte Count	1	*octetDeltaCount*
Packet Count	2	*packetDeltaCount*
Flow Start Time		Set based on when the NetFlow record for this flow is received on the connector

Reverse Flow Information

Field	Element ID	
Protocol	4	*protocolIdentifier*
Source Address	8	*sourceIPv4Address*
Source Port	7	*sourceTransportPort*
Destination Address	12	*destinationIPv4Address*
Destination Port	11	*destinationTransportPort*
Byte Count	23	*postOctetDeltaCount*

Field	Element ID	
Packet Count	24	*postPacketDeltaCount*
Flow Start Time		Set based on when the NetFlow record for this flow is received on the connector

How to configure NetFlow on Meraki Firewall

The following steps show how to configure NetFlow reporting on Meraki Firewall.

Procedure

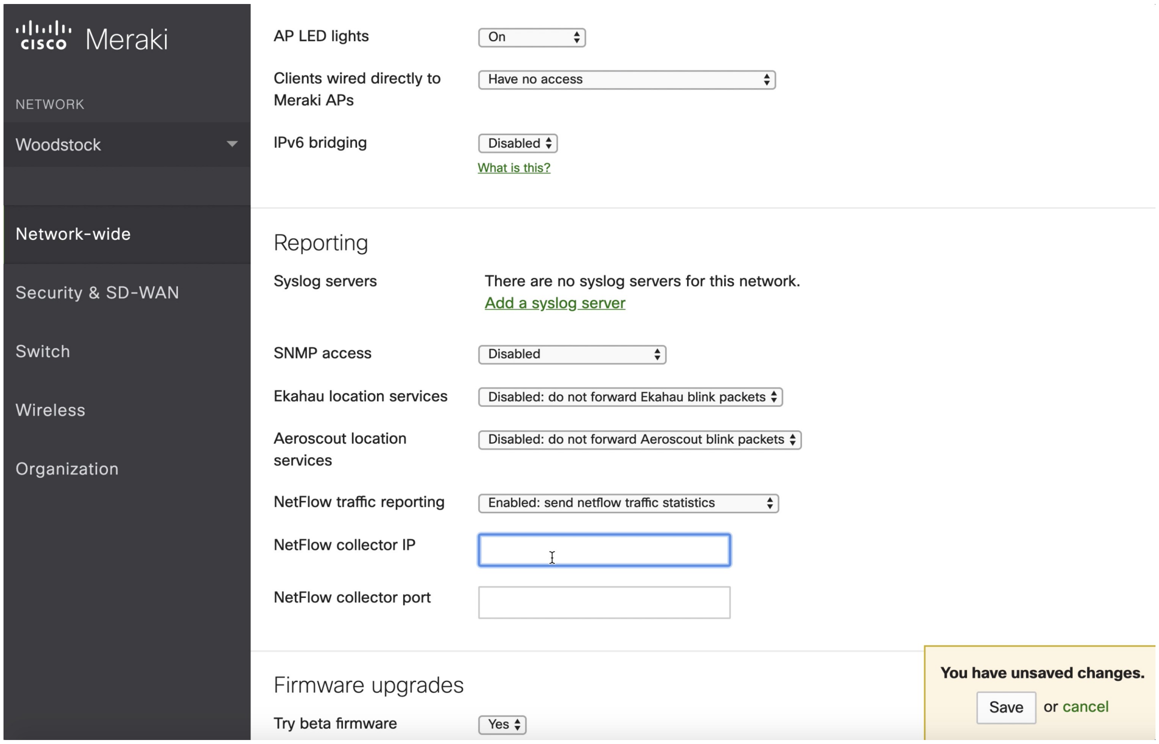
Step 1 Login to Meraki UI console.

Step 2 Navigate to **Network-wide** > **General**. In *Reporting* settings, enable **NetFlow traffic reporting** and make sure the value is set to *Enabled: send NetFlow traffic statistics.*

Step 3 Set **NetFlow collector IP** and **NetFlow collector port** to the IP and port on which Meraki connector is listening in Secure Workload Ingest appliance. Default port on which Meraki connector listens for NetFlow records is 4729.

Step 4 Save the changes.

Figure 55: Enabling NetFlow on a Meraki Firewall



AP LED lights: On

Clients wired directly to Meraki APs: Have no access

IPv6 bridging: Disabled
What is this?

Reporting

Syslog servers: There are no syslog servers for this network.
Add a syslog server

SNMP access: Disabled

Ekahau location services: Disabled: do not forward Ekahau blink packets

Aeroscout location services: Disabled: do not forward Aeroscout blink packets

NetFlow traffic reporting: Enabled: send netflow traffic statistics

NetFlow collector IP:

NetFlow collector port:

Firmware upgrades

Try beta firmware: Yes

You have unsaved changes.
Save or cancel

How to Configure the Connector

For information about required virtual appliances, see Virtual Appliances for Connectors. The following configurations are allowed on the connector.

- *Log*: For more information, see Log Configuration.

In addition, the listening ports of NetFlow v9 protocol on the connector can be updated on the Docker container in Secure Workload Ingest appliance using an allowed command. This command can be issued on the appliance by providing the connector ID of the connector, type of the port to be update, and the new port information. The connector ID can be found on the connector page in Secure Workload UI. For more information, see update-listening-ports.

Limits

Metric	Limit
Maximum number of Meraki connectors on one Secure Workload Ingest appliance	1
Maximum number of Meraki connectors on one Tenant (rootscope)	10
Maximum number of Meraki connectors on Secure Workload	100

ERSPAN Connector

ERSPAN connector allows Secure Workload to ingest flow observations from routers and switches in the network. Using this solution, the hosts do not need to run software agents, because the Cisco switches will relay the hosts’ traffic to the ERSPAN connector for processing.

What is ERSPAN

Encapsulated Remote Switch Port Analyzer (ERSPAN) is a feature present in most of Cisco switches. It mirrors frames seen by a network device, encapsulates them in a IP packet and sends them to a remote analyzer. Users can select a list of interfaces and/or VLANS on the switch to be monitored.

Commonly, the setup involves configuring source ERSPAN monitoring session(s) on one or more network devices and configuring the destination ERSPAN monitoring session(s) on the remote network device(s) directly connected to a traffic analyzer.

The Secure Workload ERSPAN connector provides both the destination ERSPAN session and traffic analyzer functionalities; therefore there is no need to configure any destination sessions on the switches with the Secure Workload solution.

What are the SPAN Agents

Each ERSPAN connector registers a SPAN agent with the cluster. The Secure Workload SPAN agents are regular Secure Workload agents configured to only process ERSPAN packets: Like Cisco destination ERSPAN sessions, they decapsulate the mirrored frames; then they process and report the flows like a regular Secure Workload agent. Unlike Deep Visibility Agents, they do not report any process or interface information.

What is the Ingest Appliance for ERSPAN

The Secure Workload Ingest appliance for ERSPAN is a VM that internally runs three ERSPAN Secure Workload connectors. It uses the same OVA or QCOW2 as the normal Ingest appliance.

Each connector runs inside a dedicated Docker container to which one vNIC and two vCPU cores with no limiting quota are exclusively assigned.

The ERSPAN connector register a SPAN agent with the cluster with the container hostname: <VM hostname>-<interface IP address>.

The connectors and agents are preserved/restored upon VM, Docker daemon or Docker container crash/reboot.

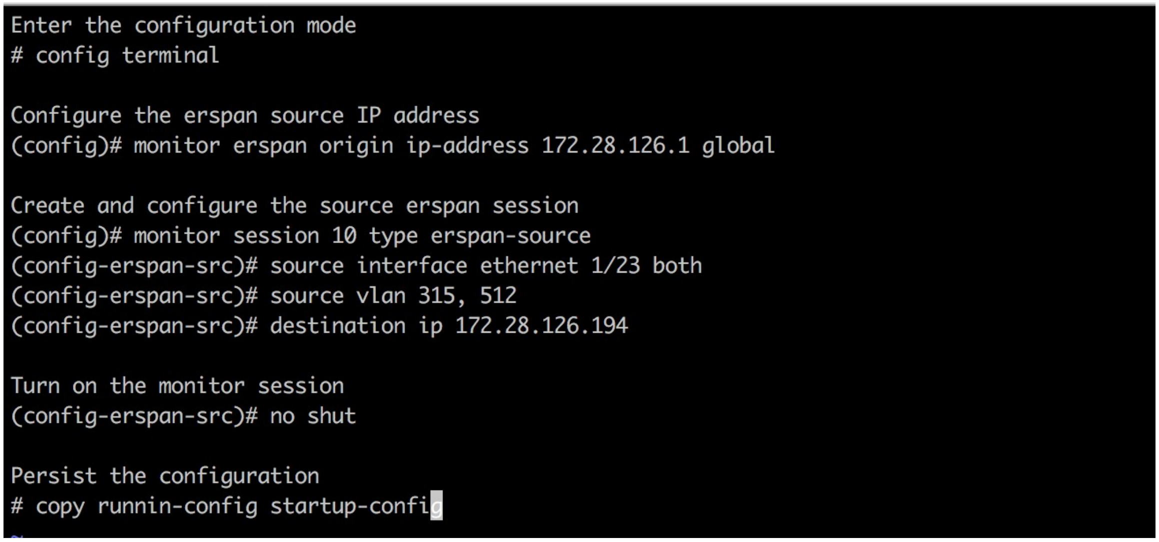
Note The ERSPAN connector's status will be reported back to the Connector page. See the Agent List page and check the corresponding SPAN agents state.

For more information about required virtual appliances, see Virtual Appliances for Connectors. For ERSPAN connectors, IPv4 and IPv6 (dual stack mode) addresses are supported. However, do note that dual stack support is a BETA feature.

How to configure the source ERSPAN session

The following steps are for a Nexus 9000 switch. The configurations may slightly differ for other Cisco platforms. For configuring a Cisco platform, see the Cisco Secure Workload User Guide.

Figure 56: Configuring ERSPAN source on Cisco Nexus 9000



```
Enter the configuration mode
# config terminal

Configure the erspan source IP address
(config)# monitor erspan origin ip-address 172.28.126.1 global

Create and configure the source erspan session
(config)# monitor session 10 type erspan-source
(config-erspan-src)# source interface ethernet 1/23 both
(config-erspan-src)# source vlan 315, 512
(config-erspan-src)# destination ip 172.28.126.194

Turn on the monitor session
(config-erspan-src)# no shut

Persist the configuration
# copy runnin-config startup-config
```

The above steps created a source ERSPAN session with id 10. The switch will mirror the frames ingressing and egressing (both) the interface eth1/23 and the ones on VLANS 315 and 512. The outer GRE packet carrying the mirrored frame will have source IP 172.28.126.1 (must be the address of a L3 interface on this switch) and destination IP 172.28.126.194. This is one of the IP addresses configured on the ERSPAN VM.

Supported ERSPAN formats

The Secure Workload SPAN Agents can process ERSPAN type I, II and III packets described in the proposed ERSPAN RFC. Therefore they can process ERSPAN packets generated by Cisco devices. Among the non

RFC compliant formats, they can process the ERSPAN packets generated by VMware vSphere Distributed Switch (VDS).

Performance considerations when configuring ERSPAN source

Carefully choose the ERSPAN source’s port/VLAN list. Although the SPAN agent has two dedicated vCPUs, the session may generate considerable amount of packets which could saturate the processing power of the agent. If an agent is receiving more packets than it can process, it will be shown in the Agent Packet Misses graph on the cluster’s Deep Visibility Agent page.

More fine grained tuning on which frames the ERSPAN source will mirror can be achieved with ACL policies, usually via the filter configuration keyword.

If the switch supports it, the ERSPAN source session can be configured to modify the maximum transport unit (MTU) of the ERSPAN packet (commonly the default value 1500 bytes), usually via a mtu keyword. Deacreasing it will limit the ERSPAN bandwidth usage in your network infrastructure, but it will have no effect on the SPAN Agent load, given the agent’s workload is on a per-packet basis. When reducing this value, allow room for 160 bytes for the mirrored frame. For the ERSPAN header overhead details, see the proposed ERSPAN RFC.

There are three versions of ERSPAN. The smaller the version, the lower the ERSPAN header overhead. Version II and III allow for applying QOS policies to the ERSPAN packets, and provide some VLAN info. Version III carries even more settings. Version II is usually the default one on Cisco switches. While Secure Workload SPAN Agents support all three versions, at the moment they do not make use of any extra information the ERSPAN version II and III packets carry.

Security considerations

The Ingest Virtual Machine for ERSPAN guest Operating System is CentOS 7.9, from which OpenSSL server/clients packages were removed.

Note CentOS 7.9 is the guest operating system for Ingest and Edge virtual appliances in Secure Workload 3.8.1.19 and earlier releases. Starting Secure Workload 3.8.1.36, the operating system is AlmaLinux 9.2.

Once the VM is booted and the SPAN agent containers are deployed (this takes a couple of minutes on first time boot only), no network interfaces, besides the loopback, will be present in the Virtual Machine. Therefore the only way to access the appliance is via its console.

The VM network interface are now moved inside the Docker containers. The containers run a centos:7.9.2009 based Docker image with no TCP/UDP port open.

Note Starting Secure Workload 3.8.1.36, the containers run almalinux/9-base:9.2.

Also, the containers are run with the base privileges (no –privileged option) plus the NET_ADMIN capability.

In the unlikely case a container is compromised, the VM guest OS should not be compromisable from inside the container.

All the other security consideration valid for Secure Workload Agents running inside a host do also apply to the Secure Workload SPAN Agents running inside the Docker containers.

Troubleshooting

Once SPAN Agents show in active state in the cluster Monitoring/Agent Overview page, no action is needed on the ERSPAN Virtual Machine, user does not need to log into it. If that is not happening or if the flows are not reported to the cluster, following information will help pinpoint deployment problems.

In normal conditions, on the VM:

- `systemctl status tet_vm_setup` reports an *inactive* service with *SUCCESS* exit satus;
- `systemctl status tet-nic-driver` reports an *active* service;
- `docker network ls` reports five networks: `host, none` and three `erspan-<iface name>;`
- `ip link` only reports the loopback interface;
- `docker ps` reports three running containers;
- `docker logs <cid>` for each container contains the message:`INFO success: tet-sensor entered RUNNING state, process has stayed up for > than 1 seconds (startsecs)`
- `docker exec <cid> ifconfig` reports only one interface, besides the loopback;
- `docker exec <cid> route -n` reports the default gateway;
- `docker exec <cid> iptables -t raw -S PREROUTING` reports the rule `-A PREROUTING -p gre -j DROP;`

If any of the above does not hold true, check the deployment script logs in `/local/tetration/logs/tet_vm_setup.log` for the reason why the SPAN agent containers deployment failed.

Any other agent registration/connectivity issue can be troubleshooted the same way it is done for agents running on a host via the *docker exec* command:

- `docker exec <cid> ps -ef` reports the two `tet-engine, tet-engine check_conf` instances and two `/usr/local/tet/tet-sensor -f /usr/local/tet/conf/.sensor_config` instances, one with root user and one with tet-sensor user, along with the process manager `/usr/bin/ python /usr/bin/supervisord -c /etc/supervisord.conf -n` instance.
- `docker exec <cid> cat /usr/local/tet/log/tet-sensor.log` shows the agent's logs;
- `docker exec <cid> cat /usr/local/tet/log/fetch_sensor_id.log` shows the agent's registration logs;
- `docker exec <cid> cat /usr/local/tet/log/check_conf_update.log` shows the configuration update polling logs;

  If necessary, traffic to/from the container can be monitored with tcpdump after setting into the container's network namespace:

  1. Retrieve the container's network namespace (SandboxKey) via docker inspect <cid> | grep SandboxKey;
  2. Set into the container's network namespace nsenter --net=/var/run/docker/netns/...;
  3. Monitor eth0 traffic tcpdump -i eth0 -n.

Limits

Metric	Limit
Maximum number of ERSPAN connectors on one Secure Workload Ingest appliance	3
Maximum number of ERSPAN connectors on one Tenant (rootscope)	24 (12 for TaaS)
Maximum number of ERSPAN connectors on Secure Workload	450

Connectors for Endpoints

Connectors for endpoints provide endpoint context for Secure Workload.

Connector	Description	Deployed on Virtual Appliance
AnyConnect	Collect telemetry data from Cisco AnyConnect Network Visibility Module (NVM) and enrich endpoint inventories with user attributes	Secure Workload Ingest
ISE	Collect information about endpoints and inventories managed by Cisco ISE appliances and enrich endpoint inventories with user attributes and secure group labels (SGL).	Secure Workload Edge

For more information about required virtual appliances, see Virtual Appliances for Connectors.

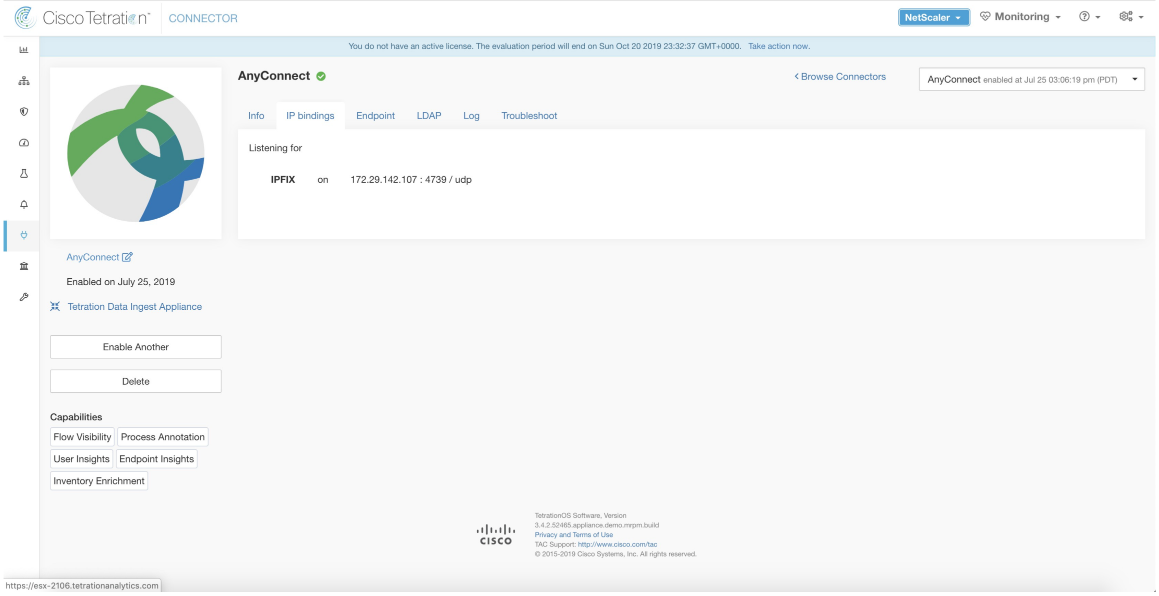
AnyConnect Connector

AnyConnect connector monitors endpoints that run Cisco AnyConnect Secure Mobility Client with Network Visibility Module (NVM). Using this solution, the hosts do not need to run any software agents on endpoints, because NVM sends host, interface, and flow records in IPFIX format to a collector (e.g., AnyConnect connector).

AnyConnect connector does the following high-level functions.

1. Register each endpoint (supported user devices such as a desktop, a laptop, or a smartphone) on Cisco Secure Workload as an AnyConnect agent.
2. Update interface snapshots from these endpoints with Secure Workload.
3. Send flow information exported by these endpoints to Secure Workload collectors.
4. Periodically send process snapshots for processes that generate flows on the endpoints tracked by the AnyConnect connector.
5. Label endpoint interface IP addresses with Lightweight Directory Access Protocol (LDAP) attributes corresponding to the logged-in-user at each endpoint.

Figure 57: AnyConnect connector



You do not have an active license. The evaluation period will end on Sun Oct 20 2019 23:32:37 GMT+0000. Take action now.

AnyConnect

AnyConnect enabled at Jul 25 03:06:19 pm (PDT)

Listening for

IPFIX on 172.29.142.107 : 4739 / udp

AnyConnect

Enabled on July 25, 2019

Tetration Data Ingest Appliance

Capabilities

Flow Visibility | Process Annotation | User Insights | Endpoint Insights | Inventory Enrichment

TetrationOS Software, Version
3.4.2.52465.appliance.demo.mrpm.build
Privacy and Terms of Use
TAC Support: http://www.cisco.com/tac
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https://esx-2106.tetrationanalytics.com

What is AnyConnect NVM

AnyConnect NVM provides visibility and monitoring of endpoint and user behavior both on and off premises. It collects information from endpoints that includes the following context.

1. **Device/Endpoint Context**: Device/endpoint specific information.
2. **User Context**: Users associated with the flow.
3. **Application Context**: Processes associated with the flow.
4. **Location Context**: Location specific attributes -if available.
5. **Destination Context**: FQDN of the destination. AnyConnect NVM generates 3 types of records.

NVM Record	Description
Endpoint Record	Device/endpoint information including unique device identifier (UDID), hostname, OS name, OS version and manufacturer.
Interface Record	Information about each interface in the endpoint including the endpoint UDID, interface unique identifier (UID), interface index, interface type, interface name, and MAC address.
Flow Record	Information about flows seen on the endpoint including endpoint UDID, interface UID, 5-tuple (source/destination ip/port and protocol), in/out byte counts, process information, user information, and fqdn of the destination.

Each record is generated and exported in IPFIX protocol format. When the device is in a trusted network (on-premise/VPN), AnyConnect NVM exports records to a configured collector. AnyConnect connector is an example IPFIX collector that can receive and process IPFIX stream from AnyConnect NVM.

Note AnyConnect connector supports AnyConnect NVM from 4.2+ versions of Cisco AnyConnect Secure Mobility Client.

How to configure AnyConnect NVM

See How to Implement AnyConnect NVM document for step by step instructions on how to implement AnyConnect NVM using either Cisco Secure Firewall ASA or Cisco Identity Services engine (ISE). Once NVM module is deployed, an NVM profile should be specified and pushed to and installed on the endpoints running Cisco AnyConnect Secure Mobility Client. When specifying NVM profile, the IPFIX collector should be configured to point to AnyConnect connector on port 4739.

AnyConnect connector also registers with Secure Workload as a Secure Workload AnyConnect Proxy agent.

Processing NVM records

AnyConnect connector processes AnyConnect NVM records as shown below.

Endpoint Record

Upon receiving an endpoint record, AnyConnect connector registers that endpoint as AnyConnect agent on Secure Workload. AnyConnect connector uses the endpoint specific information present in the NVM record along with AnyConnect connector’s certificate to register the endpoint. Once an endpoint is registered, data-plane for the endpoint is enabled by creating a new connection to one of the collectors in Secure Workload. Based on the activity (flow records) from this endpoint, AnyConnect connector checks-in the AnyConnect agent corresponding to this endpoint with the cluster periodically (20-30 minutes).

AnyConnect NVM starts to send agent version from 4.9. By default, the AnyConnect endpoint would be registered as version 4.2.x on Secure Workload. This version indicates the minimum supported AnyConnect NVM version. For the AnyConnect endpoints with version 4.9 or newer, the corresponding AnyConnect agent on Secure Workload would show the actual version installed.

Note The AnyConnect agent installed version is not controlled by Secure Workload. Attempting to upgrade the AnyConnect endpoint agent on Secure Workload UI would not take effect.

Interface Record

Interface Record IP address for an interface is not part of the AnyConnect NVM interface record. IP address for an interface is determined when flow records start coming from the endpoint for that interface. Once IP address is determined for an interface, AnyConnect connector sends a complete snapshot of all interfaces of that endpoint whose IP address is determined to config server of Secure Workload. This associates the VRF with the interface data and flows coming in on these interfaces will now be marked with this VRF.

Flow Record

Upon receiving a flow record, AnyConnect connector translates the record to the format that Secure Workload understands and sends FlowInfo over the dataplane corresponding to that endpoint. Furthermore, it stores process information included in the flow record locally. In addition, if LDAP configuration is provided to AnyConnect connector, it determines values for configured LDAP attributes of the logged-in-user of the endpoint. The attributes are associated to the endpoint IP address where the flow happened. Periodically, process information and user labels are pushed to Secure Workload.

Note Each AnyConnect connector will report only endpoints/interfaces/ flows for one VRF. The endpoints and interfaces reported by AnyConnect connector are associated with the VRF based on the Agent VRF configuration in Secure Workload. The flows exported by the AnyConnect connector agent on behalf of the AnyConnect endpoint belong to the same VRF. To configure the VRF for the agent, go to: **Manage** > **Agents** and click the **Configuration** tab. In this page, under “Agent Remote VRF Configurations” section, click “Create Config” and provide the details about the AnyConnect connector. The form requests the user to provide: the name of the VRF, IP subnet of the host on which the agent is installed, and range of port numbers that can potentially send flow records to the cluster.

Duplicate UDIDs in Windows Endpoints

If endpoint machines are cloned from the same golden image, it is possible that the UDID of all cloned endpoints are identical. In such cases, AnyConnect connector receives endpoint records from these endpoints with identical UDID and registers them on Secure Workload with same UDID. When interface/flow records are received by the connector from these endpoints, it is impossible for the connector to determine the correct AnyConnect agent on Secure Workload to associate the data. The connector associates all the data to one endpoint (and it is not deterministic).

To deal with this problem, AnyConnect NVM 4.8 release ships a tool called *dartcli.exe* to find and regenerate UDID on the endpoint.

- *dartcli.exe -u* retrieves the UDID of the endpoint.
- *dartcli.exe -nu* regenerates the UDID of the endpoint. To run this tool, use the following steps.

```
    C:\Program Files (x86)\Cisco\Cisco AnyConnect Secure Mobility Client\DART>dartcli.exe
-u
    UDID : 8D0D1E8FA0AB09BE82599F10068593E41EF1BFFF

    C:\Program Files (x86)\Cisco\Cisco AnyConnect Secure Mobility Client\DART>dartcli.exe
-nu
    Are you sure you want to re-generate UDID [y/n]: y
    Adding nonce success
    UDID : 29F596758941E606BD0AFF49049216ED5BB9F7A5

    C:\Program Files (x86)\Cisco\Cisco AnyConnect Secure Mobility Client\DART>dartcli.exe
-u
    UDID : 29F596758941E606BD0AFF49049216ED5BB9F7A5
```

Periodic Tasks

Periodically, AnyConnect connector sends process snapshots and user labels on AnyConnect endpoint inventories.

1. **Process Snapshots**: every 5 minutes, AnyConnect connector walks through the processes it maintains locally for that interval and sends process snapshot for all the endpoints that had flows during that interval.
2. **User Labels**: every 2 minutes, AnyConnect connector walks through the LDAP user labels it maintains locally and updates User Labels on those IP addresses.

For user labels, AnyConnect connector creates a local snapshot of LDAP attributes of all users in the organization. When AnyConnect connector is enabled, configuration for LDAP (server/port information, attributes to fetch for a user, attribute that contains the username) may be provided. In addition, the LDAP user credentials to access LDAP server may be provided. LDAP user credentials are encrypted and never revealed in the AnyConnect connector. Optionally, an LDAP certificate may be provided for securely accessing LDAP server.

Note AnyConnect connector creates a new local LDAP snapshot every 24 hours. This interval is configurable in LDAP configuration of the connector.

How to Configure the Connector

For information about required virtual appliances, see Virtual Appliances for Connectors. The following configurations are allowed on the connector.

- *LDAP*: LDAP configuration supports discovery of LDAP attributes and provide a workflow to pick the attribute that corresponds to username and a list of up to 6 attributes to fetch for each user. For more information, see Discovery.
- *Endpoint*: For more information, see Endpoint Configuration.
- *Log*: For more information, see Log Configuration.

In addition, the listening ports of IPFIX protocol on the connector can be updated on the Docker container in Secure Workload Ingest appliance using an allowed command. This command can be issued on the appliance by providing the connector ID of the connector, type of the port to be update, and the new port information. The connector ID can be found on the connector page in Secure Workload UI. For more information, see update-listening-ports.

Limits

Metric	Limit
Maximum number of AnyConnect connectors on one Secure Workload Ingest appliance	1
Maximum number of AnyConnect connectors on one Tenant (rootscope)	50
Maximum number of AnyConnect connectors on Secure Workload	500

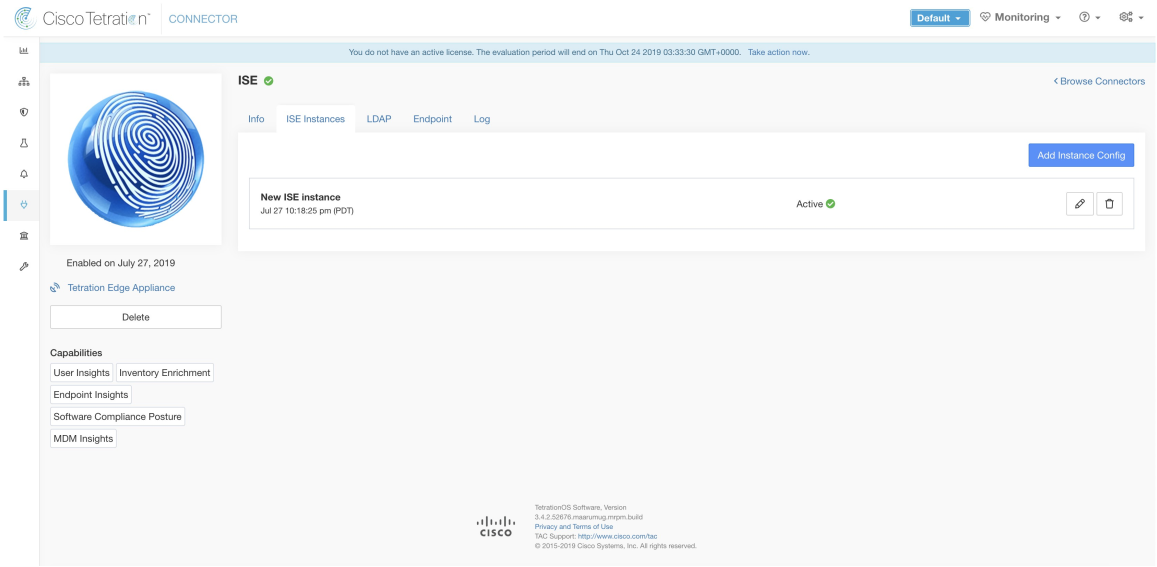
ISE Connector

The ISE connector in Secure Workload connects with Cisco Identity Services Engine (ISE) and ISE Passive Identity Connector (ISE-PIC) using the Cisco Platform Exchange Grid (pxGrid), to retrieve contextual information, such as metadata, for endpoints reported by ISE.

An ISE connector performs these functions:

1. Registers each endpoint that are identified as an ISE endpoint on Secure Workload.
2. Updates metadata information on Secure Workload regarding the endpoints, such as MDM details, authentication, Security Group labels, ISE group name, and ISE group type.
3. Periodically takes a snapshot and updates the cluster with active endpoints visible on the ISE.

Figure 58: ISE connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

New ISE instance
Jul 27 10:18:25 pm (PDT)
Active

TetrationOS Software, Version
3.4.2.52676.maarumug.mrpm.build
Privacy and Terms of Use
TAC Support: http://www.cisco.com/tac
© 2015-2019 Cisco Systems, Inc. All rights reserved.

Note Each ISE connector will register only endpoints and interfaces for one VRF. The endpoints and interfaces reported by ISE connector are associated with the VRF based on the Agent VRF configuration in Secure Workload. To configure the VRF for the agent, go to: **Manage** > **Workloads** > **Agents** and click the **Configuration** tab. In this page, under the **Agent Remote VRF Configurations** section, click **Create Config** and provide the details about the ISE connector. The form requests the user to provide: the name of the VRF, IP subnet of the host on which the agent is installed, and range of port numbers that can potentially register ISE endpoints and interfaces on Secure Workload.

Note The ISE endpoint agents are not listed on the Agents List page; instead ISE endpoints with the attributes can be viewed on the Inventory page.

How to Configure the Connector

Note ISE version 2.4+ and ISE PIC version 3.1+ are required for this integration.

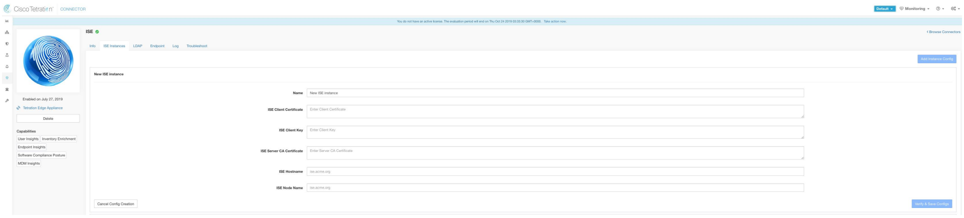
For information about required virtual appliances, see Virtual Appliances for Connectors. For ISE connectors, IPv4 and IPv6 (dual stack mode) addresses are supported. However, do note that dual stack support is a BETA feature.

The following configurations are allowed on the connector.

- *ISE Instance*: ISE connector can connect to multiple instances of ISE using provided configurations. Each instance requires ISE certificate credentials along with hostname and nodename to connect to ISE. For more information, see ISE Instance Configuration.
- *LDAP*: LDAP configuration supports discovery of LDAP attributes and provides a workflow to select the attribute that corresponds to username and a list of up to six attributes to fetch for each user. For more information, see Discovery.
- *Endpoint*: For more information, see Endpoint Configuration.
- *Log*: For more information, see Endpoint Configuration.

ISE Instance Configuration

Figure 59: ISE instance config



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

New ISE instance

Name: New ISE instance
ISE Client Certificate: Enter Client Certificate
ISE Client Key: Enter Client Key
ISE Server CA Certificate: Enter Server CA Certificate
ISE Hostname: ise.acme.org
ISE Node Name: ise.acme.org

Note Starting Cisco Secure Workload version 3.7, the SSL certificate for Cisco ISE pxGrid node requires Subject Alternative Names (SAN) for this integration. Ensure the certification configuration of the ISE nodes is done by your ISE administrator prior to performing the integration with Secure Workload.

To verify your pxGrid node's certificate and confirm if SAN is configured, you need to do the following to verify the certificate from ISE.

Procedure

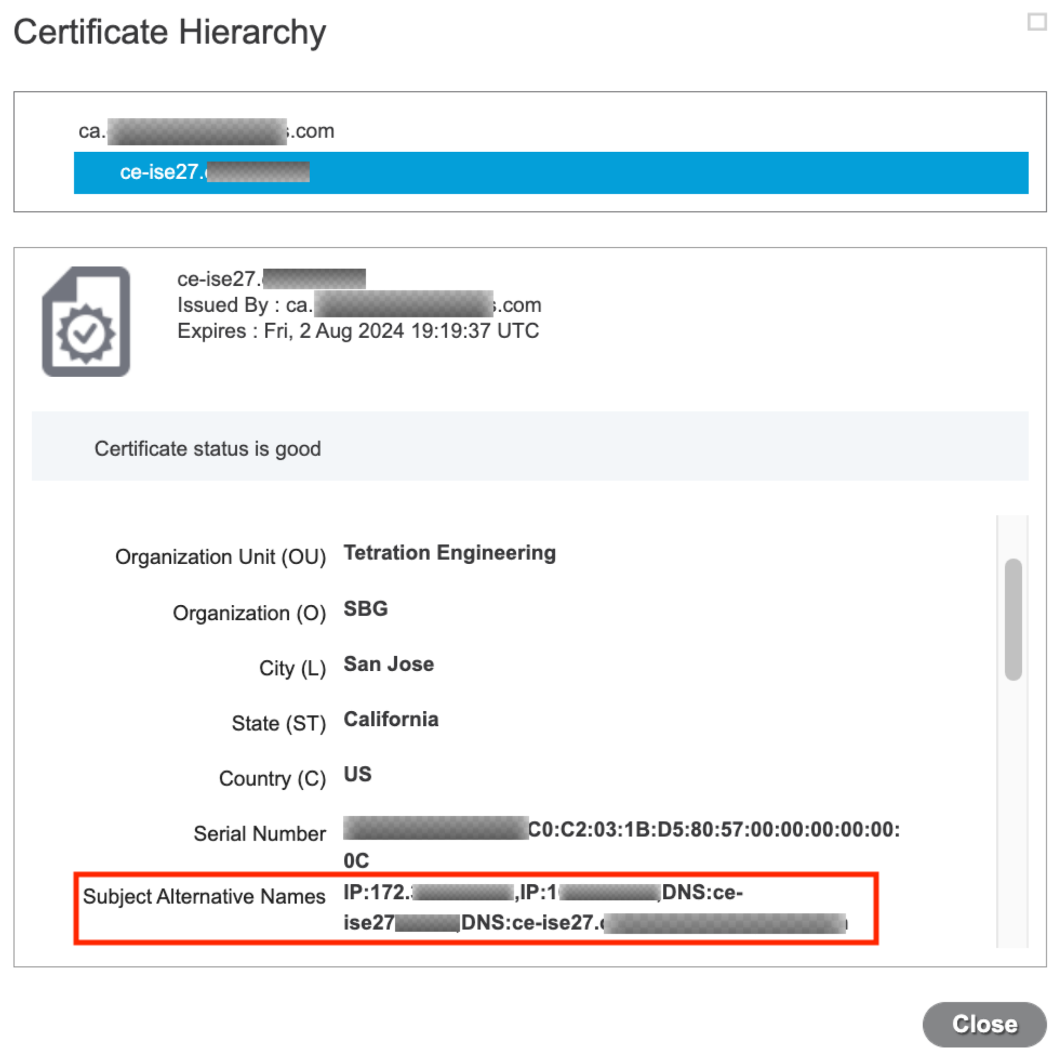
Step 1 Go to **Certificates** under **Administration** > **System**.

Step 2 Under **Certificate Management**, select **System Certificates**, select your "Used by" pxGrid certificate and choose **View** to review the pxGrid node cert.

Step 3 Scroll the certificate and ensure the Subject Alternative Names are configured for this certificate.

Step 4 This certificate should be signed by a valid Certificate Authority (CA), which should also be used to sign the pxGrid client certificate used for the Secure Workload ISE connector.

Figure 60: Example of a valid ISE pxGrid node



Certificate Hierarchy

ca.[redacted].com
ce-ise27.[redacted]

ce-ise27.[redacted]
Issued By : ca.[redacted].com
Expires : Fri, 2 Aug 2024 19:19:37 UTC

Certificate status is good

Organization Unit (OU)	Tetration Engineering
Organization (O)	SBG
City (L)	San Jose
State (ST)	California
Country (C)	US
Serial Number	[redacted]C0:C2:03:1B:D5:80:57:00:00:00:00:00:0C
Subject Alternative Names	IP:172.[redacted],IP:1[redacted]DNS:ce-ise27[redacted]DNS:ce-ise27.[redacted]

Step 5 You can now generate the pxGrid client certificate signing request using the following template on any host installed with OpenSSL.

```
[req]
distinguished_name = req_distinguished_name
req_extensions = v3_req
x509_extensions = v3_req
prompt = no
[req_distinguished_name]
C = YOUR_COUNTRY
ST = YOUR_STATE
L = YOUR_CITY
O = YOUR_ORGANIZATION
OU = YOUR_ORGANIZATION_UNIT
```

```
CN = ise-connector.example.com
[v3_req]
subjectKeyIdentifier = hash
basicConstraints = critical,CA:false
subjectAltName = @alt_names
keyUsage = critical,digitalSignature,keyEncipherment
extendedKeyUsage = serverAuth,clientAuth
[alt_names]
IP.1 = 10.x.x.x
DNS.1 = ise-connector.example.com
```

Save the file as ‘example-connector.cfg’ and use the OpenSSL command from your host to generate a Certificate Signing Request (CSR) and the certificate private key with the following command.

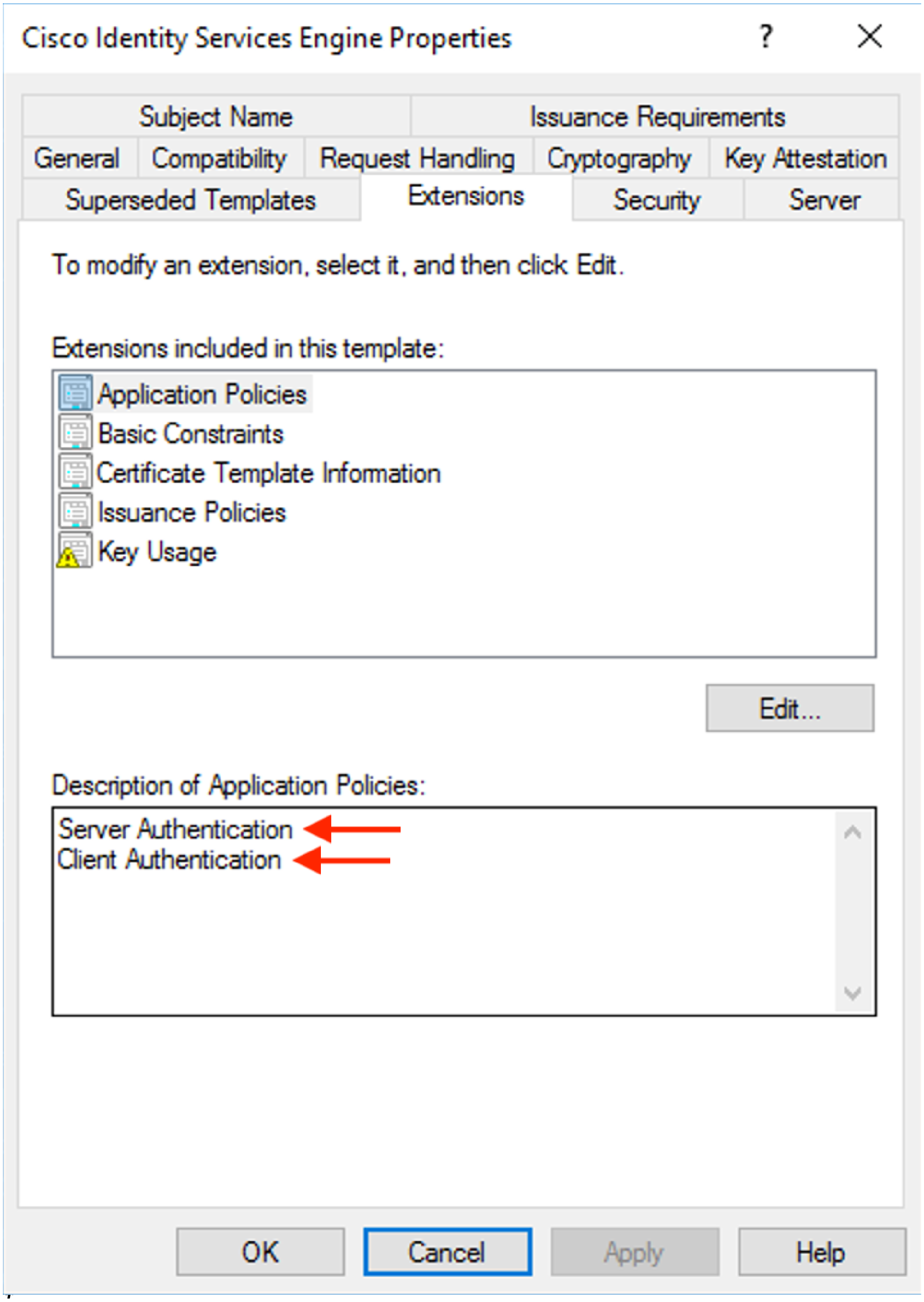
```
openssl req -newkey rsa:2048 -keyout example-connector.key -nodes -out example-connector.csr
 -config example-connector.cfg
```

Step 6 Sign the Certificate Signing Request (CSR) by your CA using a Windows CA server. If you are also using a Windows CA server, run the following command to sign the pxGrid client’s CSR.

```
certreq -submit -binary -attrib "CertificateTemplate:CiscoIdentityServicesEngine"
example-connector.csr example-connector.cer
```

Note Windows CA requires a Certificate Template. This template should contain the following extensions.

Figure 61: Extensions of Application Policies for a Certificate



To modify an extension, select it, and then click Edit.

Extensions included in this template:

- Application Policies
- Basic Constraints
- Certificate Template Information
- Issuance Policies
- Key Usage

Description of Application Policies:

Server Authentication
Client Authentication

Step 7 Copy the signed client certificate and the root CA in PEM format onto your host. This is the same host that generates the client CSR and the private key. Use OpenSSL to ensure the client certificate is in X.509 PEM format. Run the following command using OpenSSL to convert the signed client certificate to the X.509 PEM format.

```
openssl x509 -inform der -in example-connector.cer -out example-connector.pem
```

Step 8 You can also confirm the PEM that is signed by the CA, use the following command.

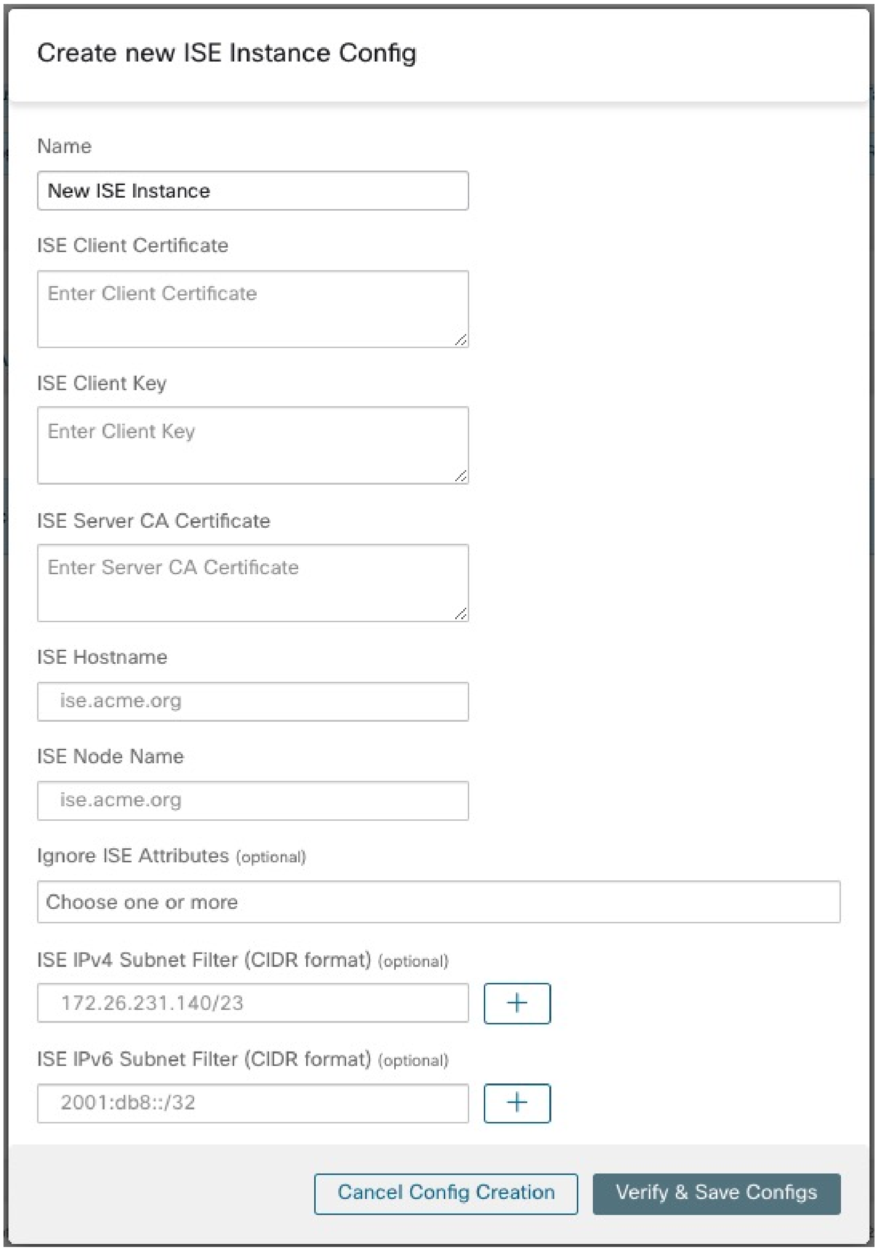
```
openssl verify -CAfile root-ca.example.com.pem example-connector.pem
example-connector.pem: OK
```

Note For multi-node ISE deployment with pxGrid, all the pxGrid nodes must trust the Certs used for the Secure Workload ISE Connector.

Step 9 Using the above example's file names, copy the ISE client cert - example-connector.pem, client key - example-connector.key and CA – root-ca.example.com.pem into the respective fields on the ISE configuration page on Secure Workload as shown below.

Note Before upgrading to the latest version of Secure Workload, ensure that you delete the ISE connector to remove any existing configuration data. After the upgrade is complete, configure the ISE connector with the new filters you want to apply.

Figure 62: ISE Connector Configuration



Create new ISE Instance Config

Name: New ISE Instance

ISE Client Certificate: Enter Client Certificate

ISE Client Key: Enter Client Key

ISE Server CA Certificate: Enter Server CA Certificate

ISE Hostname: ise.acme.org

ISE Node Name: ise.acme.org

Ignore ISE Attributes (optional): Choose one or more

ISE IPv4 Subnet Filter (CIDR format) (optional): 172.26.231.140/23

ISE IPv6 Subnet Filter (CIDR format) (optional): 2001:db8::/32

Table 16: ISE Connector Configuration

Field	Description
Name	Enter an ISE instance name.
ISE Client Certificate	Copy and paste ISE client certificate.
ISE Client Key	Copy and paste the ISE client key. The client key must be a clear key, which is not password protected.

Field	Description
ISE Server CA Certificate	Copy and paste Root CA certificate.
ISE Hostname	Enter ISE hostname (FQDN).
ISE Node Name	Enter ISE node name.
Ignore ISE Attributes (Optional)	Select one or more ISE attributes from the list. Use this option if you do not want to ingest all contextual information of endpoints reported through ISE.
ISE IPv4 Subnet Filter (CIDR Format) (Optional)	Enter multiple IPv4 subnets to filter ISE endpoints.
ISE IPv6 Subnet Filter (CIDR Format) (Optional)	Enter multiple IPv6 subnets to filter ISE endpoints.

Note

- If an IP Address is used instead of FQDN for the ISE Hostname, then use the IP address in the ISE CA certificate SAN, else, there may be connection failures.
- Number of active endpoints on ISE is not a snapshot, it depends on the configurations on ISE and the aggregation duration for computing the metric. The agent count on Secure Workload is always a snapshot based on last pull from ISE and pxgrid updates, typically the active device count over last one day (default refresh frequency for full snapshots is a day). Due to the difference in the way these numbers are depicted, it is possible that these two numbers will not always match.

Processing ISE records

ISE connector processes records as described below.

Endpoint Record

ISE connector connects to ISE instance and subscribes for any updates for endpoints over pxGrid. Upon receiving an endpoint record, ISE connector registers that endpoint as ISE agent on Secure Workload. ISE connector uses the endpoint specific information present in endpoint record along with ISE connector’s certificate to register the endpoint. Once an endpoint is registered. ISE connector uses the endpoint object for inventory enrichment by sending this as user labels on Secure Workload. When ISE connector gets a disconnected endpoint from ISE, it deletes the inventory enrichment from Secure Workload.

Security Group Record

ISE connect also subscribes for updates about Security Group Labels change via pxGrid. On receiving this record, ISE connectors maintains a local database. It uses this database to map SGT name with value on receiving an endpoint record.

Periodic Tasks

ISE connector periodically shares user labels on ISE endpoint inventories.

1. **Endpoint Snapshots**: Every 20 hours, ISE connector fetches a snapshot of endpoints and security group labels from ISE instance and updates the cluster if any change is detected. This call does not compute for endpoints that are disconnected in case we do not see endpoints on Secure Workload coming from ISE.
2. **User Labels**: Every 2 minutes, ISE connector scans through the LDAP user and ISE endpoint labels maintained locally and updates user labels on those IP addresses.

For user labels, ISE connector creates a local snapshot of LDAP attributes of all users in the organization. When ISE connector is enabled, configuration for LDAP (server/port information, attributes to fetch for a user, attribute that contains the username) may be provided. In addition, the LDAP user credentials to access LDAP server may be provided. LDAP user credentials are encrypted and never revealed in the ISE connector. Optionally, an LDAP certificate may be provided for securely accessing LDAP server.

Note ISE connector creates a new local LDAP snapshot every 24 hours. This interval is configurable in LDAP configuration of the connector.

Note On upgrading Cisco ISE device, ISE connector will need to be re-configured with new certifcates generated by ISE after upgrade.

Limits

Metric	Limit
Maximum number of ISE instances that can be configured on one ISE connector	20
Maximum number of ISE connectors on one Secure Workload Edge appliance	1
Maximum number of ISE connectors on one Tenant (rootscope)	1
Maximum number of ISE connectors on Secure Workload	150

Note Maximum number of ISE agents supported per connector is 400000.

Maximum number of ISE agents supported per connector is 20000. If there is a use case that requires support for more ISE agents, please contact Secure Workload support.

Connectors for Inventory Enrichment

Connectors for inventory enrichment provides additional meta-data and context about the inventories (IP addresses) monitored by Secure Workload.

Connector	Description	Deployed on Virtual Appliance
ServiceNow	Collect endpoint information from ServiceNow instance and enrich the inventory with ServiceNow attributes.	Secure Workload Edge
See also:	Cloud Connectors	–

For more information about required virtual appliances, see Virtual Appliances for Connectorss.

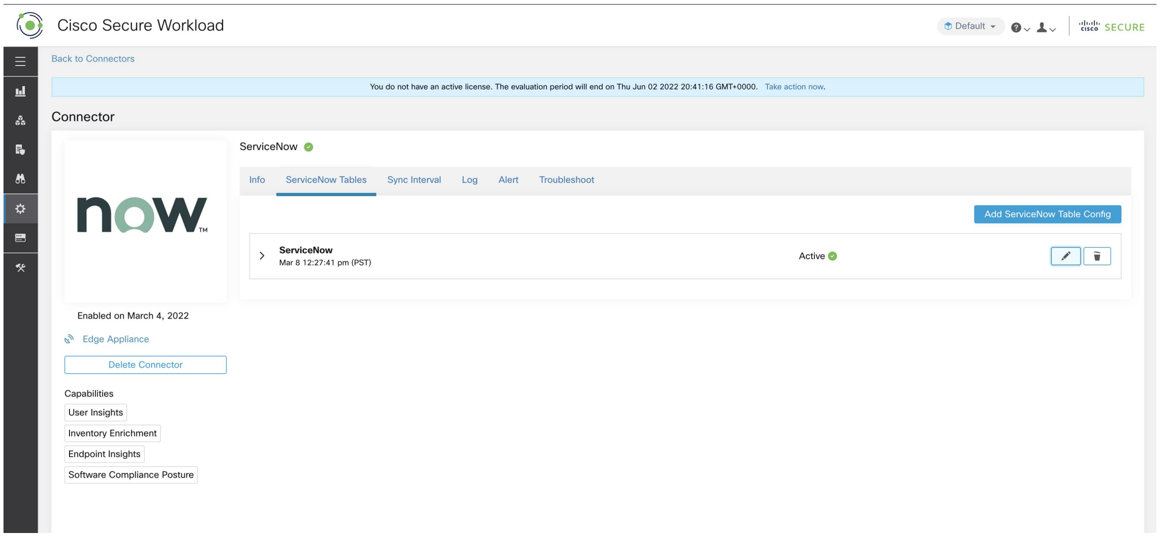
ServiceNow Connector

ServiceNow connector connects with ServiceNow Instance to get all the ServiceNow CMDB related labels for the endpoints in ServiceNow inventory. Using this solution, we can get enriched metadata for the endpoints in Cisco Secure Workload.

ServiceNow connector does the following high-level functions.

1. Update ServiceNow metadata in Secure Workload's inventory for these endpoints.
2. Periodically take snapshot and update the labels on these endpoints.

Figure 63: ServiceNow connector



You do not have an active license. The evaluation period will end on Thu Jun 02 2022 20:41:16 GMT+0000. Take action now.

How to Configure the ServiceNow Connector

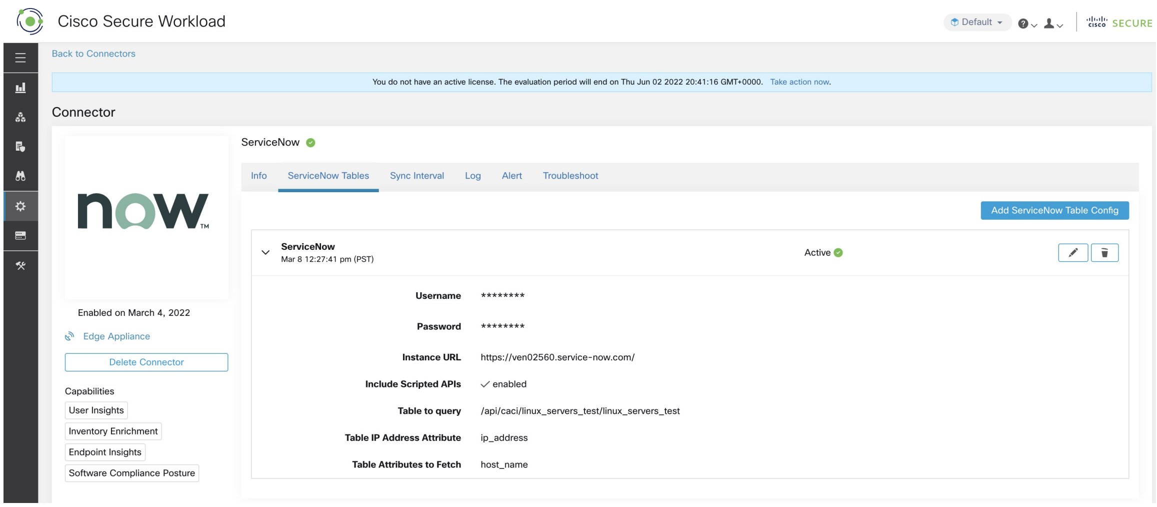
For information about required virtual appliances, see Virtual Appliances for Connectors. The following configurations are allowed on the connector.

- *ServiceNow Tables*: ServiceNow Tables configures the ServiceNow instance with it's credentials, and the information about ServiceNow tables to fetch the data from.
- *Scripted REST api*: ServiceNow scripted REST API tables can be configured similar to ServiceNow tables.

- *Sync Interval*: Sync Interval configuration allows to make change the periodicity at which Secure Workload should query ServiceNow instance for updated data.
- *Log*: For more information, see Log Configuration.

ServiceNow Instance Configuration

Figure 64: ServiceNow instance config



You do not have an active license. The evaluation period will end on Thu Jun 02 2022 20:41:16 GMT+0000. Take action now.

Enabled on March 4, 2022

ServiceNow
Mar 8 12:27:41 pm (PST)
Active

Username	********
Password	********
Instance URL	https://ven02560.service-now.com/
Include Scripted APIs	✓ enabled
Table to query	/api/caci/linux_servers_test/linux_servers_test
Table IP Address Attribute	ip_address
Table Attributes to Fetch	host_name

You will need the following items to successfully configure a ServiceNow instance.

1. ServiceNow username
2. ServiceNow password
3. ServiceNow Instance URL
4. Include Scripted APIs

Subsequently, Secure Workload performs a discovery of all the tables from the ServiceNow Instance and Scripted REST API's (only if Include Scripted APIs checkbox is enabled). It presents user with the list of tables to chose from, once a user selects table, Secure Workload fetches all the list of attributes from that table for the user to select. User has to chose the ip_address attribute from the table as the key. Subsequently, user can chose upto 10 unique attributes from the table. See the following figures for each step.

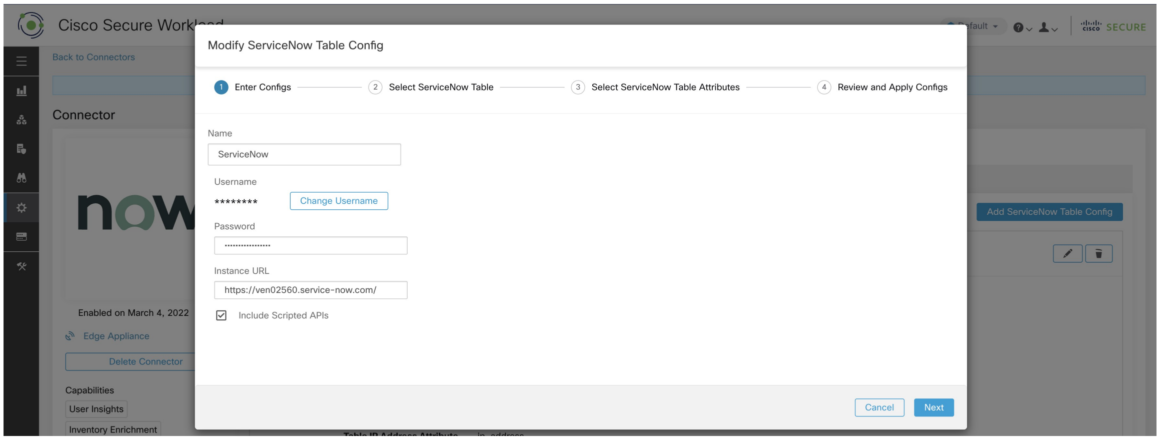
Note ServiceNow Connector can only support integrating with tables having **IP Address** field.

Note To integrate with ServiceNow Scripted REST API's you need to enable the Scripted APIs checkbox, which would give you a similar workflow to any other table.

Note For Scripted REST API's to integrate with ServiceNow Connector, they cannot have path parameters. Also, they need to support **sysparm_limit,sysparm_fields and sysparm_offset** as query parameters.

Note The ServiceNow user roles need to include **cmdb_read** for tables and **web_service_admin** for Scripted REST API's to integrate with Cisco Secure Workload.

Figure 65: ServiceNow instance config first step



Modify ServiceNow Table Config

1 Enter Configs — 2 Select ServiceNow Table — 3 Select ServiceNow Table Attributes — 4 Review and Apply Configs

Name: ServiceNow

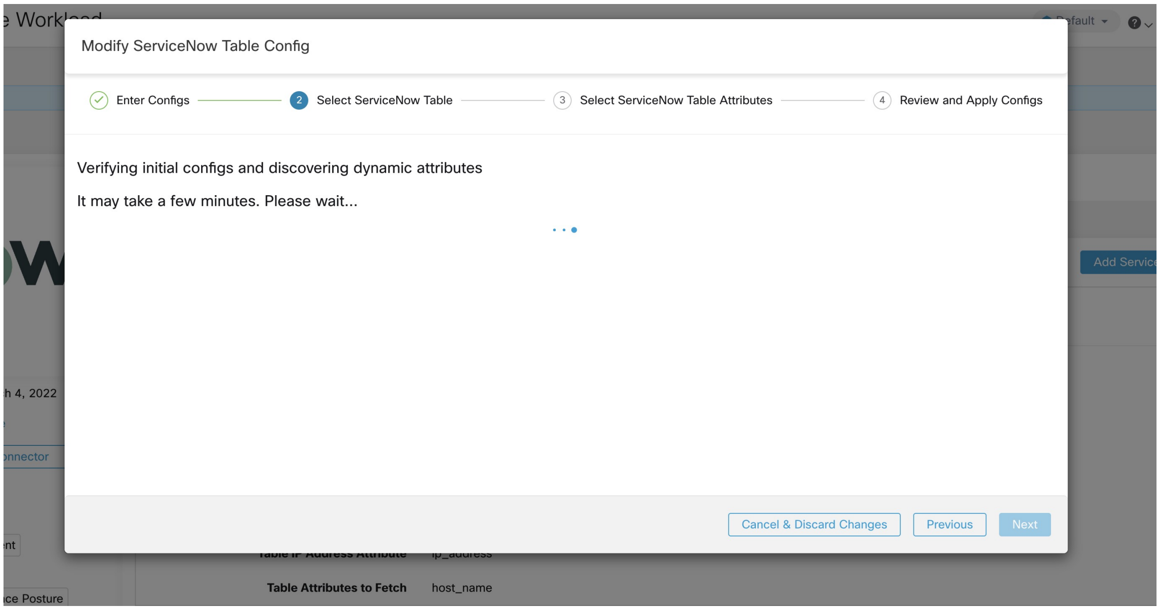
Username: ******** Change Username

Password: ··················

Instance URL: https://ven02560.service-now.com/

☑ Include Scripted APIs

Figure 66: Secure Workload Fetches the Table Info from ServiceNow Instance



Modify ServiceNow Table Config

✓ Enter Configs — 2 Select ServiceNow Table — 3 Select ServiceNow Table Attributes — 4 Review and Apply Configs

Verifying initial configs and discovering dynamic attributes

It may take a few minutes. Please wait...

Figure 67: Secure Workload presents the list of tables

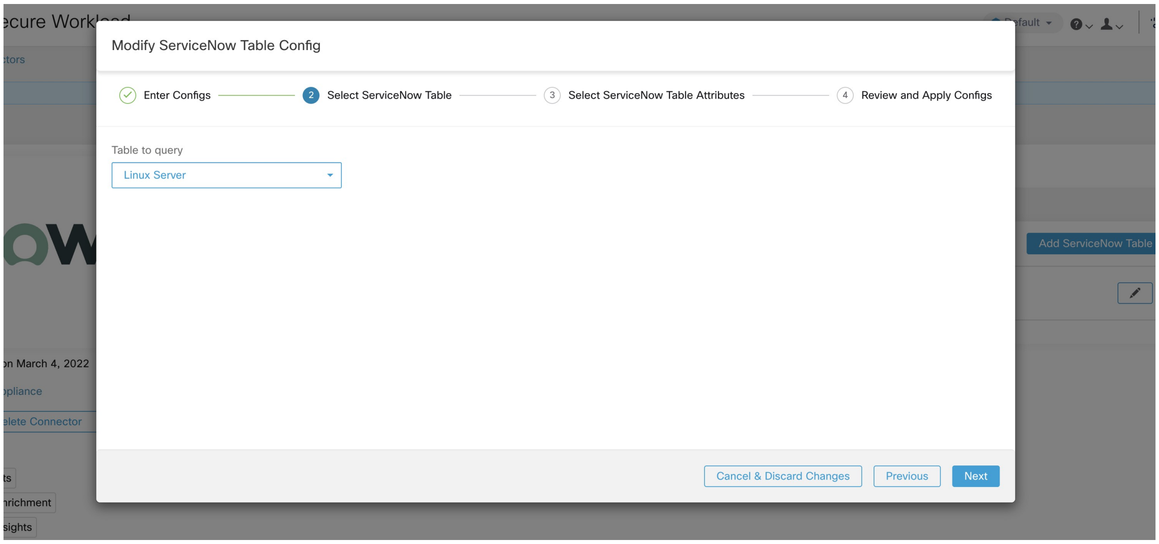

Modify ServiceNow Table Config
Enter Configs
2 Select ServiceNow Table
3 Select ServiceNow Table Attributes
4 Review and Apply Configs
Cancel & Discard Changes
Previous
Next
Add ServiceNow Table

Table to query

Linux Server

Figure 68: User selects the ip_address attribute, and other attribute in the table

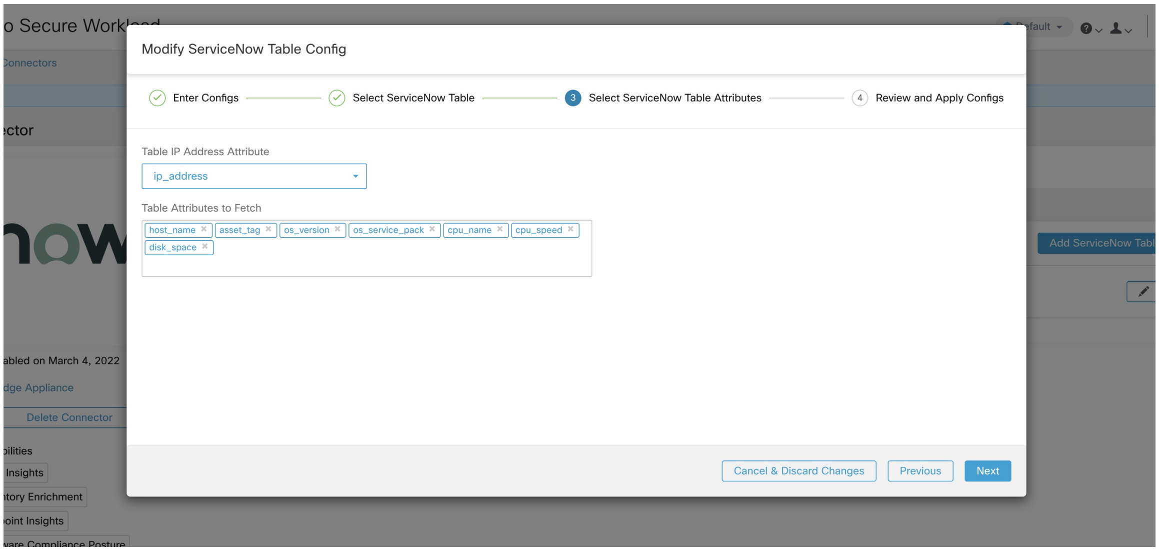

Modify ServiceNow Table Config
Enter Configs
Select ServiceNow Table
3 Select ServiceNow Table Attributes
4 Review and Apply Configs
Cancel & Discard Changes
Previous
Next
Add ServiceNow Table

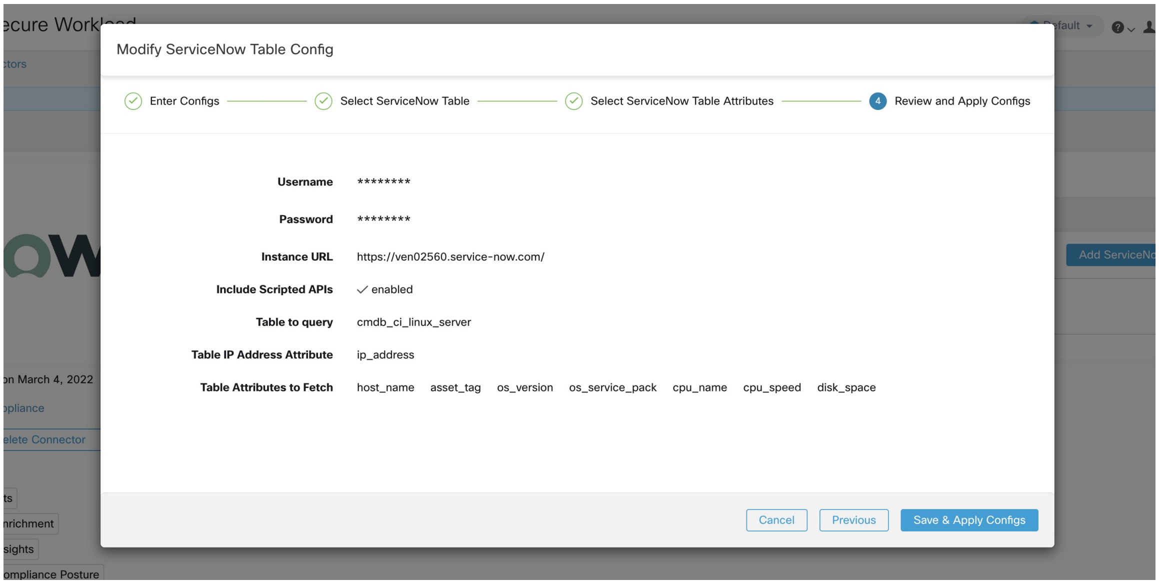
Table IP Address Attribute

ip_address

Table Attributes to Fetch

host_name ×, asset_tag ×, os_version ×, os_service_pack ×, cpu_name ×, cpu_speed ×, disk_space ×

Figure 69: User finalizes the ServiceNow config



Modify ServiceNow Table Config

✓ Enter Configs — ✓ Select ServiceNow Table — ✓ Select ServiceNow Table Attributes — 4 Review and Apply Configs

Username	********
Password	********
Instance URL	https://ven02560.service-now.com/
Include Scripted APIs	✓ enabled
Table to query	cmdb_ci_linux_server
Table IP Address Attribute	ip_address
Table Attributes to Fetch	host_name asset_tag os_version os_service_pack cpu_name cpu_speed disk_space

Processing ServiceNow records

Based on the instance url you gives in configuration, ServiceNow connector connects to ServiceNow Instance. ServiceNow Instance uses HTTP calls using `https://{Instance URL}/api/now/doc/table/schema`, to obtain the initial table schema from the ServiceNow Table API. Based on the configured Tables, it queries those tables to fetch the ServiceNow labels/metadata. Secure Workload annotates the ServiceNow labels to IP addresses in its inventory. ServiceNow connector periodically fetches new labels and updates Secure Workload inventory.

Note Secure Workload fetches records from ServiceNow tables periodically. This is configurable under SyncInterval tab in the ServiceNow connector. The default sync interval is 60 minutes. For cases where integrating with ServiceNow table with large number of entries, this sync interval should be set to a higher value.

Note Secure Workload will delete any entry not seen for 10 continuous sync intervals. In case the connection to ServiceNow instance is down for that long that could result in cleaning up of all labels for that instance.

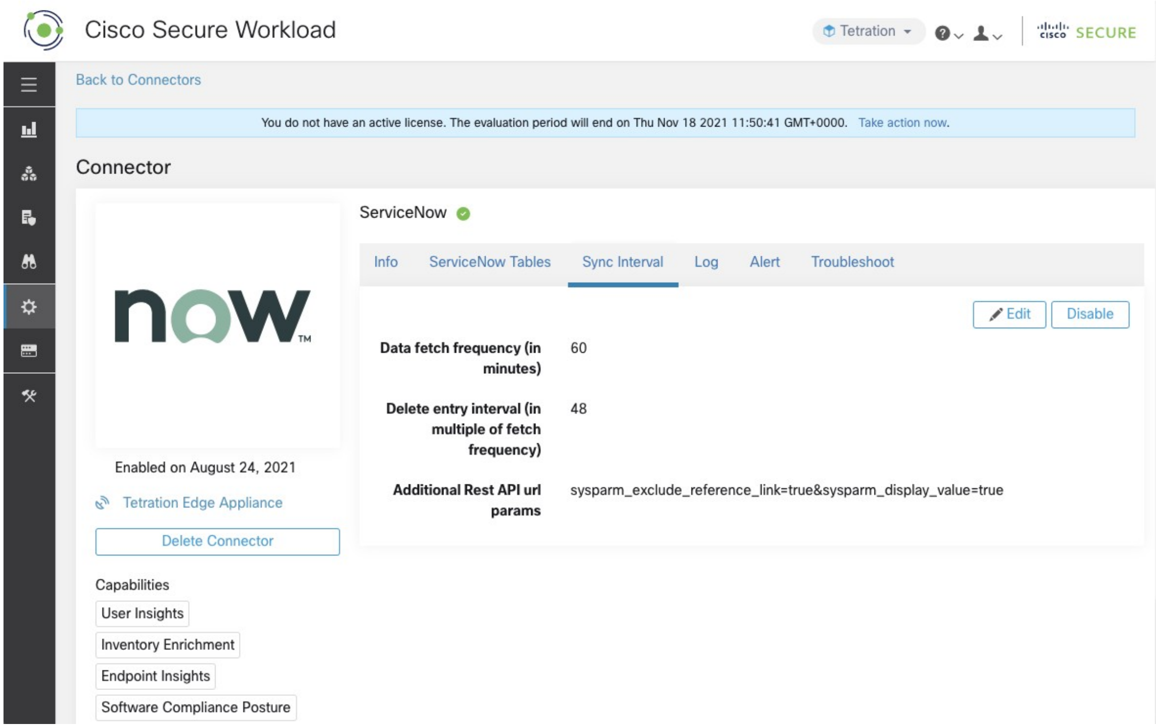
Sync Interval Configuration

1. Secure Workload ServiceNow connector provides a way to configure the frequency of sync between Secure Workload and ServiceNow instance. By default the sync interval is set to 60 minutes, but it can be changed under the sync interval configuration as **Data fetch frequency**.

2. For detecting deletion of a record, Secure Workload ServiceNow connector relies on syncs from ServiceNow instances. If an entry is not seen in 48 consecutive sync intervals, we go ahead and delete the entry. This can be configured under sync interval config as **Delete entry interval**.

3. If any additional parameters are to be passed when calling REST api's for ServiceNow tables, you can configre them as part of *Additional Rest API url params*. This configuration is optional. For example, to get a reference lookup from ServiceNow the following url parameters can be used **sysparm_exclude_reference_link=true&sysparm_display_value=true**

Figure 70: Sync Interval Configuration



You do not have an active license. The evaluation period will end on Thu Nov 18 2021 11:50:41 GMT+0000.

Enabled on August 24, 2021

Data fetch frequency (in minutes): 60

Delete entry interval (in multiple of fetch frequency): 48

Additional Rest API url params: sysparm_exclude_reference_link=true&sysparm_display_value=true

Explore Command to Delete the Labels

In case user wants to cleanup the labels for a particular IP for a given instance immediately, without waiting for delete interval, they can do so using an explore command. Here are the steps to run the command.

1. Finding vrf ID for a Tenant
2. Getting to Explore command UI
3. Running the commands

For TaaS cluster, contact TaaS Operation team to cleanup labels for ServiceNow labels.

Finding VRF ID for a Tenant

Site Admins and **Customer Support users** can access the **Tenant** page under the **Platform** menu in the navigation bar at the left side of the window. This page displays all of the currently configured Tenants and VRFs. For more information, see the Tenants section for more details.

On Tenants page, ID field of `Tenants` table is vrf ID for the Tenant.

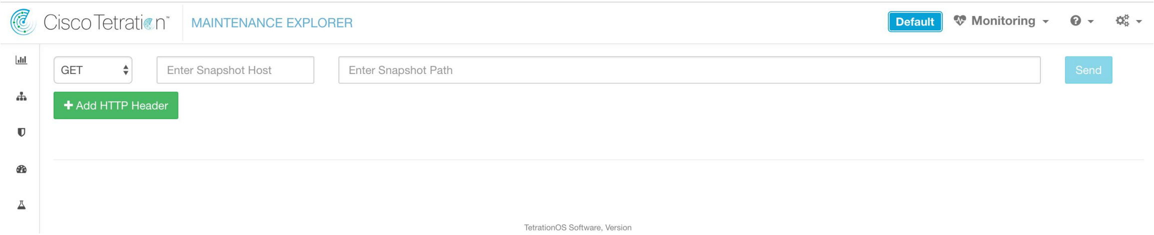
Getting to Explore Command UI

To reach the Maintenance Explorer command interface, choose **Troubleshoot** > **Maintenance Explorer** from the left navigation bar in the Secure Workload web interface.

Note Customer Support privileges are required to access explore menu. If explore tab does not show up, the account may not have needed permissions.

Click on explore tab in the drop down menu to get to the Maintenance Explorer page.

Figure 71: Maintenance Explorer tab



Running the Commands

- Choose the action as `POST`
- Enter snapshot host as `orchestrator.service.consul`
- Enter snapshot path

  To delete the labels for a particular IP for a `servicenow instance`:

  `servicenow_cleanup_annotations?args=<vrf-id> <ip_address> <instance_url> <table_name>`
- Click Send

Note If after deleting using explore command, we see the record show up in ServiceNow instace, it will be repopulated

Frequently Asked Questions

1. **What if ServiceNow CMDB table does not have IP address.**

   In such case, the recommendation is to create a View on ServiceNow which will have desired fields from current table along with IP address (potentially coming from a JOIN operation with another table). Once such a view is created, it can be used in place of table name.

2. **What if ServiceNow instance requires MFA.**

   Currently we do not support integrating with ServiceNow instance with MFA.

Limits

Metric	Limit
Maxumum number of ServiceNow instances that can be configured on one ServiceNow connector	20
Maximum number of attributes that can be fetched from one ServiceNow instance	10
Maximum number of ServiceNow connectors on one Secure Workload Edge appliance	1
Maximum number of ServiceNow connectors on one Tenant (rootscope)	1
Maximum number of ServiceNow connectors on Secure Workload	150

Connectors for Alert Notifications

Connectors for alert notifications enable Secure Workload to publish Secure Workload alerts on various messaging and logging platforms. These connectors run on TAN service on Secure Workload Edge Appliance.

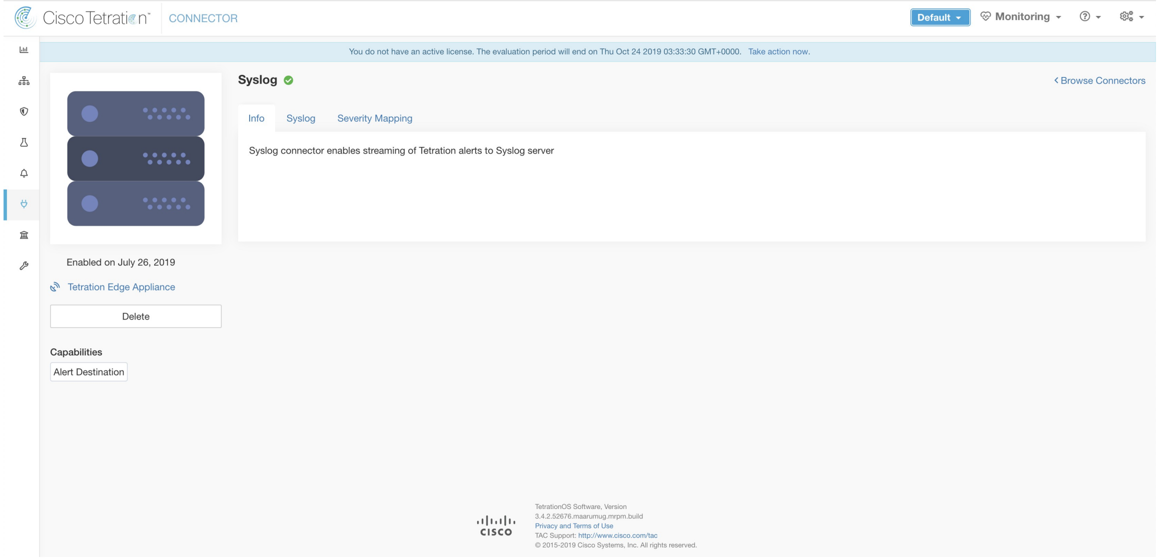
Connector	Description	Deployed on Virtual Appliance
Syslog	Send Secure Workload alerts to Syslog server.	Secure Workload Edge
Email	Send Secure Workload alerts on Email.	Secure Workload Edge
Slack	Send Secure Workload alerts on Slack.	Secure Workload Edge
Pager Duty	Send Secure Workload alerts on Pager Duty.	Secure Workload Edge
Kinesis	Send Secure Workload alerts on Amazon Kinesis.	Secure Workload Edge

For more information about required virtual appliances, see Virtual Appliances for Connectors.

Syslog Connector

When enabled, TAN service on Cisco Secure Workload Edge appliance can send alerts to Syslog server using configuration.

Figure 72: Syslog connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Syslog connector enables streaming of Tetration alerts to Syslog server

Enabled on July 26, 2019

TetrationOS Software, Version 3.4.2.52676.maarumug.mrpm.build

TAC Support: http://www.cisco.com/tac

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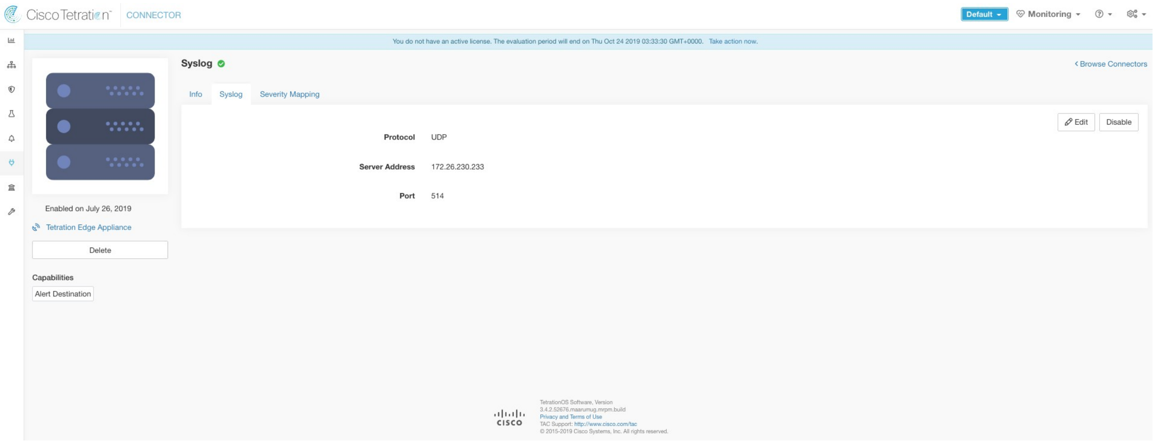
The following table explains the configuration details for publishing Secure Workload alerts on Syslog server.For more information, see Syslog Notifier Configuration.

Parameter Name	Type	Description
Protocol	dropdown	Protocol to use to connect to server
	•UDP	
	• TCP	
Server Address	string	IP address or hostname of the Syslog server
Port	number	Listening port of Syslog server. Default port value is 514.

Figure 73: Sample configuration for Syslog Connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Protocol UDP

Server Address 172.26.230.233

Port 514

Enabled on July 26, 2019

TetrationOS Software, Version 3.4.2.52676.maarumug.mrpm.build

TAC Support: http://www.cisco.com/tac

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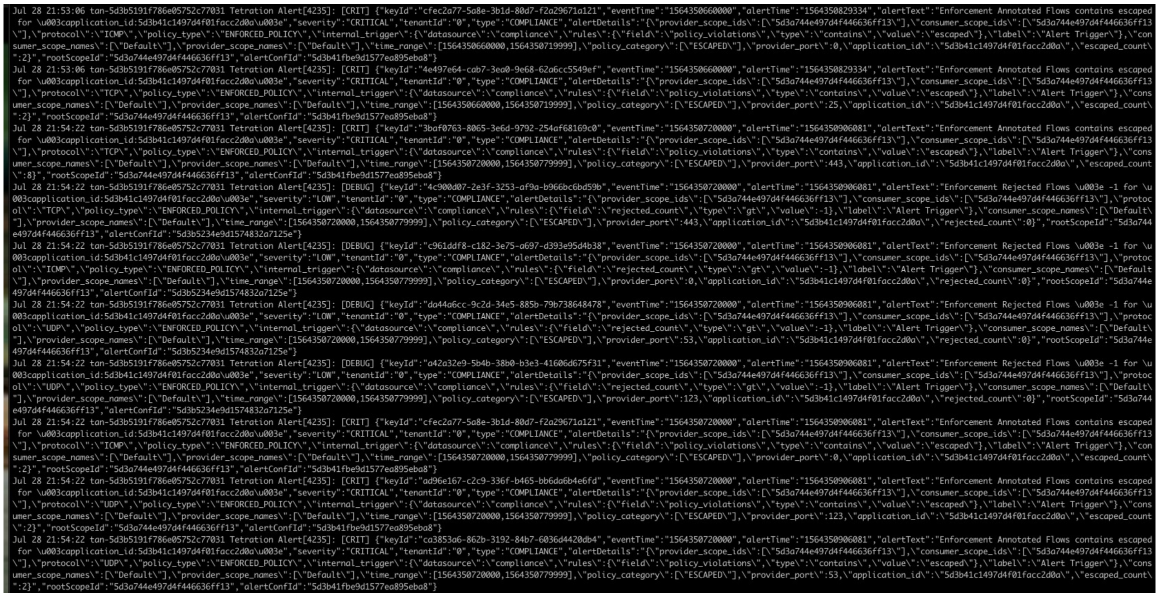
Figure 74: Sample alert



```
Jul 28 21:53:06 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [CRIT] {"keyId":"cfec2a77-5a8e-3b1d-80d7-f2a29671a121","eventTime":"1564350660000","alertTime":"1564350829334","alertText":"Enforcement Annotated Flows contains escaped
 for \u003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"CRITICAL","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13
\"],\"protocol\":\"ICMP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"con
sumer_scope_names\":[\"Default\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350660000,1564350719999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":0,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"escaped_count\
":2}","rootScopeId":"5d3a744e497d4f446636ff13","alertConfId":"5d3b41fbe9d1577ea895eba8"}
Jul 28 21:53:06 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [CRIT] {"keyId":"4e497e64-cab7-3ea0-9e68-62a6cc5549ef","eventTime":"1564350660000","alertTime":"1564350829334","alertText":"Enforcement Annotated Flows contains escaped
 for \u003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"CRITICAL","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13
\"],\"protocol\":\"TCP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"cons
umer_scope_names\":[\"Default\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350660000,1564350719999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":25,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"escaped_count\
":2}","rootScopeId":"5d3a744e497d4f446636ff13","alertConfId":"5d3b41fbe9d1577ea895eba8"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [CRIT] {"keyId":"3baf0763-8065-3e6d-9792-254af68169c0","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Annotated Flows contains escaped
 for \u003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"CRITICAL","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13
\"],\"protocol\":\"TCP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"cons
umer_scope_names\":[\"Default\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":443,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"escaped_count
\":8}","rootScopeId":"5d3a744e497d4f446636ff13","alertConfId":"5d3b41fbe9d1577ea895eba8"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [DEBUG] {"keyId":"4c900d07-2e3f-3253-af9a-b966bc6bd59b","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Rejected Flows \u003e -1 for \u
003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"LOW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"protoc
ol\":\"TCP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"rejected_count\",\"type\":\"gt\",\"value\":-1},\"label\":\"Alert Trigger\"},\"consumer_scope_names\":[\"Default\
"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":443,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"rejected_count\":0}","rootScopeId":"5d3a744
e497d4f446636ff13","alertConfId":"5d3b5234e9d1574832a7125e"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [DEBUG] {"keyId":"c961ddf8-c182-3e75-a697-d393e95d4b38","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Rejected Flows \u003e -1 for \u
003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"LOW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"protoc
ol\":\"ICMP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"rejected_count\",\"type\":\"gt\",\"value\":-1},\"label\":\"Alert Trigger\"},\"consumer_scope_names\":[\"Default
\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":0,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"rejected_count\":0}","rootScopeId":"5d3a744e
497d4f446636ff13","alertConfId":"5d3b5234e9d1574832a7125e"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [DEBUG] {"keyId":"da44a6cc-9c2d-34e5-885b-79b738648478","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Rejected Flows \u003e -1 for \u
003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"LOW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"protoc
ol\":\"UDP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"rejected_count\",\"type\":\"gt\",\"value\":-1},\"label\":\"Alert Trigger\"},\"consumer_scope_names\":[\"Default\
"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":53,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"rejected_count\":0}","rootScopeId":"5d3a744e
497d4f446636ff13","alertConfId":"5d3b5234e9d1574832a7125e"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [DEBUG] {"keyId":"a42a32e9-5b4b-38b0-b3e3-41606d675f31","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Rejected Flows \u003e -1 for \u
003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"LOW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"protoc
ol\":\"UDP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"rejected_count\",\"type\":\"gt\",\"value\":-1},\"label\":\"Alert Trigger\"},\"consumer_scope_names\":[\"Default\
"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":123,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"rejected_count\":0}","rootScopeId":"5d3a744
e497d4f446636ff13","alertConfId":"5d3b5234e9d1574832a7125e"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [CRIT] {"keyId":"cfec2a77-5a8e-3b1d-80d7-f2a29671a121","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Annotated Flows contains escaped
 for \u003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"CRITICAL","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13
\"],\"protocol\":\"ICMP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"con
sumer_scope_names\":[\"Default\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":0,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"escaped_count\
":2}","rootScopeId":"5d3a744e497d4f446636ff13","alertConfId":"5d3b41fbe9d1577ea895eba8"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [CRIT] {"keyId":"ad96e167-c2c9-336f-b465-bb6da6b4e6fd","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Annotated Flows contains escaped
 for \u003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"CRITICAL","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13
\"],\"protocol\":\"UDP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"cons
umer_scope_names\":[\"Default\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":123,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"escaped_count
\":2}","rootScopeId":"5d3a744e497d4f446636ff13","alertConfId":"5d3b41fbe9d1577ea895eba8"}
Jul 28 21:54:22 tan-5d3b5191f786e05752c77031 Tetration Alert[4235]: [CRIT] {"keyId":"ca3853a6-862b-3192-84b7-6036d4420db4","eventTime":"1564350720000","alertTime":"1564350906081","alertText":"Enforcement Annotated Flows contains escaped
 for \u003capplication_id:5d3b41c1497d4f01facc2d0a\u003e","severity":"CRITICAL","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"provider_scope_ids\":[\"5d3a744e497d4f446636ff13\"],\"consumer_scope_ids\":[\"5d3a744e497d4f446636ff13
\"],\"protocol\":\"UDP\",\"policy_type\":\"ENFORCED_POLICY\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"cons
umer_scope_names\":[\"Default\"],\"provider_scope_names\":[\"Default\"],\"time_range\":[1564350720000,1564350779999],\"policy_category\":[\"ESCAPED\"],\"provider_port\":53,\"application_id\":\"5d3b41c1497d4f01facc2d0a\",\"escaped_count\
":2}","rootScopeId":"5d3a744e497d4f446636ff13","alertConfId":"5d3b41fbe9d1577ea895eba8"}
```

Syslog Severity Mapping

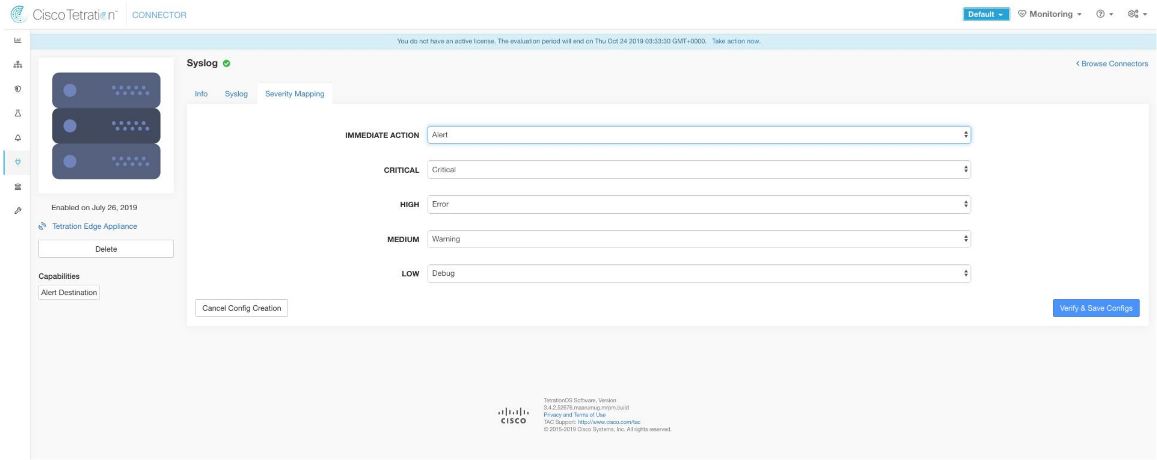
The following table shows the default severity mapping for Secure Workload alerts on Syslog.

Secure Workload Alerts Severity	Syslog Severity
LOW	LOG_DEBUG
MEDIUM	LOG_WARNING
HIGH	LOG_ERR
CRITICAL	LOG_CRIT
IMMEDIATE ACTION	LOG_EMERG

This setting can be modified using **Severity Mapping** configuration under Syslog Connector. You can choose any corresponding Syslog priority for each Secure Workload Alert Severity and change the Severity Mapping. For more information, see Syslog Severity Mapping Configuration.

Parameter Name	Dropdown of mappings
IMMEDIATE_ACTION	• *Emergency* • *Alert* • *Critical* • *Error* • *Warning* • *Notice* • *Informational* • *Debug*
CRITICAL	
HIGH	
MEDIUM	
LOW	

Figure 75: Sample config for Syslog Severity Mapping.



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Enabled on July 26, 2019

Tetration Edge Appliance

IMMEDIATE ACTION: Alert

CRITICAL: Critical

HIGH: Error

MEDIUM: Warning

LOW: Debug

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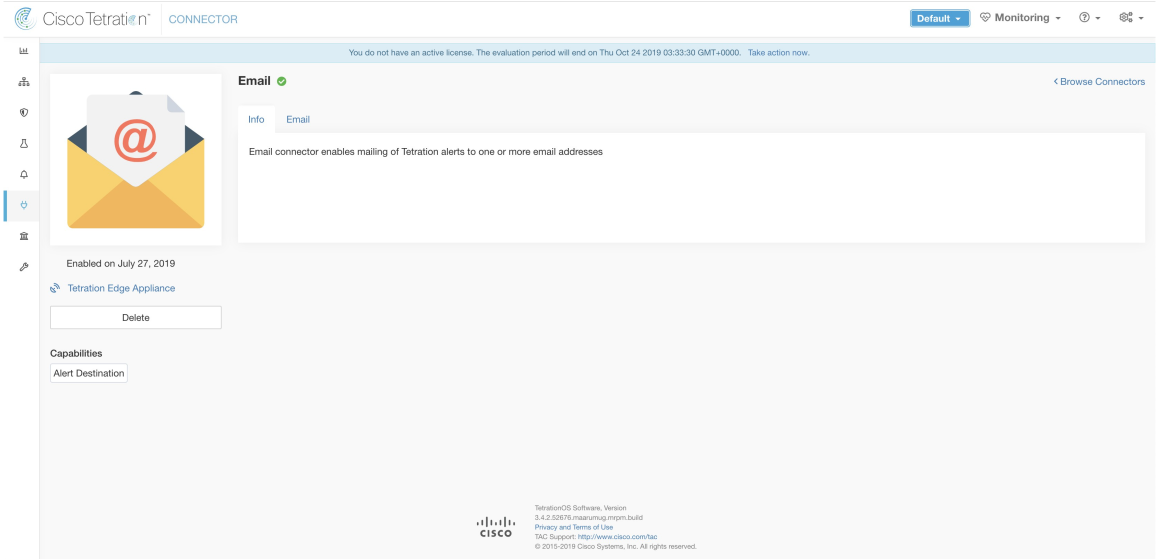
Limits

Metric	Limit
Maximum number of Syslog connectors on one Secure Workload Edge appliance	1
Maximum number of Syslog connectors on one Tenant (rootscope)	1
Maximum number of Syslog connectors on Secure Workload	150

Email Connector

When enabled, TAN service on Secure Workload Edge Appliance can send alerts to given configuration.

Figure 76: Email connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Email connector enables mailing of Tetration alerts to one or more email addresses

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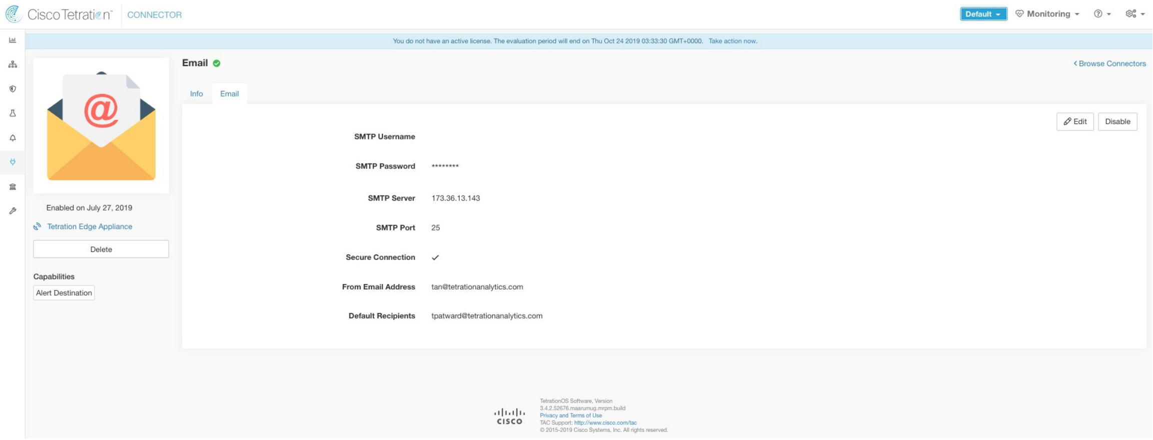
The following table explains the configuration details for publishing Secure Workload alerts on Email. For more information, see Email Notifier Configuration.

Table 17: Email Notifier Configuration for more details

Parameter Name	Type	Description
SMTP Username	string	SMTP server username. This parameter is optional.
SMTP Password	string	SMTP server password for the user (if given). This parameter is optional.
SMTP Server	string	IP address or hostname of the SMTP server
SMTP Port	number	Listening port of SMTP server. Default value is 587.
Secure Connection	checkbox	Should SSL be used for SMTP server connection?
From Email Address	string	Email address to use for sending alerts
Default Recipients	string	Comma separated list of recipient email addresses

Figure 77: Sample configuration for Email Connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Email

SMTP Username

SMTP Password ********

SMTP Server 173.36.13.143

SMTP Port 25

Secure Connection ✓

From Email Address tan@tetrationanalytics.com

Default Recipients tpatward@tetrationanalytics.com

Enabled on July 27, 2019

Capabilities

Alert Destination

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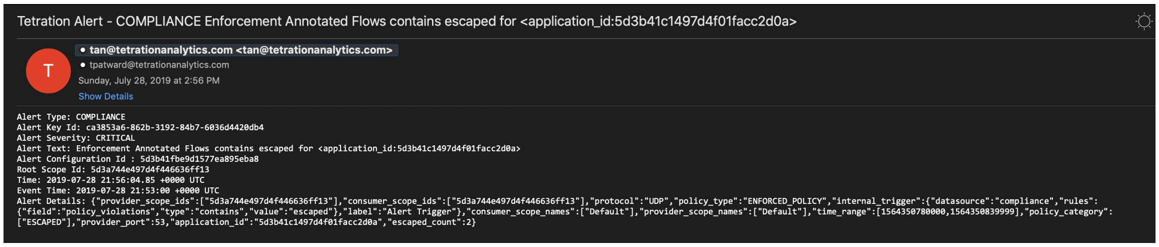
Figure 78: Sample alert



Tetration Alert - COMPLIANCE Enforcement Annotated Flows contains escaped for <application_id:5d3b41c1497d4f01facc2d0a>

- **tan@tetrationanalytics.com <tan@tetrationanalytics.com>**
- tpatward@tetrationanalytics.com

Sunday, July 28, 2019 at 2:56 PM

```
Alert Type: COMPLIANCE
Alert Key Id: ca3853a6-862b-3192-84b7-6036d4420db4
Alert Severity: CRITICAL
Alert Text: Enforcement Annotated Flows contains escaped for <application_id:5d3b41c1497d4f01facc2d0a>
Alert Configuration Id : 5d3b41fbe9d1577ea895eba8
Root Scope Id: 5d3a744e497d4f446636ff13
Time: 2019-07-28 21:56:04.85 +0000 UTC
Event Time: 2019-07-28 21:53:00 +0000 UTC
Alert Details: {"provider_scope_ids":["5d3a744e497d4f446636ff13"],"consumer_scope_ids":["5d3a744e497d4f446636ff13"],"protocol":"UDP","policy_type":"ENFORCED_POLICY","internal_trigger":{"datasource":"compliance","rules":
{"field":"policy_violations","type":"contains","value":"escaped"},"label":"Alert Trigger"},"consumer_scope_names":["Default"],"provider_scope_names":["Default"],"time_range":[1564350780000,1564350839999],"policy_category":
["ESCAPED"],"provider_port":53,"application_id":"5d3b41c1497d4f01facc2d0a","escaped_count":2}
```

Note

- SMTP username/password is optional. If no username is provided, we try to connect to SMTP server without any auth.
- If secure connection box is not checked, we will send alerts notification over non-secure connection.
- Default Recipients list is used to send alert notifications. This can be overridden per alert if required in Alert configuration.

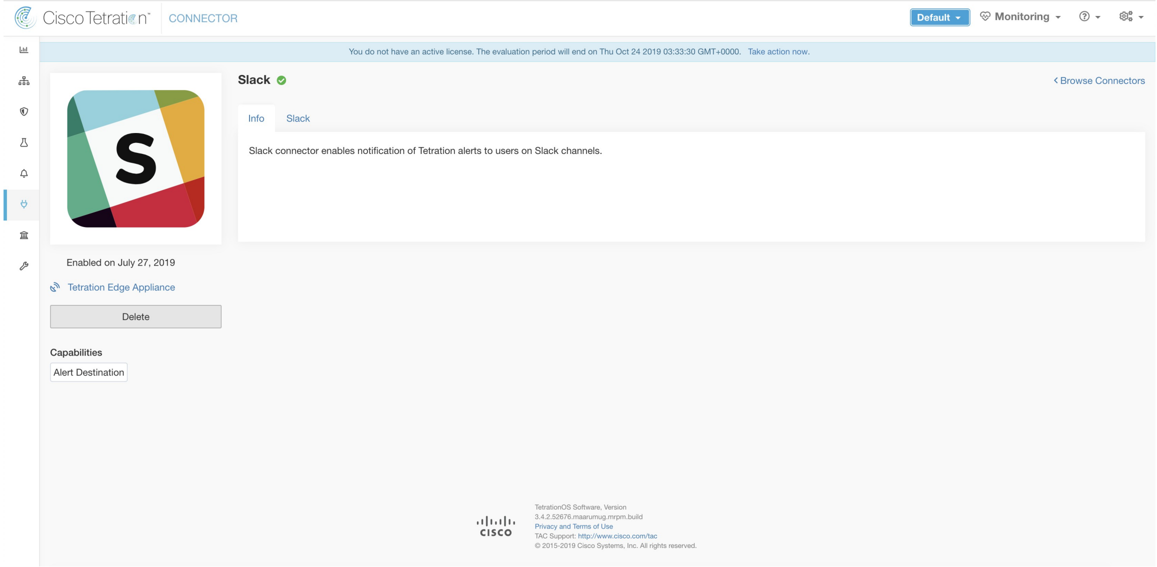
Limits

Metric	Limit
Maximum number of Email connectors on one Secure Workload Edge appliance	1
Maximum number of Email connectors on one Tenant (rootscope)	1
Maximum number of Email connectors on Secure Workload	150

Slack Connector

When enabled, TAN service on Secure Workload Edge appliance can send alerts to Slack using configuration.

Figure 79: Slack connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Slack

‹ Browse Connectors

Slack connector enables notification of Tetration alerts to users on Slack channels.

Enabled on July 27, 2019

Tetration Edge Appliance

Capabilities

Alert Destination

TetrationOS Software, Version
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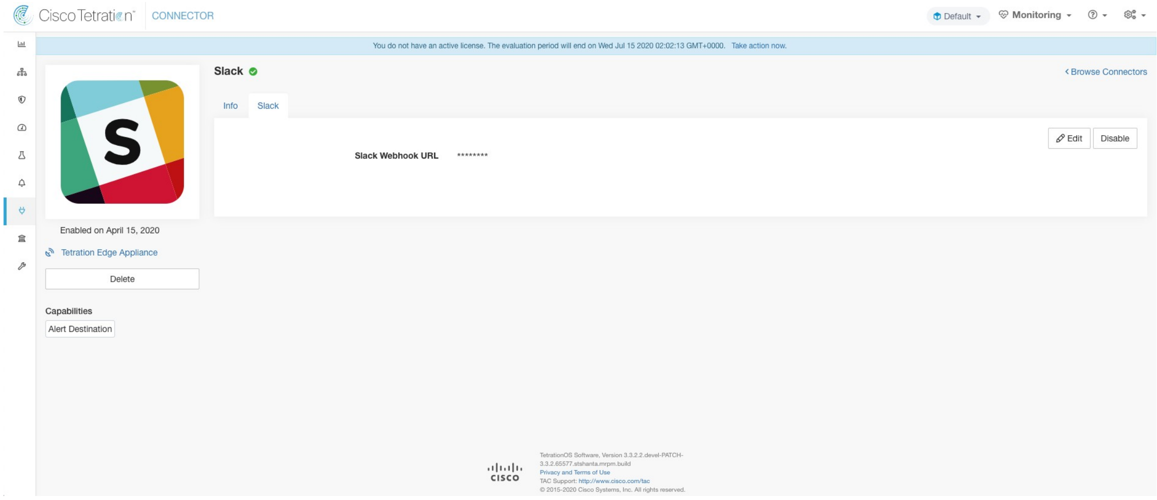
The following table explains the configuration details for publishing Secure Workload alerts on Slack. For more information, see Slack Notifier Configuration.

Parameter Name	Type	Description
Slack Webhook URL	string	Slack webhook on which Secure Workload alerts should be published

Note

- To generate slack webhook go here.

Figure 80: Sample configuration for Slack Connector



You do not have an active license. The evaluation period will end on Wed Jul 15 2020 02:02:13 GMT+0000. Take action now.

Slack

Slack Webhook URL ********

Enabled on April 15, 2020

Capabilities

Alert Destination

TetrationOS Software, Version 3.3.2.2.devel-PATCH-3.3.2.65577.stshanta.mrpm.build

TAC Support: http://www.cisco.com/tac

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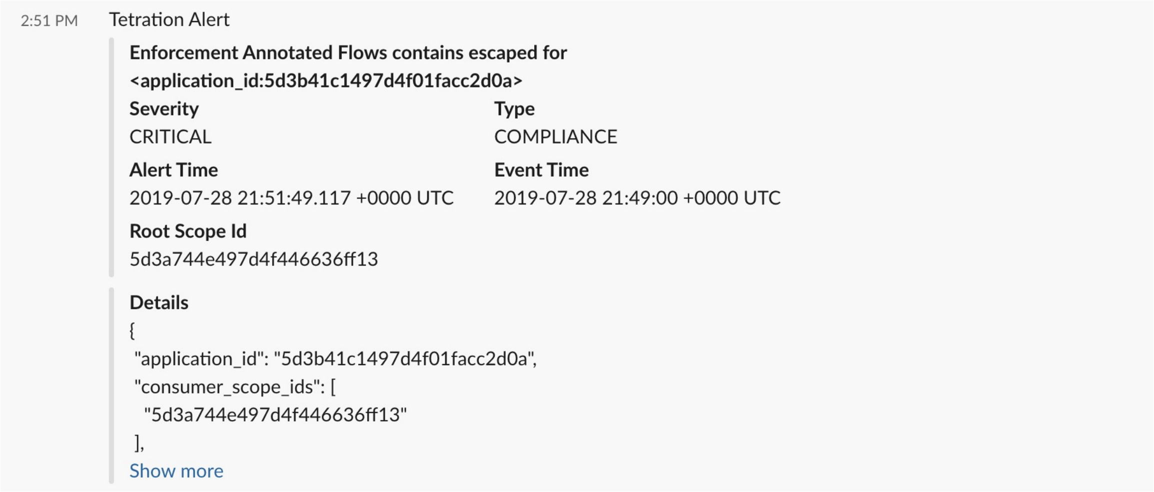
Figure 81: Sample alert



2:51 PM Tetration Alert

Enforcement Annotated Flows contains escaped for <application_id:5d3b41c1497d4f01facc2d0a>

Severity	**Type**
CRITICAL	COMPLIANCE
Alert Time	**Event Time**
2019-07-28 21:51:49.117 +0000 UTC	2019-07-28 21:49:00 +0000 UTC

Root Scope Id
5d3a744e497d4f446636ff13

Details

```
{
 "application_id": "5d3b41c1497d4f01facc2d0a",
 "consumer_scope_ids": [
   "5d3a744e497d4f446636ff13"
 ],
```

Show more

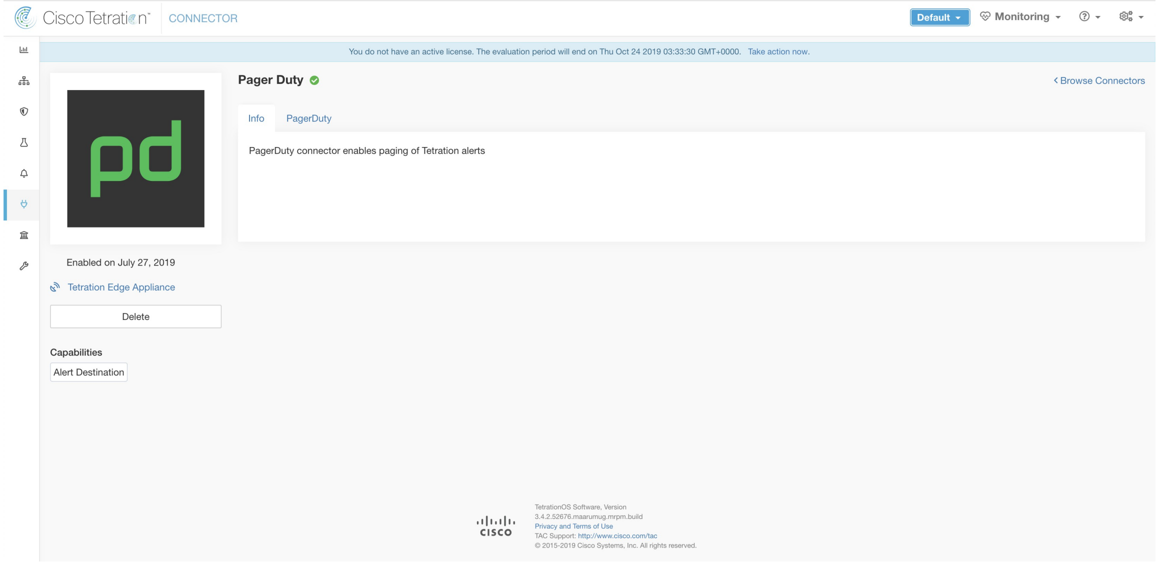
Limits

Metric	Limit
Maximum number of Slack connectors on one Secure Workload Edge appliance	1
Maximum number of Slack connectors on one Tenant (rootscope)	1
Maximum number of Slack connectors on Secure Workload	150

PagerDuty Connector

When enabled, TAN service on Secure Workload Edge appliance can send alerts to PagerDuty using configuration.

Figure 82: PagerDuty connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

PagerDuty connector enables paging of Tetration alerts

Enabled on July 27, 2019

TetrationOS Software, Version 3.4.2.52676.maarumug.mrpm.build
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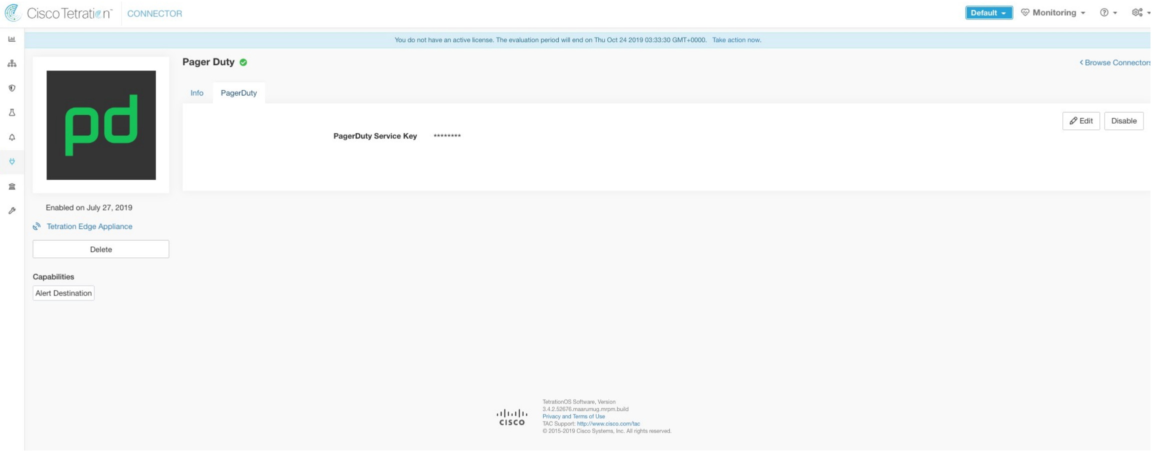
The following table explains the configuration details for publishing Secure Workload alerts on PagerDuty. For more information, see PagerDuty Notifier Configuration.

Parameter Name	Type	Description
PagerDuty Service Key	string	PagerDuty service key for pushing Secure Workload alerts on PagerDuty.

Figure 83: Sample configuration for PagerDuty Connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

PagerDuty Service Key ********

Enabled on July 27, 2019

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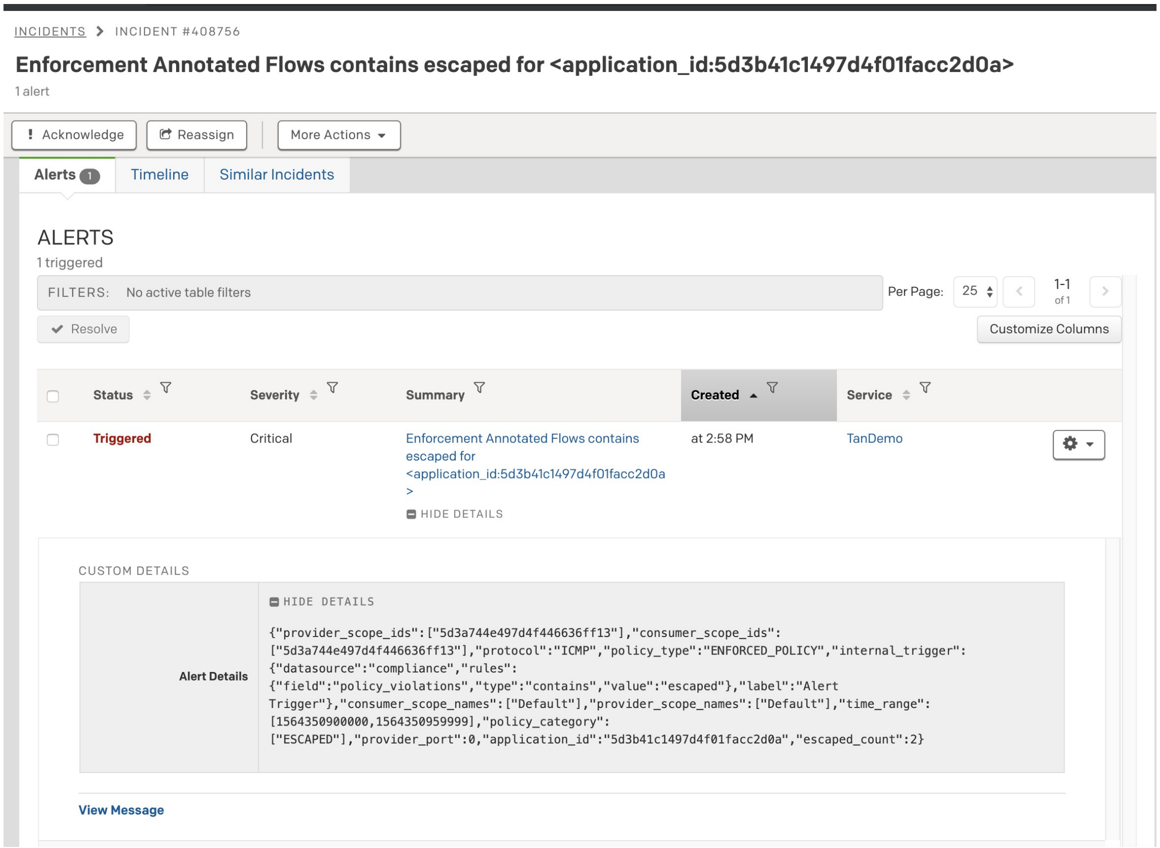
Figure 84: Sample alert



Enforcement Annotated Flows contains escaped for <application_id:5d3b41c1497d4f01facc2d0a>

1 alert

ALERTS

1 triggered

FILTERS: No active table filters

Status	Severity	Summary	Created	Service
Triggered	Critical	Enforcement Annotated Flows contains escaped for <application_id:5d3b41c1497d4f01facc2d0a>	at 2:58 PM	TanDemo

CUSTOM DETAILS

Alert Details

```
{"provider_scope_ids":["5d3a744e497d4f446636ff13"],"consumer_scope_ids":
["5d3a744e497d4f446636ff13"],"protocol":"ICMP","policy_type":"ENFORCED_POLICY","internal_trigger":
{"datasource":"compliance","rules":
{"field":"policy_violations","type":"contains","value":"escaped"},"label":"Alert
Trigger"},"consumer_scope_names":["Default"],"provider_scope_names":["Default"],"time_range":
[1564350900000,1564350959999],"policy_category":
["ESCAPED"],"provider_port":0,"application_id":"5d3b41c1497d4f01facc2d0a","escaped_count":2}
```

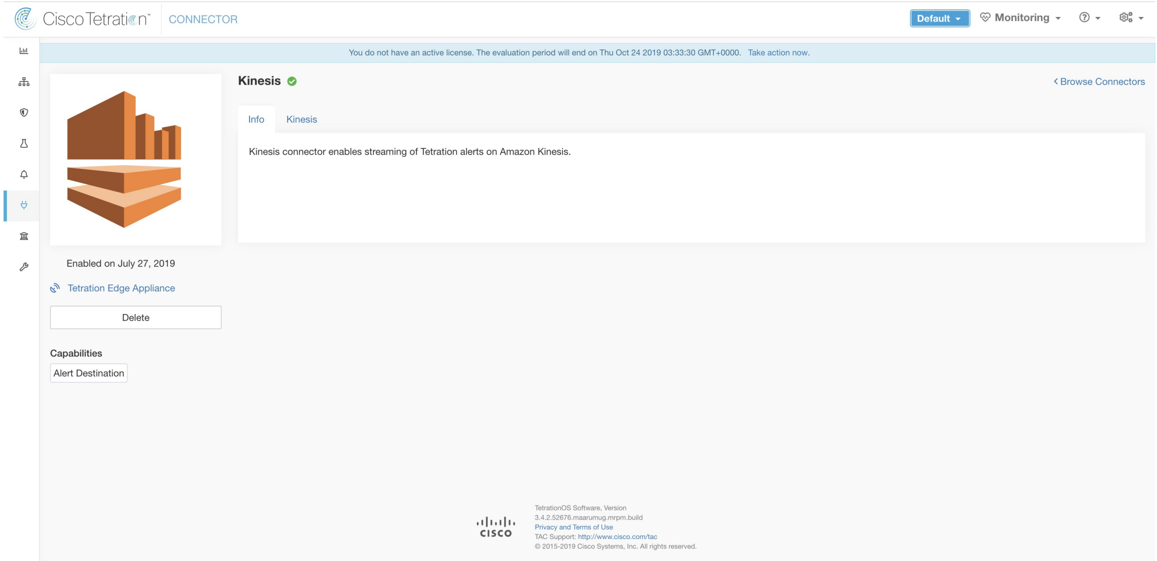
Limits

Metric	Limit
Maximum number of PagerDuty connectors on one Secure Workload Edge appliance	1
Maximum number of PagerDuty connectors on one Tenant (rootscope)	1
Maximum number of PagerDuty connectors on Secure Workload	150

Kinesis Connector

When enabled, TAN service on Secure Workload Edge appliance can send alerts using configuration.

Figure 85: Kinesis connector



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Kinesis ✓

< Browse Connectors

Info | Kinesis

Kinesis connector enables streaming of Tetration alerts on Amazon Kinesis.

Enabled on July 27, 2019

Tetration Edge Appliance

Delete

Capabilities

Alert Destination

TetrationOS Software, Version
3.4.2.52676.maarumug.mrpm.build
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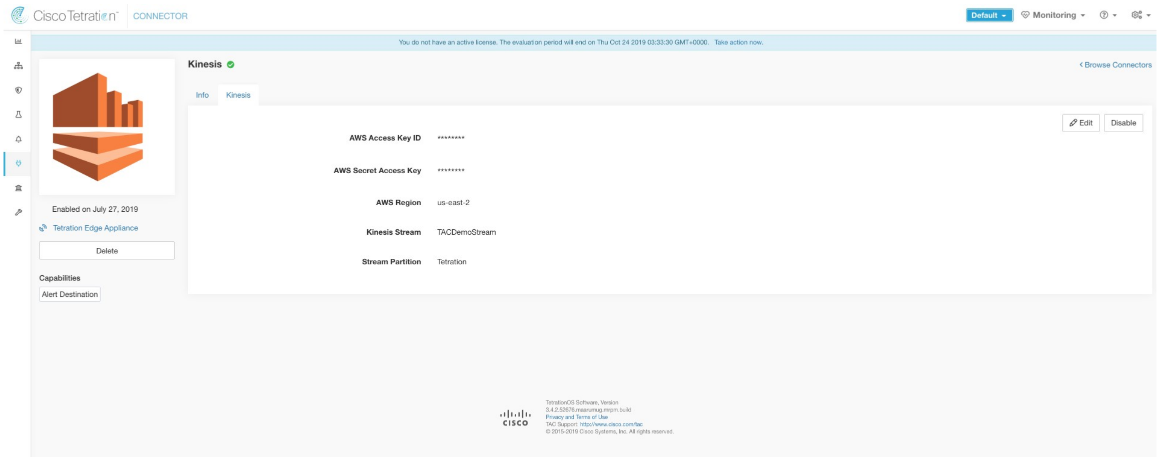
The following table explains the configuration details for publishing Secure Workload alerts on Amazon Kinesis. For more information, see Kinesis Notifier Configuration.

Parameter Name	Type	Description
AWS Access Key ID	string	AWS access key ID to communicate with AWS
AWS Secret Access Key	string	AWS secret access key to communicate with AWS
AWS Region	dropdown of AWS regions	Name of the AWS region where Kinesis stream is configured
Kinesis Stream	string	Name of the Kinesis stream
Stream Partition	string	Partition Name of the stream

Figure 86: Sample configuration for Kinesis Connector.



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

AWS Access Key ID ********

AWS Secret Access Key ********

AWS Region us-east-2

Kinesis Stream TACDemoStream

Stream Partition Tetration

Enabled on July 27, 2019

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Limits

Metric	Limit
Maximum number of Kinesis connectors on one Secure Workload Edge appliance	1
Maximum number of Kinesis connectors on one Tenant (rootscope)	1
Maximum number of Kinesis connectors on Secure Workload	150

Cloud Connectors

You can use a cloud connector for Secure Workload features on cloud-based workloads.

Cloud connectors do not require a virtual appliance.

Connector	Supported Features	Deployed on Virtual Appliance
AWS	For Amazon Web Services VPCs: • Collect metadata (labels) • Collect flow logs • Enforce segmentation policies From Elastic Kubernetes Service (EKS) clusters: • Collect metadata	N/A

Connector	Supported Features	Deployed on Virtual Appliance
Azure	For Azure VNets: • Collect metadata (labels) • Collect flow logs • Enforce segmentation policies From Azure Kubernetes Service (AKS) clusters: • Collect metadata	N/A
GCP	For Google Cloud Platform VPCs: • Collect metadata (labels) • Collect flow logs • Enforce segmentation policies From Google Kubernetes Engine (GKE) clusters: • Collect metadata (labels)	N/A

AWS Connector

Amazon Web Services (AWS) connector connects with AWS to perform the following high-level functions:

- **Automated ingestion of inventory (and its labels) live from an AWS Virtual Private Cloud (VPC)** AWS allows you to assign metadata to your resources in the form of tags. Secure Workload query the tags for these resources which can then be used for inventory and traffic flow data visualization, and policy definition. This capability keeps the resource tag mapping updated by constantly synchronizing this data.

  The tags from workloads and network interfaces of an AWS VPC are ingested. If you configure both workloads and network interfaces, Secure Workload merges and displays the tags. For more information, see Labels Generated by Cloud Connectors, on page 342.

- **Ingestion of VPC-level flow logs** If you have set up VPC flow logs in AWS for monitoring purposes, Secure Workload can ingest flow log information by reading the corresponding S3 bucket. You can use this telemetry for visualization and segmentation policy generation.

- **Segmentation** When the segmentation option is enabled, Secure Workload programs security policies using AWS native Security Groups. When enforcement is enabled for a VPC, relevant policies are automatically programmed as security groups.

- **Automated ingestion of metadata from EKS clusters** When Elastic Kubernetes Services (EKS) is running on AWS, you can choose to gather all node, service, and pod metadata related to all selected Kubernetes clusters.

You can choose which capabilities to enable for each VPC.

Note We don’t currently support China Regions.

Requirements and Prerequisites for AWS

For all capabilities: Create a dedicated user in AWS, or identify an existing AWS user for this connector. The connector configuration wizard generates a CloudFormation Template (CFT) that you can use to assign required privileges to this user. Make sure you have permissions in AWS to upload this CFT.

For granting cross AWS account access to the dedicated user, see (Optional) Configure cross AWS account access in AWS, on page 240, including required access privileges.

For granting AWS account access using role, refer to role-based access to Secure Workload cluster.

Each VPC can belong to only one AWS connector. A Secure Workload cluster can have multiple AWS connectors. Gather the information described in the tables in Configure new AWS Connector , on page 244.

This connector doesn’t require a virtual appliance.

For gathering labels and inventory: No additional prerequisites are required.

For ingesting flow logs: VPC level flow log definitions are required in order to trigger the collection of flow logs.

Only VPC-level flow logs can be ingested.

Flow logs must be published to Amazon Simple Storage Service (S3); Secure Workload cannot collect flow data from Amazon CloudWatch logs.

Secure Workload can ingest flow logs from an S3 bucket associated with any account, if the AWS user account credentials provided during connector creation have access to both the VPC flow logs and the S3 bucket.

The following flow log attributes (in any order) are required in the flow log: Source Address, Destination Address, Source Port, Destination Port, Protocol, Packets, Bytes, Start Time, End Time, Action, TCP Flags, Interface-ID, Log status and Flow Direction. Any other attributes are ignored.

Flow logs must capture both Allowed and Denied traffic.

Note The Secure Workload AWS connector supports VPC flow logs partition on an hourly and daily basis.

For segmentation: Enabling segmentation requires Gather Labels to be enabled.

Back up your existing security groups before enabling segmentation in the connector, as all existing rules are overwritten when you enable segmentation for a VPC.

For more information, see Best Practices When Enforcing Segmentation Policy for AWS Inventory.

For managed Kubernetes services (EKS): If you enable the Kubernetes option, see Requirements and Prerequisites for EKS in the Managed Kubernetes Services Running on AWS (EKS) section, including required access privileges.

(Optional) Configure cross AWS account access in AWS

If the given user credentials has access to VPCs belonging to other AWS accounts, they will be available for processing as part of the AWS connector.

1. The designated Secure Workload user should have the following AWS access permissions:

   ```
   1. iam:GetPolicyVersion
   2. iam:ListPolicyVersions
   3. iam:ListAttachedUserPolicies
   4. iam:GetUser
   5. servicequotas:ListServiceQuotas
   ```

   Example AWS policy JSON:

   ```
   {
     "Version": "2012-10-17",
     "Statement": [
       {
         "Sid": "VisualEditor0",
         "Effect": "Allow",
         "Action": [
           "iam:GetPolicyVersion",
           "iam:ListPolicyVersions",
           "iam:ListAttachedUserPolicies",
           "iam:GetUser",
           "servicequotas:ListServiceQuotas"
         ],
         "Resource": "*"
       }
     ]
   }
   ```

2. Create an AWS IAM role in the desired AWS account of which the designated Secure Workload user is NOT part of.

3. Allow the AWS IAM role to be assumed by the Secure Workload user. This can be done by adding the Secure Workload user ARN to the AWS IAM role trust policy.

   Example AWS IAM role trust policy JSON:

   ```
   {
     "Version": "2012-10-17",
     "Statement": [
         {
           "Effect": "Allow",
           "Principal": {
             "AWS": <Secure Workload_user_arn>
               },
     "Action": "sts:AssumeRole",
     "Condition": {}
       }
     ]
   }
   ```

4. Perform the steps 2 and 3 for all the desired AWS accounts which the Secure Workload user does not belong to.

5. Create a customer managed policy (NOT Inline policy) with permission to assume all the created AWS roles from different accounts.

   Note In AWS connector, Customer Inline Policy is not supported.

   Example Managed policy JSON:

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "VisualEditor0",
      "Effect": "Allow",
      "Action": "sts:AssumeRole",
      "Resource": [<AWS_role_cross_account_1_arn>, <AWS_role_cross_account_2_arn>...]
    }
  ]
}
```

6. Attach the created customer managed policy to the Secure Workload user.

7. The connector configuration wizard will provide a CloudFormation Template. After uploading the CFT as-is to the designated Secure Workload user, you will edit the template and upload the edited template to the CloudFormation portal to grant the required permissions to the AWS IAM roles. For details, see Configure new AWS Connector , on page 244.

Authentication Using Roles

User-based authentication requires credential keys. If the credential key is not properly managed, it can cause security threat due to their sensitive nature.

Using the role-based authentication you can configure the AWS account using roles. The connector configuration accepts the role id (ARN) and assume that role to perform specific actions on the customer's account.

Role-based authentication reduces the risk of unauthorized access.

To access the Role-based authentication, follow these steps:

Procedure

Step 1 Click on the **Role** tab in the connector configuration page.

Step 2 Register the cluster. If the cluster is not registered, it dislays a message *"Cluster is not registered to use role credentials". Download the provided payload and contact a customer service representative..*

Step 3 From the notification message, click on the **download** button and download the payload file.

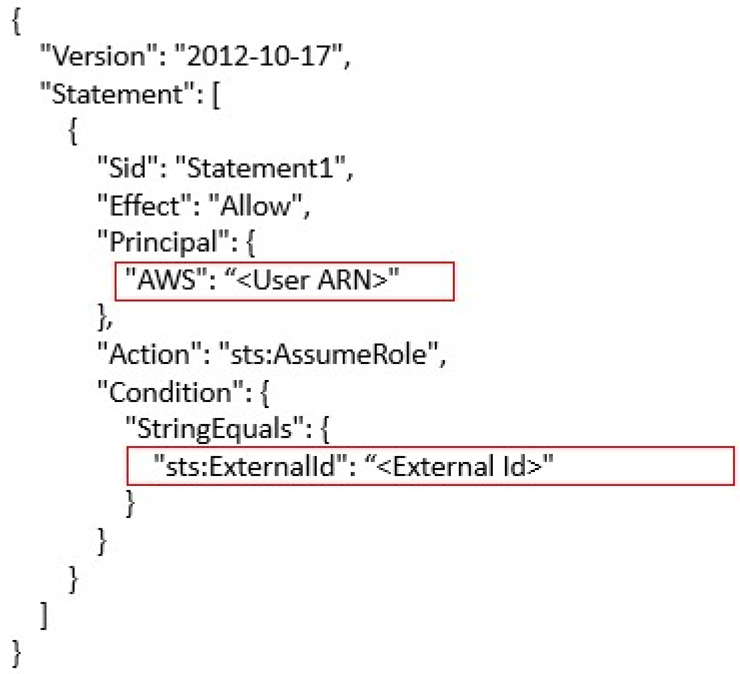
Step 4 You can use the link in the notification message to contact the **TAC** team and raise the ticket and provide the file that you have downloaded.

Step 5 When the cluster is registered, the **External Id** and **User ARN** gets auto populated.

Note Refresh the page to view the External Id and User ARN.

Step 6 Use the generated **External Id** and **User ARN** to update the role trust relationship. It enables to assume the role.

The same part of the JSON file:



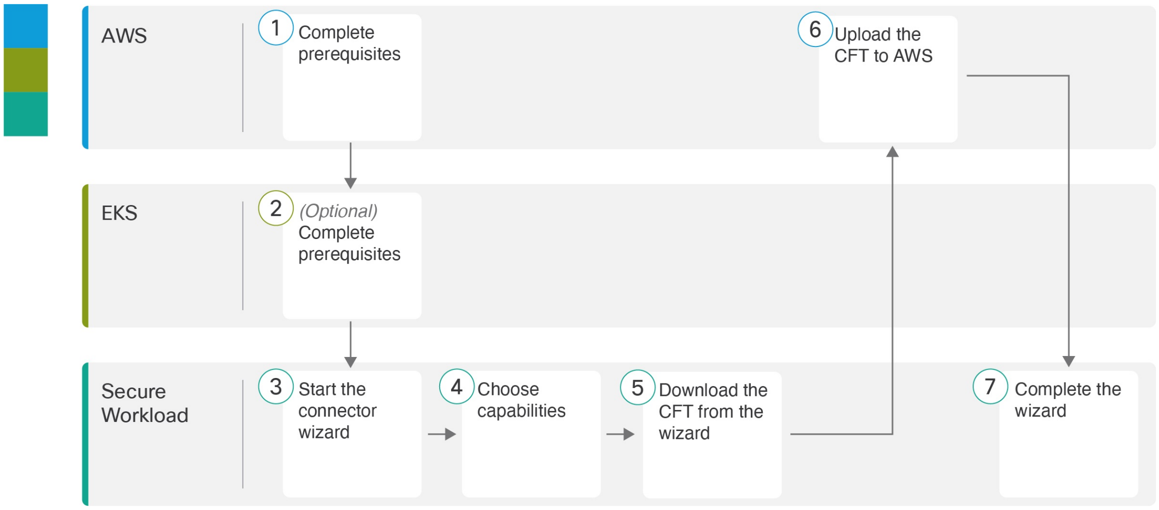
```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "Statement1",
      "Effect": "Allow",
      "Principal": {
        "AWS": “<User ARN>"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringEquals": {
          "sts:ExternalId": “<External Id>"
        }
      }
    }
  ]
}
```

Step 7 When the previous step is complete, you can copy the **Role ARN** from the AWS account and paste it in the AWS connector configuration page.

AWS Connector Configuration Overview

The following graphic gives a high-level overview of the connector configuration process. For essential details, see the next topic (Configure new AWS Connector , on page 244.)

Figure 87: AWS connector configuration overview



(Note that the numbers in the graphic do not correspond to step numbers in the detailed procedure.)

Configure new AWS Connector

Procedure

Step 1 In the navigation pane, choose **Manage** > **Workloads** > **Connectors**.

Step 2 Click **AWS Connector**.

Step 3 Click **Generate Template** and choose the desired capabilities.

Based on the capabilities selected, CloudFormation Template (CFT) is generated. Use the generated CFT template in your AWS CloudFormation to create the policy for the User or Role.

To enable segmentation, you must also enable **Gather Labels**.

Step 4 Download the generated CloudFormation Template (CFT). The generated CFT can be used for both the user and role.

This template has the IAM privileges required for the capabilities that you selected in the previous step.

If you enabled the Kubernetes option, you must separately configure permissions for EKS. See Managed Kubernetes Services Running on AWS (EKS), on page 250.

Step 5 Upload the CFT to the AWS CloudFormation portal to assign privileges to the user for this connector. Ensure the AWS user have the required privileges before you can continue with the AWS connector configuration.

Note We recommend this task whether or not you are using AWS cross-account access.

You can apply the CFT using either the portal or the CLI. For more information, see:

- **Portal:** AWS Management Console
- **CLI:** Creating a stack

When you upload the CFT, AWS requires the following details:

a. Name of the policy (This can be anything. For example, Secure WorkloadConnector)

b. Rolename: Name of the AWS IAM role to which you are applying the CFT

c. List of bucket ARNs And Object ARNs (Default: *)

d. Username: Name of the AWS user to which you are applying the CFT

e. List of VPC ARNs (Default: *)

To enter a specific list of VPC ARNs, enter the security group and network interface resources paired with the specific VPC to enable segmentation.

1. `arn:aws:ec2:<region>:<account_id>:security-group/*`
2. `arn:aws:ec2:<region>:<account_id>:network-interface/*`

Sample Code

Example 1

```
{
   "Action": [
    "ec2:RevokeSecurityGroupIngress",
    "ec2:AuthorizeSecurityGroupEgress",
    "ec2:AuthorizeSecurityGroupIngress",
    "ec2:CreateSecurityGroup",
    "ec2:RevokeSecurityGroupEgress",
    "ec2:DeleteSecurityGroup",
    "ec2:ModifyNetworkInterfaceAttribute",
    "ec2:CreateTags"
   ],
   "Resource": [
    "arn:aws:ec2:us-east-1:123456789:vpc/vpc-abcdef",
    "arn:aws:ec2:us-east-1:123456789:security-group/*",
    "arn:aws:ec2:us-east-1:123456789:network-interface/*"
   ],
   "Effect": "Allow"
  },
```

Example 2

```
{
   "Action": [
    "ec2:RevokeSecurityGroupIngress",
    "ec2:AuthorizeSecurityGroupEgress",
    "ec2:AuthorizeSecurityGroupIngress",
    "ec2:CreateSecurityGroup",
    "ec2:RevokeSecurityGroupEgress",
    "ec2:DeleteSecurityGroup",
    "ec2:ModifyNetworkInterfaceAttribute",
    "ec2:CreateTags"
   ],
   "Resource": [
    "arn:aws:ec2:us-east-1:123456789:vpc/vpc-abcdef",
    "arn:aws:ec2:*:*:security-group/*",
    "arn:aws:ec2:*:*:network-interface/*"
   ],
   "Effect": "Allow"
  },
```

Step 6 If you are using AWS role based authentication to connect to the Secure Workload Connector, see EKS Roles and Access privileges section.

Step 7 If you are using AWS cross-account access, follow the additional steps:

a. You can use the same uploaded CFT to give access to role/user. If you have multiple account use the same CFT on each account.

b. Upload the CFT to the AWS CloudFormation portal of each AWS account where the desired IAM role exists.

You can apply the CFT using either the portal or the CLI, as described in the previous step.

When you upload the CFT, AWS asks for the following:

1. Name of the policy (This can be anything. For example, Secure WorkloadConnector)
2. List of bucket ARNs And Object ARNs (Default: *)
3. Rolename: Name of the AWS IAM role to which you are applying the CFT
4. List of VPC ARNs (Default: *)

Step 8 Click **Getting started guide** (recommended) or **Configure your new connector here** button to configure the connector.

Step 9 Understand and meet the Requirements and Prerequisites for AWS, EKS Roles and Access Privileges and Best Practices When Enforcing Segmentation Policy for AWS Inventory, then click **Get Started**. Or if you are configuring using the **Configure your new connector** button, then click **yes**.

Step 10 Name the connector and enter the description.

Step 11 Configure settings:

You can use either of the one option to connect to AWS account.

a. Credential Keys

b. Roles

Parameter Name	Attribute	Description
Credential Keys	Access Key	ACCESS KEY ID associated with the AWS user that has the privileges described in the CFT above.
	Secret Key	SECRET KEY associated with the ACCESS KEY ID above.
Roles	External Id	It is auto generated unique identifier for granting access to AWS resources. It is used by the user to add trust relationship to the role.
	User ARN	It is auto generated unique identifier assigned to an IAM. It is used by the user to add trust relationship to the role.
	ARN	A unique identifier assigned to each AWS resource.
	HTTP Proxy	(Optional) Proxy required for Secure Workload to reach AWS.
	Full Scan Interval	Frequency with which Secure Workload refreshes complete inventory data from AWS. Default and minimum is 3600 seconds.
	Delta Scan Interval	Frequency with which Secure Workload fetches incremental changes in inventory data from AWS. Default and minimum is 600 seconds.

Step 12 Click Next.

Step 13 The next page displays a **Resource Tree** where the user can expands to view various region and inside the region you can select or unselect the resource check boxes to obtain the list of VPCs and EKS clusters from AWS.

Step 14 From the list of VPCs (Virtual Networks), choose the VPCs for which you want to enable your selected capabilities.

Generally, you should enable flow ingestion as soon as possible, so that Secure Workload can begin to collect enough data required to suggest accurate policies.

Note that since EKS only supports Gather Labels capability, no explicit capability selection has been provided. Selecting an EKS cluster will implicitly enable the supported capability. For each cluster for which you enable this capability, enter the **Assume Role ARN** (The Amazon resource number of the role to assume while connecting to Secure Workload.)

Enable Segmentation on VPCs will remove existing Security Group(s) and provides default access to all VPCs.

Generally, you should not choose **Enable Segmentation** during initial configuration. Later, when you are ready to enforce segmentation policy for specific VPCs, you can edit the connector and enable segmentation for those VPCs. See the Best Practices When Enforcing Segmentation Policy for AWS Inventory.

Step 15 For the EKS cluster, you can allow AWS IAM role access by providing the Assume Role ARN access id to connect to the AWS connector.

Step 16 Once your selections are complete, click **Create** and wait a few minutes for the validation check to complete.

What to do next

If you have enabled gathering labels, ingesting flow data, and/or segmentation:

- If you enable flow ingestion, it may take up to 25 minutes for flows to begin appearing on the **Investigate** > **Traffic** page.
- (Optional) For richer flow data and other benefits including visibility into host vulnerabilities (CVEs), install the appropriate agent for your operating system on your VPC-based workloads. For requirements and details, see the agent installation chapter.
- After you have successfully configured the AWS connector to gather labels and ingest flows, follow the standard process for building segmentation policies. For example: Allow Secure Workload to gather sufficient flow data to generate reliable policies; define or modify scopes (typically one for each VPC); create a workspace for each scope; automatically discover policies based on your flow data, and/or manually create policies; analyze and refine your policies; ensure that your policies meet the guidelines and best practices below; and then, when you are ready, approve and enforce those policies in the workspace. When you are ready to enforce segmentation policy for a particular VPC, return to the connector configuration to enable segmentation for the VPC. For details, see Best Practices When Enforcing Segmentation Policy for AWS Inventory, on page 248.

If you have enabled the Kubernetes managed services (EKS) option:

- Install Kubernetes agents on your container-based workloads. For details, see the *Kubernetes/Openshift Agents - Deep Visibility and Enforcement* section in the agent deployment chapter.

Event Log:

The event logs can be used to know significant events happening per connector from different capabilities. We can filter them using various attributes like Component, Namespace, Messages and Timestamp.

Edit an AWS Connector

You can edit an AWS connector, for example to enable segmentation enforcement for specific VPCs or to make other changes.

Changes are not saved until you finish the wizard.

Procedure

Step 1 From the navigation bar at the left side of the window, choose **Manage** > **Workloads** > **Connectors**.

Step 2 Click **AWS**.

Step 3 If you have more than one AWS connector, choose the connector to edit from the top of the window.

Step 4 Click **Edit Connector**.

Step 5 Click through the wizard again and make changes. For detailed descriptions of the settings, see Configure new AWS Connector , on page 244.

Step 6 If you enable different capabilities (gathering labels, ingesting flows, enforcing segmentation, or gathering EKS data), you must download the revised CloudFormation Template (CFT) and upload it to AWS before continuing the wizard.

Step 7 To enable enforcement of segmentation policy, first make sure you have completed recommended prerequisites described in Best Practices When Enforcing Segmentation Policy for AWS Inventory. On the page that lists the VPCs, choose **Enable Segmentation** for the VPCs on which you want to enable enforcement.

Step 8 If you have already created scopes for any of the selected VPCs, either using the wizard or manually, click **Skip this step** to complete the wizard.

You can edit the scope tree manually using the **Organize** > **Scopes and Inventory** page.

Step 9 If you have not already created any scopes for the selected VPCs and you want to keep the proposed hierarchy, choose the parent scope from above the scope tree, then click **Save**.

Deleting Connectors and Data

If you delete a connector, data already ingested by that connector is not deleted.

Labels and inventory are automatically deleted from active inventory after 24 hours.

Best Practices When Enforcing Segmentation Policy for AWS Inventory

Warning Before you enable segmentation enforcement on any VPC, create a backup of the security groups on that VPC. Enabling segmentation for a VPC removes existing Security Groups from that VPC. Disabling segmentation does not restore the old security groups.

When creating policies:

- As with all discovered policies, ensure that you have enough flow data to produce accurate policies.

- Because AWS allows only ALLOW rules in security groups, your segmentation policies should include only Allow policies, except the Catch-All policy, which should have the Deny action.

We recommend that you enable enforcement in the workspace before you enable segmentation for the associated VPC. If you enable segmentation for a VPC that is not included in a workspace that has enforcement enabled, all traffic will be allowed on that VPC.

When you are ready to enforce policy for a VPC, edit the AWS connector (see Edit an AWS Connector) and enable segmentation for that VPC.

View AWS Inventory Labels, Details, and Enforcement Status

To view summary information for an AWS connector, navigate to the connector page (Manage > Connectors), then choose the connector from the top of the page. For more details, click a VPC row.

To view information about AWS VPC inventory, click an IP address on the AWS Connectors page to see the Inventory Profile page for that workload. For more information about inventory profiles, see Inventory Profile.

For information about labels, see:

- Labels Generated by Cloud Connectors
- Labels Related to Kubernetes Clusters

Concrete policies for VPC inventory are generated based on their orchestrator_system/interface_id label value. You can see this on the Inventory Profile page.

To view enforcement status, choose **Defend** > **Enforcement Status** from the navigation bar on the left side of the Secure Workload window. For more information, see Enforcement Status for Cloud Connectors.

Troubleshoot AWS Connector Issues

Problem: The Enforcement Status page shows that a Concrete Policy was SKIPPED.

Solution: This occurs when the number of security groups exceeds the AWS limits, as configured in the AWS connector.

When a concrete policy shows as SKIPPED, the new security groups are not implemented and the previously existing security groups on AWS remain in effect.

To resolve this issue, see if you can consolidate policies, for example by using a larger subnet in one policy rather than multiple policies with smaller subnets.

If you choose to increase limits on the number of rules, you must contact Amazon before changing the limits in the AWS connector configuration.

Background:

Concrete policies are generated for each VPC when segmentation is enabled. These concrete policies are used to create security groups in AWS. However, AWS and Secure Workload count policies differently. When converting Secure Workload policies to AWS security groups, AWS counts each unique subnet as one rule.

Accounting example:

Consider the following example Secure Workload policy:

OUTBOUND: Consumer Address Set -> Provider Address Set Allow TCP port 80, 8080

AWS counts this policy as (the number of unique subnets in the Provider Address set) multiplied by (the number of unique ports).

So, if the provider address set consists of 20 Unique subnets, then this single Secure Workload policy counts in AWS as 20(unique subnets) * 2(Unique ports) = 40 rules in security groups.

Keep in mind that because the VPCs are dynamic, the rule count is also dynamic, so the counts are approximate.

Problem: AWS unexpectedly allows all traffic

Solution: Make sure your Catch-All policy in Secure Workload is set to Deny.

Managed Kubernetes Services Running on AWS (EKS)

If you have deployed Amazon Elastic Kubernetes Service (EKS) on your AWS cloud, then you can use an AWS connector to pull in inventory and labels (EKS tags) from your Kubernetes cluster.

When an AWS connector is configured to pull metadata from managed Kubernetes services, Secure Workload connects to the cluster's API server and tracks the status of nodes, pods and services in that cluster. For the Kubernetes labels gathered and generated using this connector, see Labels Related to Kubernetes Clusters.

Requirements and Prerequisites for EKS

- Verify that your Kubernetes version is supported. See https://www.cisco.com/go/secure-workload/requirements/integrations.
- Configure the required access in EKS, as described below.

EKS Roles and Access Privileges

User credentials and AssumeRole (if applicable) must be configured with a minimum set of privileges. The user/role must be specified in the aws-auth.yaml config map. The aws-auth.yaml config map can be edited using the following command.

```
$ kubectl edit configmap -n kube-system aws-auth
```

If AssumeRole is not used, the user must be added to the "mapUsers" section of the aws-auth.yaml config map with appropriate group. If AssumeRole ARN is specified, the role must be added to the "mapRoles" section of the aws-auth.yaml config map. A sample aws-auth.yaml config map with AssumeRole is provided below.

```
apiVersion: v1
data:
  mapAccounts: |
    []
  mapRoles: |
    - "groups":
      - "system:bootstrappers"
      - "system:nodes"
     "rolearn": "arn:aws:iam::938996165657:role/eks-cluster-2021011418144523470000000a"

      "username": "system:node:{{EC2PrivateDNSName}}"
    - "rolearn": arn:aws:iam::938996165657:role/BasicPrivilegesRole
      "username": secure.workload.read.only-user
      "groups":
        - secure.workload.read.only

  mapUsers: |
    []
kind: ConfigMap
metadata:
  creationTimestamp: "2021-01-14T18:14:47Z"
  managedFields:
```

```
- apiVersion: v1
  fieldsType: FieldsV1
  fieldsV1:
    f:data:
      .: {}
      f:mapAccounts: {}
      f:mapRoles: {}
      f:mapUsers: {}
  manager: HashiCorp
  operation: Update
  time: "2021-01-14T18:14:47Z"
name: aws-auth
namespace: kube-system
resourceVersion: "829"
selfLink: /api/v1/namespaces/kube-system/configmaps/aws-auth
uid: 6c5a3ac7-58c7-4c57-a9c9-cad701110569
```

EKS specific RBAC considerations

Create a cluster role binding of the cluster role and the user/service account.

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: csw-clusterrolebinging
subjects:
- kind: User
  name: csw.read.only
  apiGroup: rbac.authorization.k8s.io
roleRef:
  kind: ClusterRole
  name: csw.read.only
  apiGroup: rbac.authorization.k8s.io
  kubectl create -f clusterrolebinding.yaml
clusterrolebinding.rbac.authorization.k8s.io/csw-clusterrolebinging created
```

For information on EKS roles and access, see the EKS Roles and Access Privileges section.

Configure EKS Settings in the AWS Connector Wizard

You enable the Managed Kubernetes Services capability when you configure the AWS connector. See Configure new AWS Connector , on page 244.

You will need the Assume Role ARN for each EKS cluster. For more information, see: https://docs.aws.amazon.com/STS/latest/APIReference/API_AssumeRole.html

If you are using the AWS user to access the EKS cluster, allow the user to access the Assume Role.

If you are using a cross-account IAM role, allow the IAM role to access the Assume Role.

Support for EKS Load Balancer

We add support for load balancer services in EKS. The CSW agents enforce rules on consumer hosts and provider hosts/pods.

An EKS Load Balancer has two options:

1. Preserve Client IP.

2. Target Type.

Before starting with cases, for the following policy intent:

Consumer to provider service, service protocol and port with allow action rules for various cases are generated as follows:

Case	Preserve Client	Target Type
1	On	IP
2	On	Instance
3	Off	IP
4	Off	Instance

Case 1:

On consumer node we generate an egress rule with consumer to load balancer service (lb ingress ip) service protocol and port allow.

There are no host rules on the provider node, but we generate an Ingress rule on the provider pod with source as the consumer, the destination as provider pod (any), the protocol as the target protocol, the port as the target port, and the action as allow.

Case 2:

On consumer node we generate an egress rule with consumer to load balancer service (lb ingress ip) service protocol and port allow.

On provider node there is a prerouting rule generated with source as consumer and destination as all provider nodes, protocol as service protocol, port as node port of the service and an action as allow.

On provider pod, we generate an Ingress rule with source as provider nodes, destination as provider pod (any), protocol as target protcol, port as target port and action as allow.

Case 3:

On consumer node we generate an egress rule with consumer to load balancer service (lb ingress ip) service protocol and port allow.

There are no host rules on the provider node. On provider pod, we generate an Ingress rule with source as lb ingress ip's destination as provider pod (any), protocol as target protcol, port as target port and action as allow.

Case 4:

On consumer node we generate an egress rule with consumer to load balancer service(lb ingress ip) service protocol and port allow.

The provider node generates a prerouting rule that sets the lb ingress IPs as the source and all provider nodes as the destination. The rule specifies the service protocol as the protocol and the node port of the service as the port, with the action set to allow.

On provider pod, we generate an Ingress rule with source as provider nodes, destination as provider pod (any), protocol as target protcol, port as target port and action as allow.

Azure Connector

The Azure connector connects with your Microsoft Azure account to perform the following high-level functions:

- **Automated ingestion of inventory (and its tags) live from your Azure virtual networks (VNets)** Azure allows you to assign metadata to your resources in the form of tags. Secure Workload can ingest the tags associated with virtual machines and network interfaces, which can then be used as labels in Secure Workload for inventory and traffic flow data visualization and policy definitions. This metadata is synchronized constantly.

The tags from workloads and network interfaces of the subscription associated with the connector are ingested. If both workloads and network interfaces are configured then the tags are merged and displayed in Secure Workload. For more information, see Labels Generated by Cloud Connectors, on page 342.

- **Ingestion of flow logs** The connector can ingest flow logs that you set up in Azure for your Network Security Groups (NSGs). You can then use this telemetry data in Secure Workload for visualization and segmentation policy generation.
- **Segmentation** When enforcement of segmentation policy is enabled for a virtual network, Secure Workload policies will be enforced using Azure's native Network Security Groups.
- **Automated ingestion of metadata from AKS clusters** When Azure Kubernetes Services (AKS) are running on Azure, you can choose to gather all node, service, and pod metadata related to all selected Kubernetes clusters.

You can choose which of the above capabilities to enable for each VNet.

Azure connector supports multiple subscriptions.

Note China Regions are currently not supported.

Requirements and Prerequisites for Azure

For all capabilities: A single connector can handle multiple subscriptions. You will need a subscription ID to configure the connector. This subscription ID can be one of the many subscription IDs that are being onboarded to a connector.

In Azure, create/register an application using Azure Active Directory (AD). You will need the following information from this application:

- Application (client) ID
- Directory (tenant) ID
- Client credentials (you can use either a certificate or a client secret)
- Subscription ID

The connector configuration wizard will generate an Azure Resource Manager (ARM) template that you can use to create a custom role with the permissions needed for the connector capabilities you choose to enable. These permissions will apply to all resources in the subscription you specify for the connector. Make sure you have permissions in Azure to upload this template.

If required for connectivity, ensure that you have an HTTP proxy available for this integration.

Each virtual network (VNet) can belong to only one Azure connector. An Azure account can have multiple Azure connectors.

This connector does not require a virtual appliance.

For gathering labels and inventory: No additional prerequisites are required.

For ingesting flow logs: Each virtual network (VNet) must have at least one subnet configured.

Every subnet under each VNet must have a Network Security Group (NSG) associated with it. You can associate a single NSG with multiple subnets. You can specify any Resource Group when configuring the NSG.

Only traffic that hits an NSG rule will be included in flow logs. Therefore, every NSG should have at least one rule each for inbound traffic and for outbound traffic that applies to any source, any destination – the equivalent of a catch-all rule in Secure Workload. (By default, NSGs include these rules.)

Each NSG must have flow logs enabled.

- A storage account in Azure is required. Access permissions must be included for the subscription you are using for this connector.
- The flow logs must use Version 2.
- Retention time can be 2 days (the connector pulls new flow data every minute, and two days should allow enough time for any connection failures to be remedied.)

For segmentation: Enabling segmentation requires Gather Labels to be enabled.

When you enable segmentation for a virtual network (VNet), all existing rules are removed from the NSGs associated with subnets and the network interfaces that are part of those subnets. Back up your existing NSG rules on subnet and network interface before you enable segmentation in the connector.

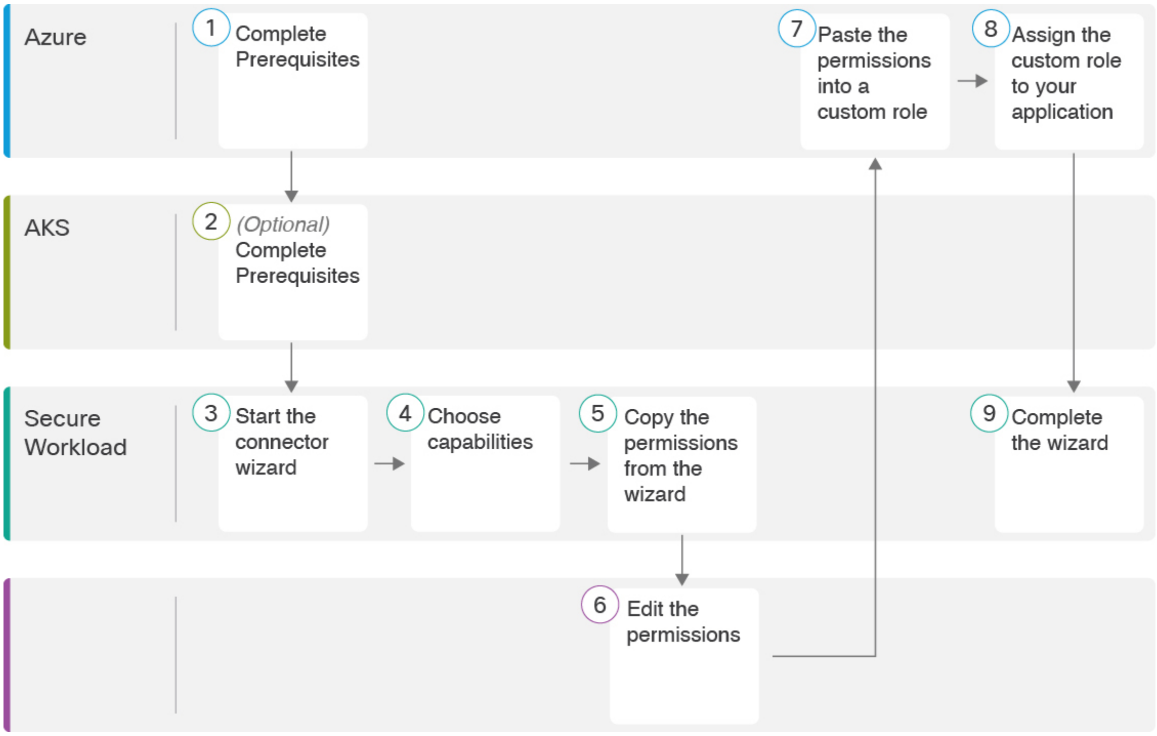
See also Best Practices When Enforcing Segmentation Policy for Azure Inventory, on page 259, below.

For managed Kubernetes services (AKS): If you will enable the Kubernetes AKS option, see requirements and prerequisites in the Managed Kubernetes Services running on Azure (AKS) section below, .

Azure Connector Configuration Overview

The following graphic gives a high-level overview of the connector configuration process. For essential details, see the next topic (Configure an Azure Connector.)

Figure 88: Azure connector configuration overview


Azure
1 Complete Prerequisites
7 Paste the permissions into a custom role
8 Assign the custom role to your application
AKS
2 (Optional) Complete Prerequisites
Secure Workload
3 Start the connector wizard
4 Choose capabilities
5 Copy the permissions from the wizard
9 Complete the wizard
6 Edit the permissions

(Note that the numbers in the graphic do not correspond to step numbers in the detailed procedure.)

Configure an Azure Connector

Procedure

Step 1 From the navigation bar at the left side of the window, choose **Manage** > **Connectors**.

Step 2 Click the Azure connector.

Step 3 Click **Enable** for the first connector (in a root scope) or **Enable Another** for additional connectors in the same root scope.

Step 4 Understand and meet requirements and prerequisites in Requirements and Prerequisites for Azure, then click Get Started.

Step 5 Name the connector and choose desired capabilities:

Selections you make on this page are used only to determine the privileges included in the Azure Resource Manager (ARM) template that will be generated in the next step, and to display the settings that you will need to configure.

In order to enable segmentation, you must also enable **Gather Labels**.

Enabling Segmentation on this page does not in itself enable policy enforcement or affect existing network security groups. Policy enforcement and deletion of existing security groups occurs only if you enable Segmentation for individual VNets later in the wizard. You can return to this wizard later to enable segmentation policy enforcement for individual VNets.

Step 6 Click **Next** and read the information on the configuration page.

Step 7 Your subscription must have the required privileges before you can continue to the next page in the wizard.

To use the provided Azure Resource Manager (ARM) template to assign required permissions for the connector:

a. Download the ARM template from the wizard.

b. Edit the template text to replace **<subscription_ID>** with your subscription ID.

Note For a connector, you can create multiple subscription IDs in the Azure account.

You can enter multiple subscription IDs where the credentials belong to the same subscription ID.

c. In Azure, create a custom role in the applicable subscription.

d. In the custom role form, for the Baseline permissions, choose **Start from scratch**.

e. In the JSON tab of the custom role creation form, paste the text from the edited file you downloaded from the connector wizard.

f. Save the custom role.

g. Attach the custom role to the application you configured in the prerequisites for this procedure.

This template has the IAM permissions required for the capabilities that you selected in the previous step.

If you enabled the Kubernetes managed services option, you must separately configure permissions for AKS. See Managed Kubernetes Services Running on Azure (AKS), on page 259.

Step 8 Configure settings:

Attribute	Description
SubscriptionID	The ID of the Azure subscription that you are associating with this connector.
ClientID	The **Application (client) ID** from the application that you created in Azure for this connector.
TenantID	The **Directory (tenant) ID** from the application that you created in Azure for this connector.
Client Secret or Client Certificate	For authentication, you can use either a client secret or a client certificate and key. Obtain either from the **Client credentials** link in the application that you created in Azure for this connector. If you use a certificate: The certificate should be unencrypted. Only RSA certificates are supported. Private keys can be either PKCS1 or PKCS8.
HTTP Proxy	Proxy required for Secure Workload to reach Azure. Supported proxy ports: 80, 8080, 443, and 3128.
Full Scan Interval	Frequency with which Secure Workload refreshes complete inventory data from Azure. Default and minimum is 3600 seconds.

Attribute	Description
Delta Scan Interval	Frequency with which Secure Workload fetches incremental changes in inventory data from Azure. Default and minimum is 600 seconds.

Step 9 Click **Next**. It may take a few minutes for the system to obtain the list of VNets and AKS clusters from Azure.

Step 10 From the list of VNets and AKS clusters for each VNet, choose the VNets and AKS clusters for which you want to enable your selected capabilities.

Generally, you should enable flow ingestion as soon as possible, so that Secure Workload can begin to collect enough data to suggest accurate policies.

Note that since AKS only supports Gather Labels capability, no explicit capability selection has been provided. Selecting an AKS cluster will implicitly enable the supported capability. Upload the client certificate and key for each cluster for which you enable this functionality.

Generally, you should not choose **Enable Segmentation** during initial configuration. Later, when you are ready to enforce segmentation policy for specific VNets, you can edit the connector and enable segmentation for those VNets. See Best Practices When Enforcing Segmentation Policy for Azure Inventory, on page 259.

Step 11 Once your selections are complete, click **Create** and wait a few minutes for the validation check to complete.

The View Groups page shows all VNets that you enabled for any functionality on the previous page, grouped by region. Each region, and each VNet in each region, is a new scope.

Step 12 (Optional) Choose the parent scope under which to add the new set of scopes. If you have not yet defined any scopes, your only option is the default scope.

Step 13 (Optional) To accept all settings configured in the wizard *including* the hierarchical scope tree, click **Save**.

To accept all settings *except* the hierarchical scope tree, click **Skip** this step.

You can manually create or edit the scope tree later, under **Organize** > **Scopes and Inventory**.

What to do next

If you have enabled gathering labels, ingesting flows data, and/or segmentation:

- If you enabled flow ingestion, it may take up to 25 minutes for flows to begin appearing on the **Investigate** > **Traffic** page.
- (Optional) For richer flow data and other benefits including visibility into host vulnerabilities (CVEs), install the appropriate agent for your operating system on your VNet-based workloads. For requirements and details, see the agent installation chapter.
- After you have successfully configured the Azure connector to gather labels and ingest flows, follow the standard process for building segmentation policies. For example: Allow Secure Workload to gather sufficient flow data to generate reliable policies; define or modify scopes (typically one for each VNet); create a workspace for each scope; automatically discover policies based on your flow data, and/or manually create policies; analyze and refine your policies; ensure that your policies meet the guidelines and best practices below; and then, when you are ready, approve and enforce those policies in the workspace. When you are ready to enforce segmentation policy for a particular VNet, return to the

connector configuration to enable segmentation for the VNet. For details, see Best Practices When Enforcing Segmentation Policy for Azure Inventory, on page 259.

If you have enabled the Kubernetes managed services (AKS) option:

- Install Kubernetes agents on your container-based workloads. For details, see Installing Kubernetes or OpenShift Agents for Deep Visibility and Enforcement, on page 27 in the agent deployment chapter.

Event Log:

The event logs can be used to know significant events happening per connector from different capabilities. We can filter them using various attributes like Component, Namespace, Messages and Timestamp.

Edit an Azure Connector

You can edit an Azure connector, for example to enable segmentation enforcement for specific VNets or to make other changes.

Changes are not saved until you finish the wizard.

Procedure

Step 1 From the navigation bar at the left side of the window, choose **Manage** > **Connectors**.

Step 2 Click **Azure**.

Step 3 If you have more than one Azure connector, choose the connector to edit from the top of the window.

Step 4 Click **Edit Connector**.

Step 5 Click through the wizard again and make changes. For detailed descriptions of the settings, see Configure an Azure Connector, on page 255.

Step 6 If you enable different capabilities (gathering labels, ingesting flows, enforcing segmentation, or gathering AKS data), you must download the revised ARM template, edit the new template text to specify the subscription ID, and upload the new template to the custom role you created in Azure before continuing the wizard.

Step 7 To enable enforcement of segmentation policy, first make sure you have completed recommended prerequisites described in Best Practices When Enforcing Segmentation Policy for Azure Inventory, on page 259. Then, on the wizard page that lists the VNets, choose **Enable Segmentation** for the VNets on which you want to enable enforcement.

Step 8 If you have already created scopes for any of the selected VNets, either using the wizard or manually, click **Skip this step** to complete the wizard.

You can edit the scope tree manually using the **Organize** > **Scopes and Inventory** page.

Step 9 If you have not already created any scopes for the selected VNets and you want to keep the proposed hierarchy, choose the parent scope from above the scope tree, then click **Save**.

Deleting Connectors and Data

If you delete a connector, data already ingested by that connector is not deleted.

Labels and inventory are automatically deleted from active inventory after 24 hours.

Best Practices When Enforcing Segmentation Policy for Azure Inventory

Warning Before you enable segmentation enforcement on any VNet, create a backup of the network security groups on that VNet. Enabling segmentation for a VNet removes existing rules from the network security group associated with that virtual network. Disabling segmentation does not restore the old network security groups.

When creating policies: As with all discovered policies, ensure that you have enough flow data to produce accurate policies.

We recommend that you enable enforcement in the workspace before you enable segmentation for the associated VNet. If you enable segmentation for a VNet that is not included in a workspace that has enforcement enabled, all traffic will be allowed on that VNet.

When you are ready to enforce policy for a VNet, edit the Azure connector (see Edit an Azure Connector, on page 258) and enable segmentation for that VNet.

Note that if a subnet does not have a Network Security Group associated with it, Secure Workload does not enforce segmentation policy on that subnet. When you enforce segmentation policy on a VNet, the NSG at the subnet level is changed to allow all traffic, and Secure Workload policies overwrite the interface-level NSGs. An NSG for the interface is automatically created if not already present.

View Azure Inventory Labels, Details, and Enforcement Status

To view summary information for an Azure connector, navigate to the connector page (Manage > Connectors), then choose the connector from the top of the page. For more details, click a VNet row.

To view information about Azure VNet inventory, click an IP address on the Azure Connectors page to view the Inventory Profile page for that workload. For more information about inventory profiles, see Inventory Profile.

For information about labels, see:

- Labels Generated by Cloud Connectors
- Labels Related to Kubernetes Clusters

Concrete policies for VNet inventory are generated based on their orchestrator_system/interface_id label value. You can see this on the Inventory Profile page.

To view enforcement status, choose **Defend** > **Enforcement Status** from the navigation bar on the left side of the Secure Workload window. For more information, see Enforcement Status for Cloud Connectors.

Troubleshoot Azure Connector Issues

Problem: Azure unexpectedly allows all traffic

Solution: Make sure your Catch-All policy in Secure Workload is set to Deny.

Managed Kubernetes Services Running on Azure (AKS)

If you have deployed Azure Kubernetes Services (AKS) on your Azure cloud, then you can use an Azure connector to dynamically pull in inventory and labels (AKS tags) from your Kubernetes cluster.

When an Azure connector is configured to pull metadata from managed Kubernetes services, Secure Workload tracks the status of nodes, pods and services in that cluster.

For the Kubernetes labels gathered and generated using this connector, see Labels Related to Kubernetes Clusters.

Requirements and Prerequisites for AKS

- Verify that your Kubernetes version is supported. See the Compatibility Matrix for the operating systems, external systems, and connectors for Secure Workload agents.
- Enable and configure the Managed Kubernetes Services (AKS) capability when you configure the Azure connector. See Configure an Azure Connector for details.

Support for AKS Load Balancer

AKS supports Preserve client IP.

For the following policy intent:

Consumer to provider service, service protocol and port with allow action rules for various cases generates as follows:

Case	Preserve Client
1	On
2	Off

Case 1: Preserve client IP is **on**.

On the consumer node we generate an egress rule with consumer to load balancer service (lb ingress ip) service protocol and port allow.

A prerouting rule generated for provider node, which specifies the consumer as the source and all provider nodes as the destination. The rule includes the service protocol as the protocol and the node port of the service as the port, with the action set to allow.

On the provider pod, we generate an Ingress rule with src as provider nodes, dest as provider pod (any), protocol as target protocol, port as target port and action as allow.

Case 2: Preserve client IP is **off**.

On the consumer node we generate an egress rule with consumer to load balancer service (lb ingress ip) service protocol and port allow.

The provider node generates a prerouting rule that sets the lb ingress IPs as the source and all provider nodes as the destination. The rule specifies the service protocol as the protocol and the node port of the service as the port, with the action set to allow.

On the provider pod, we generate an Ingress rule with source as provider nodes, destination as provider pod (any), protocol as target protocol, port as target port and action as allow.

GCP Connector

The Google Cloud Platform connector connects with GCP to perform the following high-level functions:

- **Automated ingestion of inventory (and its tags) live from GCP Virtual Private Cloud (VPC)**

  GCP allows you to assign metadata to your resources in the form of tags. Secure Workload will query the tags for these resources which can then be used for inventory and traffic flow data visualization, and policy definition. This capability keeps the resource tag mapping updated by constantly synchronizing this data.

The tags from workloads and network interfaces of a GCP VPC are ingested. If both workloads and network interfaces are configured then the tags are merged and displayed in Secure Workload. For more information, see Labels Generated by Cloud Connectors, on page 342.

- **Ingestion of flow logs from VPC** If you have set up VPC flow logs in GCP for monitoring purposes, Secure Workload can ingest flow log information by reading the corresponding Google Storage bucket. This telemetry can be used for visualization and segmentation policy generation.
- **Segmentation** Enabling this option will allow Secure Workload to program security policies using GCP native VPC firewall. When enforcement is enabled for a VPC, relevant policies will be automatically programmed to the VPC firewall.
- **Automated ingestion of metadata from GKE clusters** (K8s capabilities) when Google Kubernetes Engine (GKE) is running on GCP, you can choose to gather all node, service, and pod metadata related to all selected Kubernetes clusters.

You can choose which of the above capabilities to enable for each VPC.

Requirements and Prerequisites for GCP Conector

For all capabilities: Create a dedicated service account in GCP, or identify an existing GCP service account for this connector. The connector configuration wizard generates a IAM policy list that you can use to assign required privileges to this service account. Make sure you have permissions in GCP to upload this IAM policy list.

Note The recommended method for applying the permission in the IAM policy list to the service account is through the CLI.

Each VPC can belong to only one GCP connector. An Secure Workload cluster can have multiple GCP connectors. Gather the information described in the tables in Configure a GCP Connector, on page 263, below.

This connector does not require a virtual appliance.

- **For gathering labels and inventory:** No additional prerequisites are required.
- **For ingesting flow logs:** VPC level flow log definitions are required in order to trigger the collection of flow logs.

  To use the flow log ingestion, user is required to enable flow logs on the desired VPCs and setup a log router sink.

  Inclusion filter for the log router sink:

  1. `resource.type="gce-subnetwork"`
  2. `log_name="projects/<project_id>/logs/compute.googleapis.com%2Fvpc_flows"`

  Choose the sink destination as a cloud storage bucket and then choose the desired storage bucket.

  While configuring the GCP connector with ingress flow logs, it is mandatory to enter the storage bucket name.

  Only flow logs from VPC can be ingested.

Flow logs must be published to Google storage bucket; Secure Workload cannot collect flow data from Google Cloud Operations Suite.

Secure Workload can ingest flow logs from an Google Storage bucket associated with any account, if the GCP user account provided during connector creation have access to both the VPC flow logs and the Google storage bucket.

The following flow log attributes (in any order) are required in the flow log: Source Address, Destination Address, Source Port, Destination Port, Protocol, Packets, Bytes, Start Time, End Time, Action, TCP Flags, Interface-ID, Log status and Flow Direction. Any other attributes are ignored.

Flow logs must capture both Allowed and Denied traffic.

- **For segmentation:** Enabling segmentation requires Gather Labels to be enabled.

  Back up your existing security groups before enabling segmentation in the connector, as all existing rules will be overwritten when you enable segmentation policy enforcement for a VPC.

  See also Best Practices When Enforcing Segmentation Policy for GCP Inventory, on page 267, below.

- **For managed Kubernetes services (GKE):** If you enable the Kubernetes option, see requirements and prerequisites in the Managed Kubernetes Services Running on GCP (GKE), on page 268 section below, including required access privileges.

Configure Multiple Projects Access in GCP

To configure cross multiple projects access in GCP, you can follow these steps:

Procedure

Step 1 Sign in to your GCP console.

Step 2 Click on the project drop-down menu in the top navigation bar and select **New Project** or you can either create a new Project or use an existing project with service Account.

Step 3 Enter a name for your new project. Choose the organization that own the new project or select **No organization** if you do not have one.

Step 4 Click on the **Create** button to create the new project.

Note You can repeat the step 2 to 4 to create as many projects as you need.

Step 5 To link multiple projects in a single service account, navigate to **IAM & Admin** page and choose **Service Account**.

Step 6 Click on the **Create Service Account** button. Follow the prompts to create the service account and grant it the necessary permissions.

Note You can either use an existing service account or create a new service account.

Step 7 From the **Keys** tab, click **Add Key** to generate a private key in JSON file.

Step 8 Go to the **IAM & Admin** page in the GCP console and select **IAM**.

Note You have to first change the project before you click on IAM & Admin and then try to grant privilege.

Step 9 Click on the **Grant access** button to add a new project.

Step 10 In the **New principals** field, enter the email address of the service account you want to link to the project.

Step 11 Click on the **Save** button to associate the service account to your project.

Note Repeat these steps for each project that you want to link to your original project.

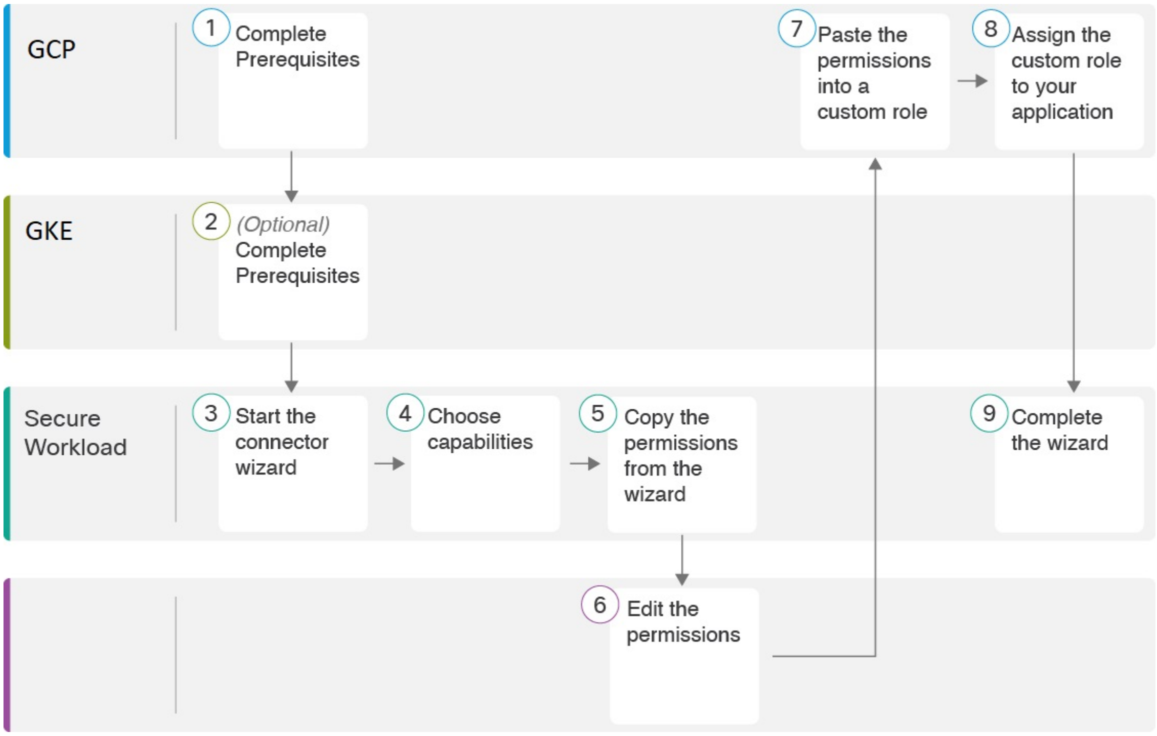
You can manage the service account permissions by going to the **IAM & Admin** page in the GCP console and selecting **IAM** for each project.

Step 12 Make sure that the Service Account has permissions to least common ancestor (common ancestor to all the projects selected) resource level, such as a folder or organization.

GCP Connector Configuration Overview

The following graphic gives a high-level overview of the connector configuration process. For essential details, see the next topic (Configure a GCP Connector, on page 263.)

Figure 89: GCP connector configuration overview


GCP
1 Complete Prerequisites
7 Paste the permissions into a custom role
8 Assign the custom role to your application
GKE
2 (Optional) Complete Prerequisites
Secure Workload
3 Start the connector wizard
4 Choose capabilities
5 Copy the permissions from the wizard
9 Complete the wizard
6 Edit the permissions

(Note that the numbers in the graphic do not correspond to step numbers in the detailed procedure.)

Configure a GCP Connector

Procedure

Step 1 From the navigation bar at the left side of the window, choose **Manage** > **Connectors**.

Step 2 Click the **GCP connector**.

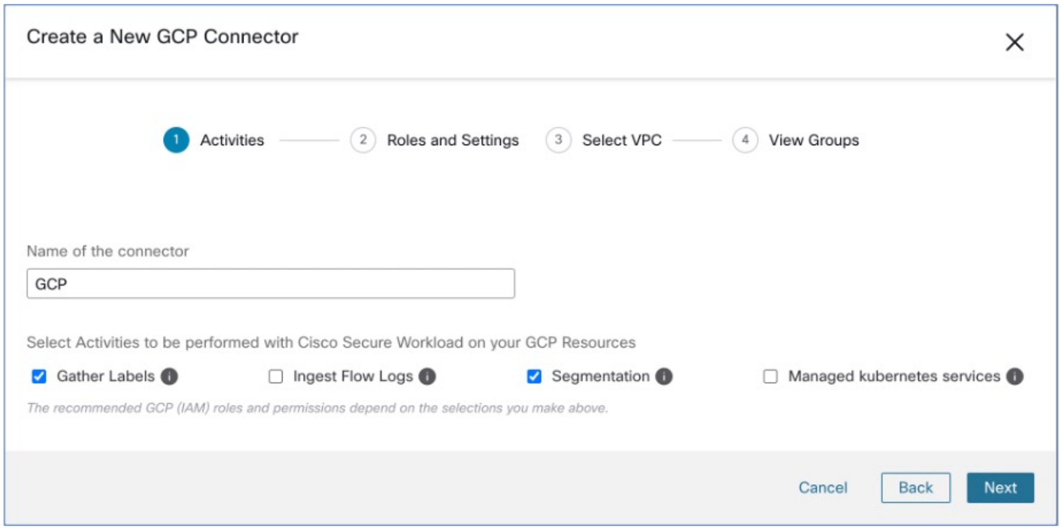
Step 3 Click **Enable** for the first connector (in a root scope) or **Enable Another** for additional connectors in the same root scope.

Step 4 Understand and meet requirements and prerequisites in Requirements and Prerequisites for GCP Conector, on page 261 and Managed Kubernetes Services Running on GCP (GKE), on page 268, then click **Get Started**.

Step 5 Enter a name for the connector and choose desired capabilities, then click **Next**.

Selections you make on this page are used only to determine the privileges included in the IAM policy list that will be generated in the next step, and to display the settings that you will need to configure.

In order to enable **segmentation**, you must enable **Gather Labels**.



Create a New GCP Connector

1 Activities — 2 Roles and Settings — 3 Select VPC — 4 View Groups

Name of the connector: GCP

Select Activities to be performed with Cisco Secure Workload on your GCP Resources

☑ Gather Labels ☐ Ingest Flow Logs ☑ Segmentation ☐ Managed kubernetes services

The recommended GCP (IAM) roles and permissions depend on the selections you make above.

Step 6 Create **service account** in the Google Cloud console.

Step 7 Download the generated IAM custom role policy list from the Secure Workload GCP Connector configuration windows.

This IAM custom role policy list has the IAM privileges required for the capabilities that you selected in the previous step.

If you enabled the Kubernetes option, you must separately configure permissions for GKE. See the Managed Kubernetes Services Running on GCP (GKE), on page 268.

Step 8 (Optional) To generate IAM custom role using Google Cloud CLI.

Sample command for custom role creation using Google Cloud CLI is as shown below.

```
gcloud iam roles create <Role Name> --project=<Project id> --file=<File path>
```

Step 9 Attach the created role to the service account in GCP console.

Step 10 Upload service account json file with required capabilities you have prepared in the prerequisites above.

Note In GCP, the single connector supports multiple projects and ensure that the service account is directly linked to all projects.

Step 11 Enter the **Flow Log Storage Bucket Name** if the the Ingress Flow logs capability is checked.

Step 12 Enter the **Root Resource Id**, which is the GCP folder ID or organization ID.

Note To obtain the Root Resource ID, you can view it directly in the Cloud Console by navigating to the IAM & Admin, Settings section. Alternatively, you can also utilize the Cloud SDK command to retrieve the Root Resource ID

Step 13 Configure the following settings:

Attribute	Description
HTTP Proxy	Proxy required for Secure Workload to reach GCP.
Full Scan Interval	Frequency with which Secure Workload refreshes complete inventory data from GCP. Default and minimum is 3600 seconds.
Delta Scan Interval	Frequency with which Secure Workload fetches incremental changes in inventory data from GCP. Default and minimum is 600 seconds.

Step 14 Click **Next**. It may take a few minutes for the system to obtain the list of virtual network and GKE clusters from your GCP project(s).

Step 15 From the list of VPCs (Virtual Networks) and GKE clusters, choose the resources and their respective capabilities.

Generally, you should enable flow ingestion as soon as possible, so that Secure Workload can begin to collect enough data required to suggest accurate policies.

Generally, you should not choose **Enable Segmentation** during initial configuration. Later, when you are ready to enforce segmentation policy for specific VPCs, you can edit the connector and enable segmentation for those VPCs. See the Best Practices When Enforcing Segmentation Policy for GCP Inventory.

Step 16 Click **Create** and wait a few minutes for the validation check to complete.

The View Groups page shows all VPCs that you enabled for any functionality on the previous page, grouped by logical_group_id (CSW), which is also a project_id (GCP). Each logical_group_id, and each VPC in each logical_group_id, is a new scope.

Step 17 Choose the parent scope under which to add the new set of scopes. If you have not yet defined any scopes, your only option is the default scope.

Step 18 To accept all settings configured in the wizard *including* the hierarchical scope tree, click **Save**.

To accept all settings *except* the hierarchical scope tree, click **Skip** this step.

You can manually create or edit the scope tree later, under **Organize** > **Scopes and Inventory**.

What to do next

If you have enabled gathering labels, ingesting flow data, and/or segmentation:

- If you enabled flow ingestion, it may take up to 25 minutes for flows to begin appearing on the **Investigate** > **Traffic** page.

- (Optional) For richer flow data and other benefits including visibility into host vulnerabilities (CVEs), install the appropriate agent for your operating system on your VPC-based workloads. For requirements and details, see the agent installation chapter.
- After you have successfully configured the GCP connector to gather labels and ingest flows, follow the standard process for building segmentation policies. For example: Allow Secure Workload to gather sufficient flow data to generate reliable policies; define or modify scopes (typically one for each VPC); create a workspace for each scope; automatically discover policies based on your flow data, and/or manually create policies; analyze and refine your policies; ensure that your policies meet the guidelines and best practices below; and then, when you are ready, approve and enforce those policies in the workspace. When you are ready to enforce segmentation policy for a particular VPC, return to the connector configuration to enable segmentation for the VPC. For details, see Best Practices When Enforcing Segmentation Policy for GCP Inventory, on page 267.

If you have enabled the Kubernetes managed services (GKE) option:

- Install Kubernetes agents on your container-based workloads. For details, see Installing Kubernetes or OpenShift Agents for Deep Visibility and Enforcement in the agent deployment chapter.

Event Log:

The event logs can be used to know significant events happening per connector from different capabilities. We can filter them using various attributes like Component, Namespace, Messages and Timestamp.

Edit a GCP Connector

If you want to enable gathering data from different or additional VPCs or GKE clusters, you may need to upload a service account json file with required capabilities with different permissions before you can select different VPCs or GKEs.

Changes are not saved until you finish the wizard.

Procedure

Step 1 From the navigation bar at the left side of the window, choose **Manage** > **Workloads** > **Connectors**.

Step 2 Click **GCP Connector**.

Step 3 If you have more than one GCP connector, choose the connector to edit from the top of the window.

Step 4 Click **Edit Connector**.

Step 5 Click through the wizard again and make changes. For detailed descriptions of the settings, see Configure a GCP Connector, on page 263.

Step 6 If you enable different capabilities (gathering labels, ingesting flows, enforcing segmentation, or gathering GKE data), you must download the revised IAM template and upload it to GKE before continuing the wizard.

Step 7 To enable enforcement of segmentation policy, first ensure that you have completed recommended prerequisites described in Best Practices When Enforcing Segmentation Policy for GCP Inventory, on page 267. On the page that lists the VPCs, select **Enable Segmentation** for the VPCs on which you want to enable enforcement.

Step 8 If you have already created scopes for any of the selected VPCs, either using the wizard or manually, click **Skip this step** to complete the wizard.

You can edit the scope tree manually using the **Organize** > **Scopes and Inventory** page.

Step 9 If you have not already created any scopes for the selected VPCs and you want to keep the proposed hierarchy, choose the parent scope from above the scope tree, then click **Save**.

Deleting Connectors and Data GCP

If you delete a connector, data already ingested by that connector is not deleted.

Labels and inventory are automatically deleted from active inventory after 24 hours.

Best Practices When Enforcing Segmentation Policy for GCP Inventory

Warning Before you enable segmentation enforcement on any VPC, create a backup of the security groups on that VPC. Enabling segmentation for a VPC removes existing Security Groups from that VPC. Disabling segmentation does not restore the old security groups.

When creating policies:

- As with all discovered policies, ensure that you have enough flow data to produce accurate policies.
- Because GCP allows both ALLOW/DENY rules in firewall policy. Since GCP has very strict limitation on number of rules.So, it is better to have only ALLOW-list.

We recommend that you enable enforcement in the workspace before you enable segmentation for the associated VPC. If you enable segmentation for a VPC that is not included in a workspace that has enforcement enabled, all traffic will be allowed on that VPC.

When you are ready to enforce policy for a VPC, edit the GCP connector (see Edit a GCP Connector, on page 266) and enable segmentation for that VPC.

GKE Inventory Labels, Details, and Enforcement Status

To view summary information for a GCP connector, navigate to **Connector** > and choose GCP Connector on the Connectors page.

To view information about inventory, click the IP address of a particular workload from the Scopes and Inventory page. You can also access the Inventory Profile from the interface tab on the VPC Profile. For more information about the Inventory profile, see Inventory Profile.

Similarly, to view all Concrete Policies under the VPC profile, from the Inventory Profile Concrete Policies tab, navigate to the parent VPC Profile to see all the Concrete Policies under the VPC.

The VPC Profile is accessible from the GCP Configuration or Enforcement Status page (either global or within a workspace). You can view the Enforcement Status and Concrete Policies at the VPC level on the VPC Profile. You can also view the combined VPC Firewall Polices of all the interfaces on the VPC Firewall Policies tab.

For more information on labels, see:

- Labels Generated by Cloud Connectors
- Labels Related to Kubernetes Clusters

Troubleshoot GCP Connector Issues

Problem: The Enforcement Status page shows that a Concrete Policy was SKIPPED.

Solution: This occurs when the number of rules in firewall policy exceeds the GCP limits, as configured in the GCP connector.

When a concrete policy shows as SKIPPED, the new security groups are not implemented and the previously existing security groups on GCP remain in effect.

To resolve this issue, see if you can consolidate policies, for example by using a larger subnet in one policy rather than multiple policies with smaller subnets.

Background:

Concrete policies are generated for each VPC when segmentation is enabled. These concrete policies are used to create firewall policy in GCP. However, GCP and Secure Workload count policies differently. When converting Secure Workload policies to GCP firewall rules in firewall policy, GCP counting mechanism is complex. For more details,see GCP.

Problem: GCP unexpectedly allows all traffic

Solution: Make sure your Catch-All policy in Secure Workload is set to Deny.

Managed Kubernetes Services Running on GCP (GKE)

You can use a cloud connector to gather metadata from Google Kubernetes Engine (GKE) clusters running on Google Cloud Platform (GCP).

The connector gathers all node, service, and pod metadata related to all selected Kubernetes clusters.

Requirements and Prerequisites

Secure Workload requirements: This connector does not require a virtual appliance.

Platform requirements:

- Make sure you have permissions in GCP to configure the required access for this connector.
- Each GKE cluster can only belong to one GCP connector.
- Gather the information described in the tables in *Configure a GCP connector*, below.

GKE requirements:

- You must configure the required access privileges in GKE.
- To support Managed K8s capabilities, the roles required by the service account are:
  - Compute Network Viewer is an IAM role that gives read-only access to all network resources in GCP.https://cloud.google.com/compute/docs/access/iam#compute.networkViewer
  - Kubernetes Engine Viewer is a GKE cluster role that provides read-only access to resources within GKE clusters, such as nodes, pods, and GKE API objects. https://cloud.google.com/iam/docs/understanding-roles#kubernetes-engine-roles

Virtual Appliances for Connectors

Most connectors are deployed on Secure Workload virtual appliances. You will deploy required virtual appliances on an ESXi host in VMware vCenter using the OVA templates or on other KVM-based hypervisors using the QCOW2 image. The procedure to deploy virtual appliances is described in Deploying a Virtual Appliance.

Types of Virtual Appliances

Each connector that requires a virtual appliance can be deployed on one of two types of virtual appliances.

Secure Workload Ingest

Secure Workload Ingest appliance is a software appliance that can export flow observations to Secure Workload from various connectors.

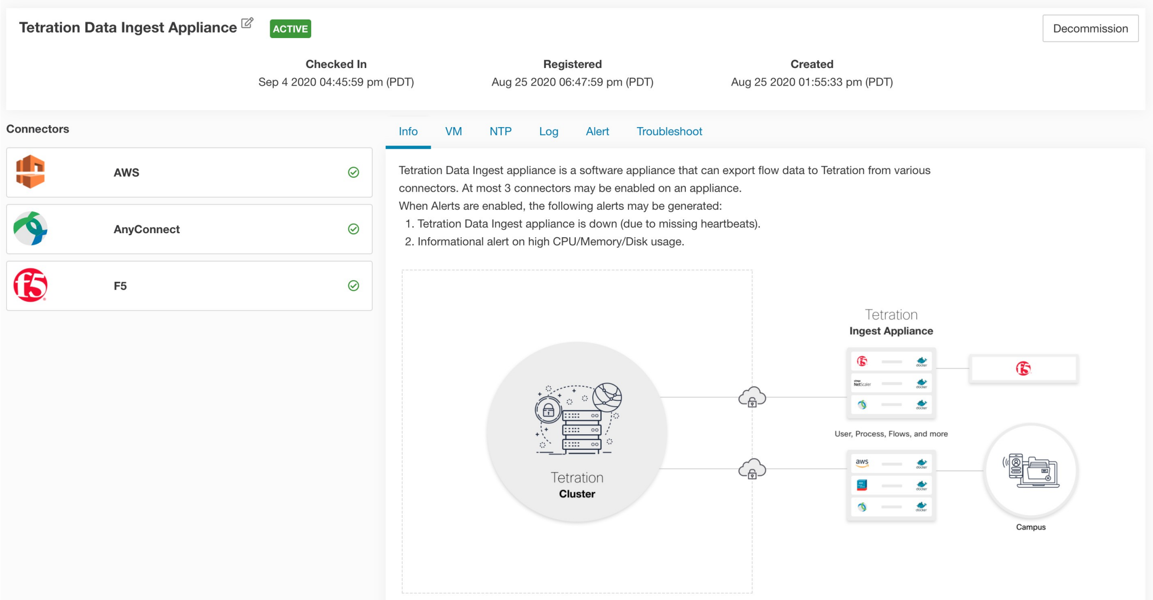
Specification

- Number of CPU cores: 8
- Memory: 8 GB
- Storage: 250 GB
- Number of network interfaces: 3
- Number of connectors on one appliance: 3
- Operating System: CentOS 7.9 (Secure Workload 3.8.1.19 and earlier), AlmaLinux 9.2 (Secure Workload 3.8.1.36 and later)

See important limits at Connectors.

Note Each root scope on Secure Workload can have at most 100 Secure Workload Ingest appliances deployed.

Figure 90: Secure Workload Ingest appliance



Tetration Data Ingest Appliance ACTIVE

Decommission

Checked In	Registered	Created
Sep 4 2020 04:45:59 pm (PDT)	Aug 25 2020 06:47:59 pm (PDT)	Aug 25 2020 01:55:33 pm (PDT)

Connectors

- AWS ✓
- AnyConnect ✓
- F5 ✓

Info VM NTP Log Alert Troubleshoot

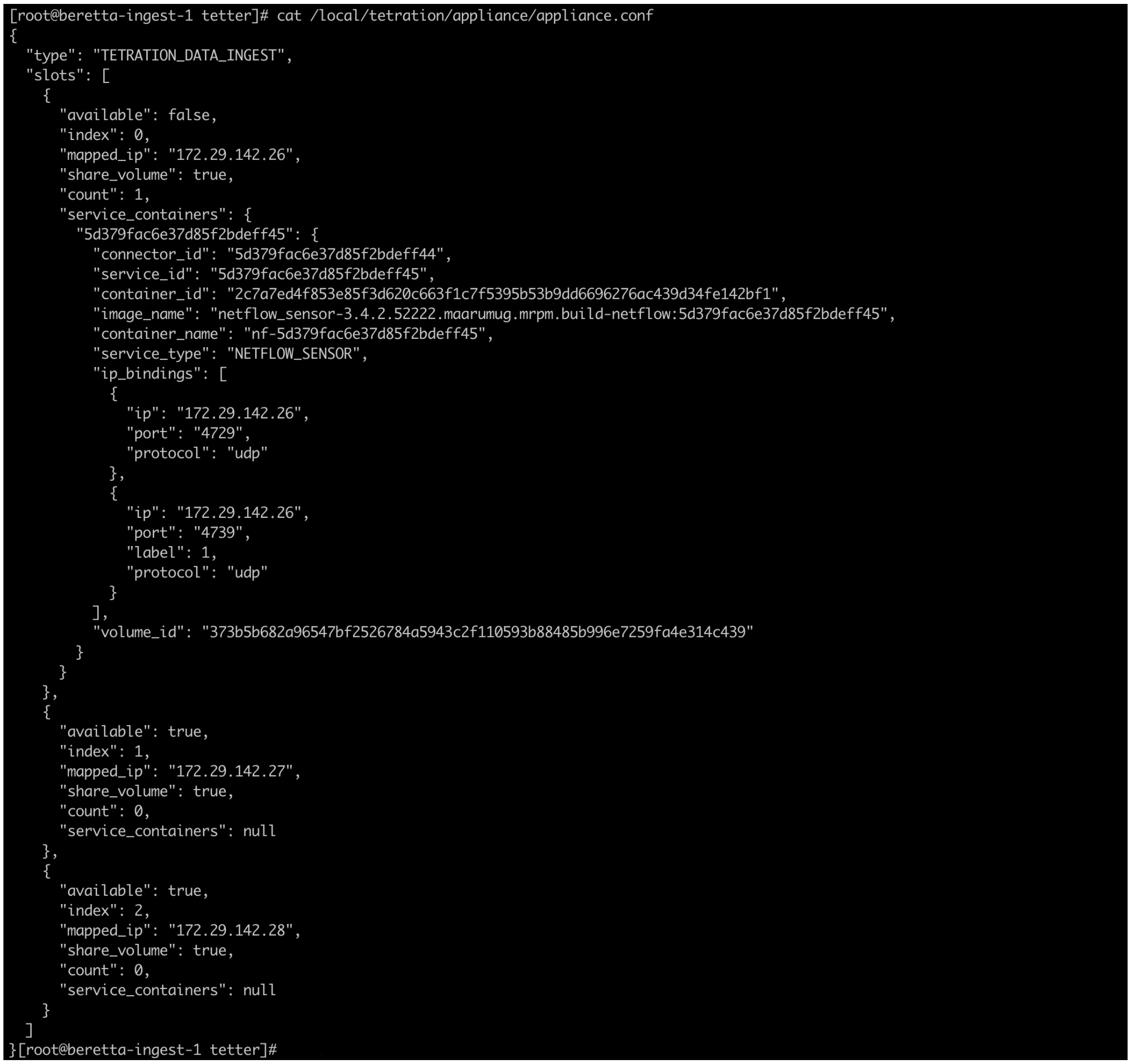
Tetration Data Ingest appliance is a software appliance that can export flow data to Tetration from various connectors. At most 3 connectors may be enabled on an appliance.

When Alerts are enabled, the following alerts may be generated:

1. Tetration Data Ingest appliance is down (due to missing heartbeats).
2. Informational alert on high CPU/Memory/Disk usage.

Secure Workload Ingest appliance allows at most 3 connectors to be enabled on an appliance. There can be more than one instance of the same connector enabled on the same appliance. For the ERSPAN Ingest appliance three ERSPAN connectors are always automatically provisioned. Many of the connectors deployed on Ingest appliance collects telemetry from various points in the network, these connectors need to listen on specific ports on the appliance. Each connector is therefore bound to one of the IP address and the default ports on which the connector should be listening to collect telemetry data. As a result, each IP address is essentially a slot that a connector occupies on the appliance. When a connector is enabled, a slot is taken (thereby, the IP corresponding to the slot). And, when a connector is disabled, the slot occupied by the connector is released (thereby, the IP corresponding to the slot). See the *Secure Workload Ingest appliance slots* for how to ingest appliance maintains the state of the slots.

Figure 91: Secure Workload Ingest appliance slots



```
[root@beretta-ingest-1 tetter]# cat /local/tetration/appliance/appliance.conf
{
  "type": "TETRATION_DATA_INGEST",
  "slots": [
    {
      "available": false,
      "index": 0,
      "mapped_ip": "172.29.142.26",
      "share_volume": true,
      "count": 1,
      "service_containers": {
        "5d379fac6e37d85f2bdeff45": {
          "connector_id": "5d379fac6e37d85f2bdeff44",
          "service_id": "5d379fac6e37d85f2bdeff45",
          "container_id": "2c7a7ed4f853e85f3d620c663f1c7f5395b53b9dd6696276ac439d34fe142bf1",
          "image_name": "netflow_sensor-3.4.2.52222.maarumug.mrpm.build-netflow:5d379fac6e37d85f2bdeff45",
          "container_name": "nf-5d379fac6e37d85f2bdeff45",
          "service_type": "NETFLOW_SENSOR",
          "ip_bindings": [
            {
              "ip": "172.29.142.26",
              "port": "4729",
              "protocol": "udp"
            },
            {
              "ip": "172.29.142.26",
              "port": "4739",
              "label": 1,
              "protocol": "udp"
            }
          ],
          "volume_id": "373b5b682a96547bf2526784a5943c2f110593b88485b996e7259fa4e314c439"
        }
      }
    },
    {
      "available": true,
      "index": 1,
      "mapped_ip": "172.29.142.27",
      "share_volume": true,
      "count": 0,
      "service_containers": null
    },
    {
      "available": true,
      "index": 2,
      "mapped_ip": "172.29.142.28",
      "share_volume": true,
      "count": 0,
      "service_containers": null
    }
  ]
}[root@beretta-ingest-1 tetter]#
```

Allowed Configurations

- *NTP*: Configure NTP on the appliance. For more information, see NTP Configuration.
- *Log*: Configure Logging on the appliance. For more information, see Log Configuration.

Secure Workload Edge

Secure Workload Edge is a control appliance that streams alerts to various notifiers and collects inventory metadata from network access controllers such as Cisco ISE. In a Secure Workload Edge appliance, all alert notifier connectors (such as Syslog, Email, Slack, PagerDuty, and Kinesis), ServiceNow connector, Workload AD connector, and ISE connector can be deployed.

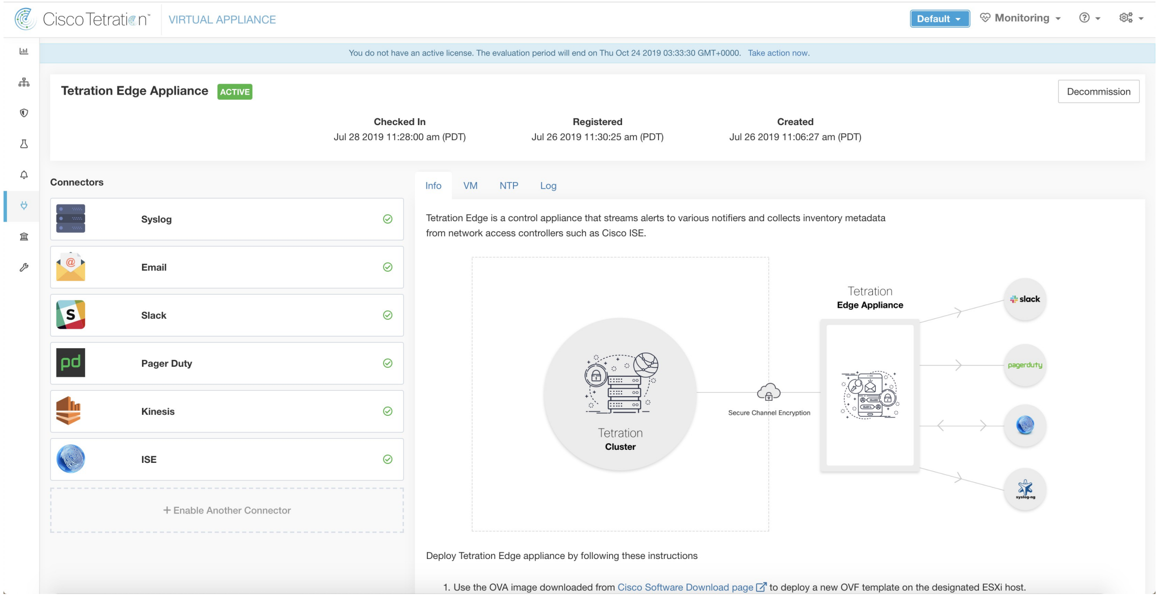
Specification

- Number of CPU cores: 8
- Memory: 8 GB
- Storage: 250 GB
- Number of network interfaces: 1
- Number of connectors on one appliance: 8
- Operating System: CentOS 7.9 (Secure Workload 3.8.1.19 and earlier), AlmaLinux 9.2 (Secure Workload 3.8.1.36 and later)

See important limits at Connectors.

Note Each root scope on Secure Workload can have at most one Secure Workload Edge appliance deployed.

Figure 92: Secure Workload Edge appliance



You do not have an active license. The evaluation period will end on Thu Oct 24 2019 03:33:30 GMT+0000. Take action now.

Tetration Edge Appliance ACTIVE

Decommission

Checked In	Registered	Created
Jul 28 2019 11:28:00 am (PDT)	Jul 26 2019 11:30:25 am (PDT)	Jul 26 2019 11:06:27 am (PDT)

Connectors

Tetration Edge is a control appliance that streams alerts to various notifiers and collects inventory metadata from network access controllers such as Cisco ISE.

Deploy Tetration Edge appliance by following these instructions

1. Use the OVA image downloaded from Cisco Software Download page to deploy a new OVF template on the designated ESXi host.

The connectors deployed on Secure Workload Edge appliance do not listen on ports. Therefore, the Docker containers instantiated for the connectors on Secure Workload Edge appliance do not expose any ports to the host.

Allowed Configurations

- *NTP*: Configure NTP on the appliance. For more information, see NTP Configuration.
- *Log*: Configure Logging on the appliance. For more information, see Log Configuration.

Deploying a Virtual Appliance

You will deploy virtual appliances on an ESXi host in VMware vCenter or other KVM-based hypervisors such as Red Hat Virtualization. This procedure will prompt you to download virtual appliance OVA template or QCOW2 image from the Cisco Software Download page.

Attention To deploy a Secure Workload external appliance, the ESXi host where the appliance is created should have the following specifications:

- **vSphere**: version 5.5 or better.
- **CPU**: at least 2.2 GHz per core, and has enough reservable capacity for the appliance.
- **Memory**: at least enough space to fit the appliance.

To deploy a virtual appliance to collect data from connectors:

Procedure

Step 1 In the Secure Workload web portal, choose **Manage** > **Virtual Appliances** from the navigation bar on the left.

Step 2 Click **Enable a Connector**. The type of virtual appliance you need to deploy depends on the type of connector you are enabling.

Step 3 Click the type of connector for which you need to create the virtual appliance. For example, click the NetFlow connector.

Step 4 On the connector page, click **Enable**.

Step 5 If you see a notice telling you that you need to deploy a virtual appliance, click **Yes**. If you do not see this notice, you may already have a virtual appliance that this connector can use, in which case you do not need to perform this procedure.

Step 6 Click the link to download the OVA template or QCOW2 image for the virtual appliance. Leave the wizard open on your screen without clicking anything else.

Step 7 Use the downloaded:

- OVA to deploy a new OVF template on a designated ESXi host.
  - To deploy an OVA on a vSphere Web Client, follow the instructions on how to Deploy an OVF Template.
  - Ensure that the deployed VM settings match the recommended configuration for the virtual appliance type.
  - **Do not power on the deployed VM**
- QCOW2 image to create a new VM on KVM hypervisors such as Red Hat Virtualization.

Step 8 After the VM is deployed, but before you power it on, return to the virtual appliance deployment wizard in the Secure Workload web portal.

Step 9 Click **Next** in the virtual appliance deployment wizard.

Step 10 Configure the virtual appliance by providing IP address(es), gateway(s), hostname, DNS, proxy server settings and docker bridge subnet configuration. See the screenshot for *Configuring the VM with network parameters*.

- If the appliance needs to use proxy server to reach Secure Workload, check the box *Use proxy server to connect to Secure Workload*. If this is not set correctly, connectors may not be able to communicate with Secure Workload for control messages, register connectors, and send flow data to Secure Workload collector.
- If the IP address(es) and gateways(s) of the appliance conflict with the default docker bridge subnet (*172.17.0.1/16*), the appliance can be configured with a customized docker bridge subnet specified in *Docker Bridge (CIDR format)* field. This requires appliance OVA 3.3.2.16 or later.

Step 11 Click **Next**.

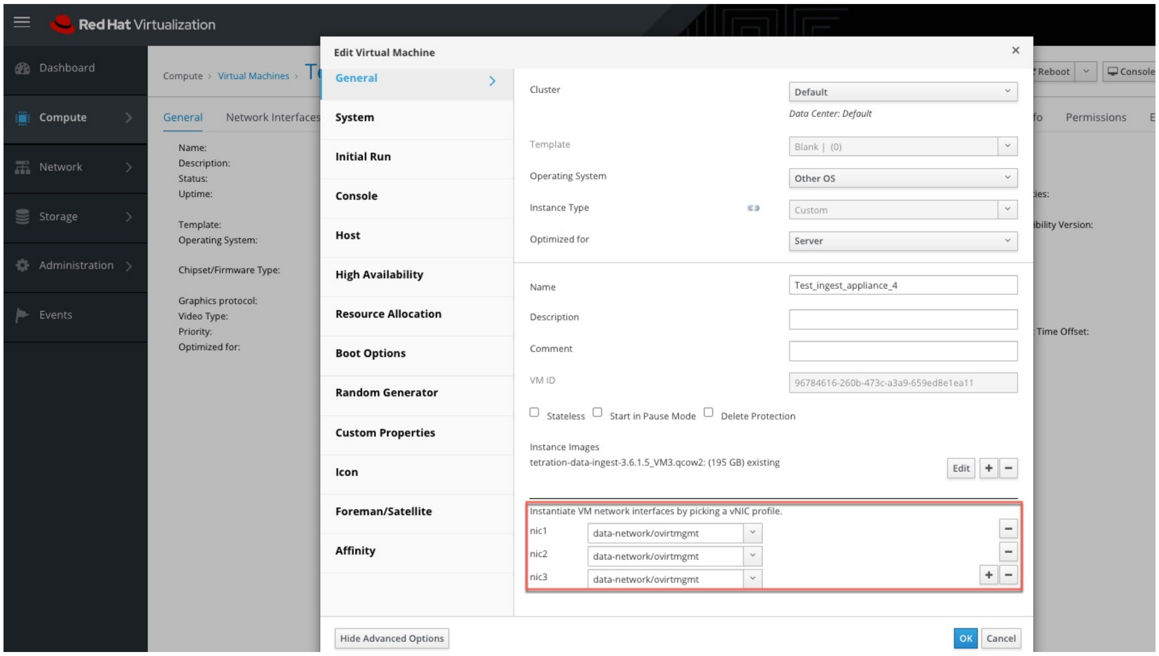
Step 12 In the next step, a VM configuration bundle will be generated and available for download. Download the VM configuration bundle. See the screenshot for *Download the VM configuration bundle*.

Step 13 Upload the VM configuration bundle to the datastore corresponding to the target ESXi host or other virtualization host.

Step 14 [**Applicable only when using QCOW2 image**] Complete the following configurations on the other virutalization host where you have uploaded the VM configuration bundle:

- For ingest appliances, configure three network interfaces.

Figure 93: Example of configuring network interfaces in KVM-based environments

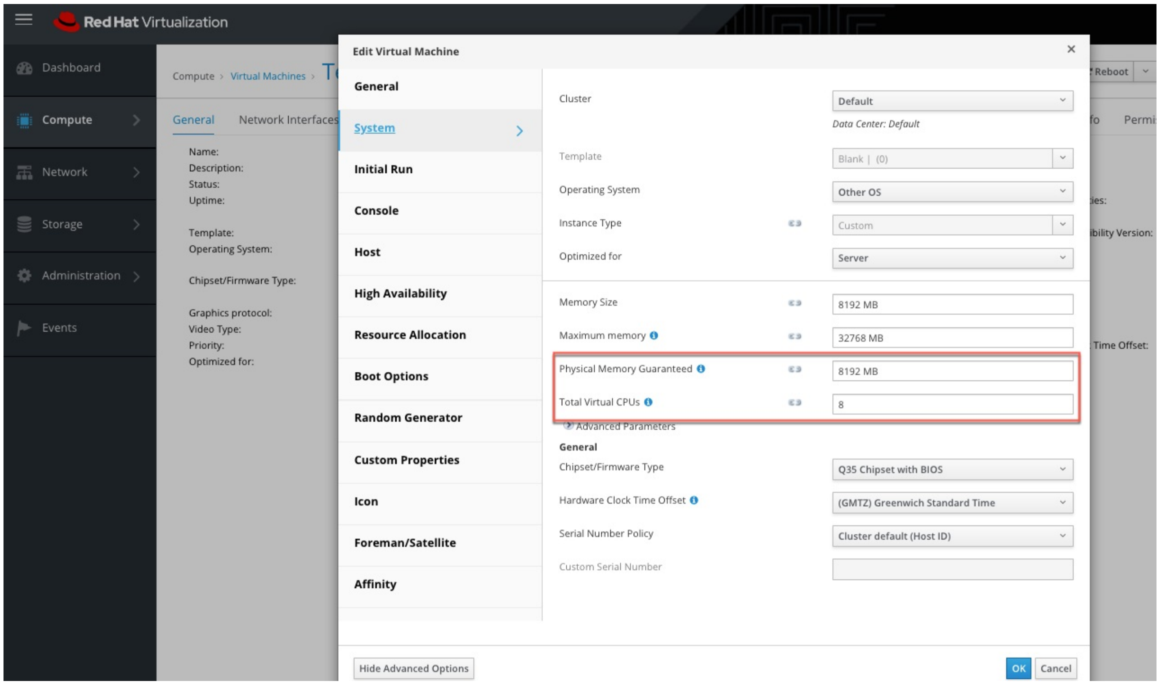


Cluster: Default
Data Center: Default
Template: Blank | (0)
Operating System: Other OS
Instance Type: Custom
Optimized for: Server
Name: Test_ingest_appliance_4
Description:
Comment:
VM ID: 96784616-260b-473c-a3a9-659ed8e1ea11
☐ Stateless ☐ Start in Pause Mode ☐ Delete Protection
Instance Images
tetration-data-ingest-3.6.1.5_VM3.qcow2: (195 GB) existing

Instantiate VM network interfaces by picking a vNIC profile.
nic1: data-network/ovirtmgmt
nic2: data-network/ovirtmgmt
nic3: data-network/ovirtmgmt

- In the memory allocation, specify the minimum requirement of 8192 MB of RAM.
- Specify the total number of virtual CPUs to be 8.

Figure 94: Example of configuring system resources in KVM-based environments



Cluster: Default
Data Center: Default
Template: Blank | (0)
Operating System: Other OS
Instance Type: Custom
Optimized for: Server
Memory Size: 8192 MB
Maximum memory: 32768 MB
Physical Memory Guaranteed: 8192 MB
Total Virtual CPUs: 8
Advanced Parameters
General
Chipset/Firmware Type: Q35 Chipset with BIOS
Hardware Clock Time Offset: (GMTZ) Greenwich Standard Time
Serial Number Policy: Cluster default (Host ID)
Custom Serial Number:

Step 15 Edit the VM settings and mount the VM configuration bundle from the datastore to the CD/DVD drive. Make sure to select **Connect at Power On** checkbox.

Step 16 Power on the deployed VM.

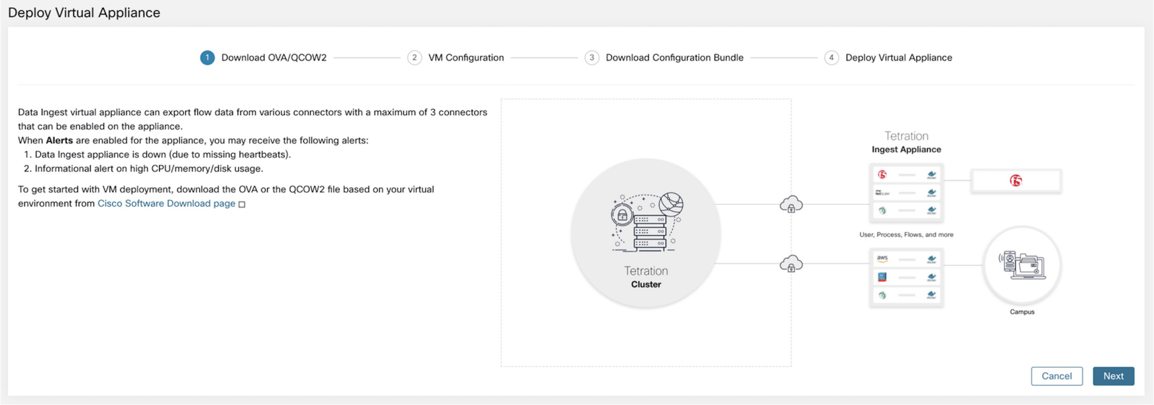
Step 17 Once the VM boots up and configures itself, it will connect back to Secure Workload. This may take a few minutes. The appliance status on Secure Workload should transition from *Pending Registration* to *Active*. See the screenshot for *Secure Workload Ingest appliance in Pending Registration state*.

Note We do not recommend vMotion to be enabled for Secure Workload external appliances.

Note We recommend to use Secure Workload external appliance OVAs as-is and to reserve 8 vCPU cores and 8192 MB of memory for QCOW2 images to deploy VMs. If sufficient resources are not available, the VM setup script would fail after the boot.

Once the appliance is *Active*, connectors can be enabled and deployed on it.

Figure 95: ploying a Secure Workload Ingest appliance



Deploy Virtual Appliance

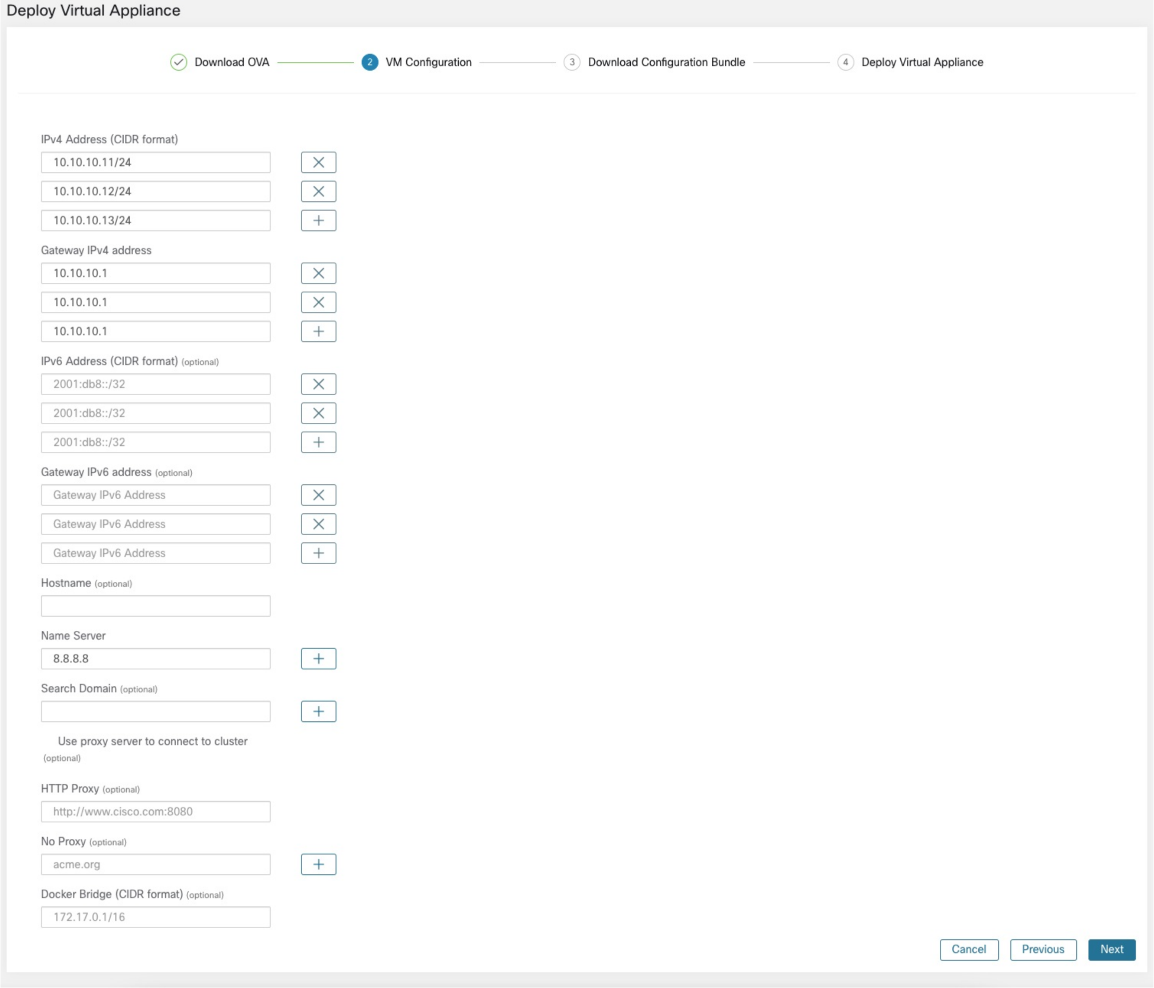
1 Download OVA/QCOW2 — 2 VM Configuration — 3 Download Configuration Bundle — 4 Deploy Virtual Appliance

Data Ingest virtual appliance can export flow data from various connectors with a maximum of 3 connectors that can be enabled on the appliance.
When **Alerts** are enabled for the appliance, you may receive the following alerts:

1. Data Ingest appliance is down (due to missing heartbeats).
2. Informational alert on high CPU/memory/disk usage.

To get started with VM deployment, download the OVA or the QCOW2 file based on your virtual environment from Cisco Software Download page

Figure 96: Configuring the VM with network parameters



Deploy Virtual Appliance

✓ Download OVA — 2 VM Configuration — 3 Download Configuration Bundle — 4 Deploy Virtual Appliance

IPv4 Address (CIDR format)
10.10.10.11/24
10.10.10.12/24
10.10.10.13/24

Gateway IPv4 address
10.10.10.1
10.10.10.1
10.10.10.1

IPv6 Address (CIDR format) (optional)
2001:db8::/32
2001:db8::/32
2001:db8::/32

Gateway IPv6 address (optional)
Gateway IPv6 Address
Gateway IPv6 Address
Gateway IPv6 Address

Hostname (optional)

Name Server
8.8.8.8

Search Domain (optional)

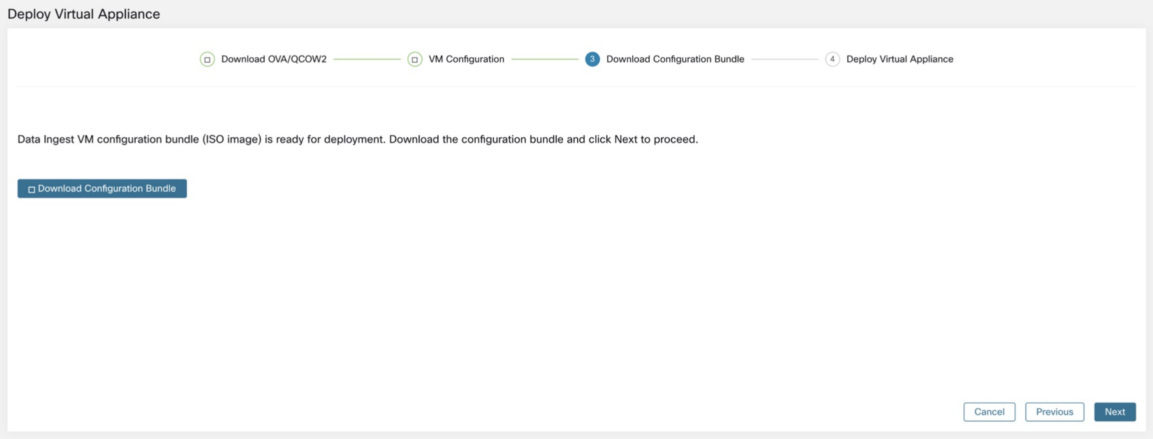
Use proxy server to connect to cluster (optional)

HTTP Proxy (optional)
http://www.cisco.com:8080

No Proxy (optional)
acme.org

Docker Bridge (CIDR format) (optional)
172.17.0.1/16

Figure 97: Download the VM configuration bundle



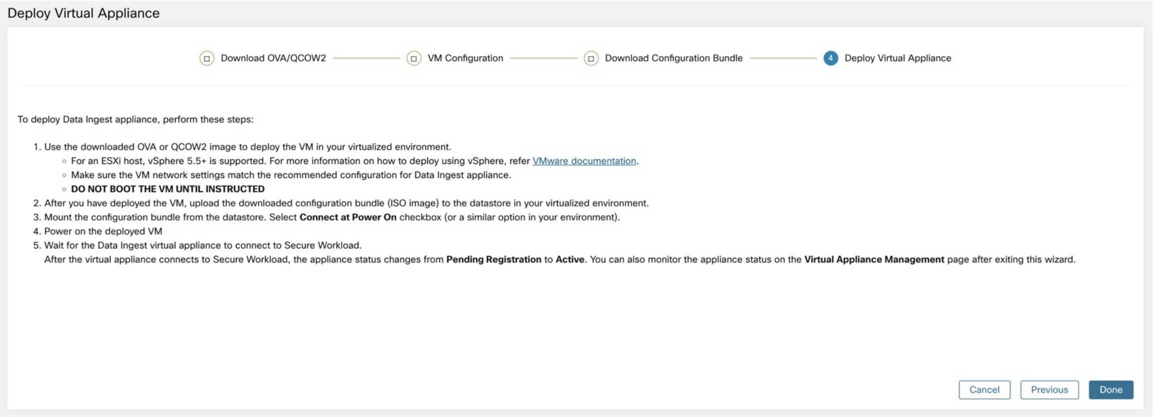
Deploy Virtual Appliance

□ Download OVA/QCOW2
□ VM Configuration
3 Download Configuration Bundle
4 Deploy Virtual Appliance

Data Ingest VM configuration bundle (ISO image) is ready for deployment. Download the configuration bundle and click Next to proceed.

□ Download Configuration Bundle
Cancel
Previous
Next

Figure 98: Deploy the VM

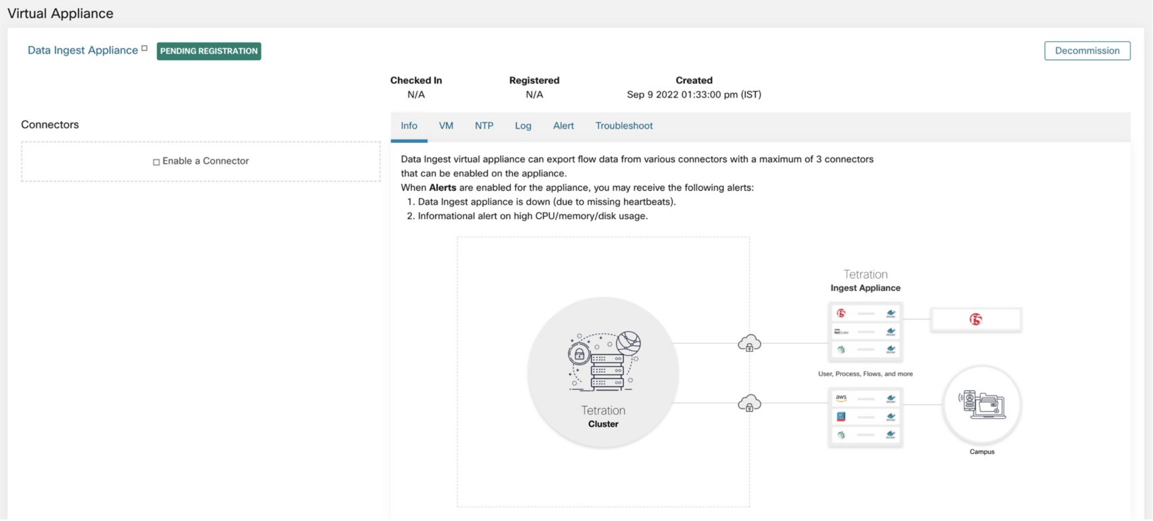


Deploy Virtual Appliance

To deploy Data Ingest appliance, perform these steps:

1. Use the downloaded OVA or QCOW2 image to deploy the VM in your virtualized environment.
   - For an ESXi host, vSphere 5.5+ is supported. For more information on how to deploy using vSphere, refer VMware documentation.
   - Make sure the VM network settings match the recommended configuration for Data Ingest appliance.
   - **DO NOT BOOT THE VM UNTIL INSTRUCTED**
2. After you have deployed the VM, upload the downloaded configuration bundle (ISO image) to the datastore in your virtualized environment.
3. Mount the configuration bundle from the datastore. Select **Connect at Power On** checkbox (or a similar option in your environment).
4. Power on the deployed VM
5. Wait for the Data Ingest virtual appliance to connect to Secure Workload.
   After the virtual appliance connects to Secure Workload, the appliance status changes from **Pending Registration** to **Active**. You can also monitor the appliance status on the **Virtual Appliance Management** page after exiting this wizard.

Figure 99: Secure Workload Ingest appliance in Pending Registration state



Virtual Appliance

Checked In	Registered	Created
N/A	N/A	Sep 9 2022 01:33:00 pm (IST)

Data Ingest virtual appliance can export flow data from various connectors with a maximum of 3 connectors that can be enabled on the appliance.
When **Alerts** are enabled for the appliance, you may receive the following alerts:
1. Data Ingest appliance is down (due to missing heartbeats).
2. Informational alert on high CPU/memory/disk usage.

When a virtual appliance is deployed and booted up for the first time, *tet-vm-setup* service executes and sets up the appliance. This service is responsible for the following tasks

a. **Validate the appliance:** validate the appliance for mandatory resource requirements for the type of the virtual appliance deployed.

b. **IP address assignment:** assign IP addresses to all the network interfaces provisioned on the appliance.

c. **Hostname assignment:** assign hostname for the appliance (if hostname is configured).

d. **DNS configuration:** update the DNS resolv.conf file (if nameserver and/or search-domain parameters are configured).

e. **Proxy server configuration:** update HTTPS_PROXY and NO_PROXY settings on the appliance (if provided).

f. **Prepare appliance:** copies cert bundle for the Kafka topic over which appliance management messages are sent and received.

g. **Install appliance controller:** install and bring up *Appliance Controller* which is managed by *supervisord* as *tet-controller* service.

Once *tet-controller* is instantiated, it takes over the management of the appliance. This service is responsible for the following functions:

a. **Registration:** registers the appliance with Secure Workload. Until the appliance is registered, no connectors can be enabled on the appliance. When Secure Workload receives a registration request for an appliance, it updates the state of the appliance to *Active*.

b. **Deploying a connector:** deploys a connector as a Docker service on the appliance. For more information, see Enabling a Connector.

c. **Deleting a connector:** stops and removes the Docker service and the corresponding Docker image from the appliance. For more information, see Deleting a Connector.

d. **Configuration updates on appliances:** tests and applies configuration updates on the appliance. For more information, see Configuration Management on Connectors and Virtual Appliances.

e. **Troubleshooting commands on appliances:** executes allowed set of commands on the appliances for troubleshooting and debugging issues on the appliance. For more information, see the Troubleshooting.

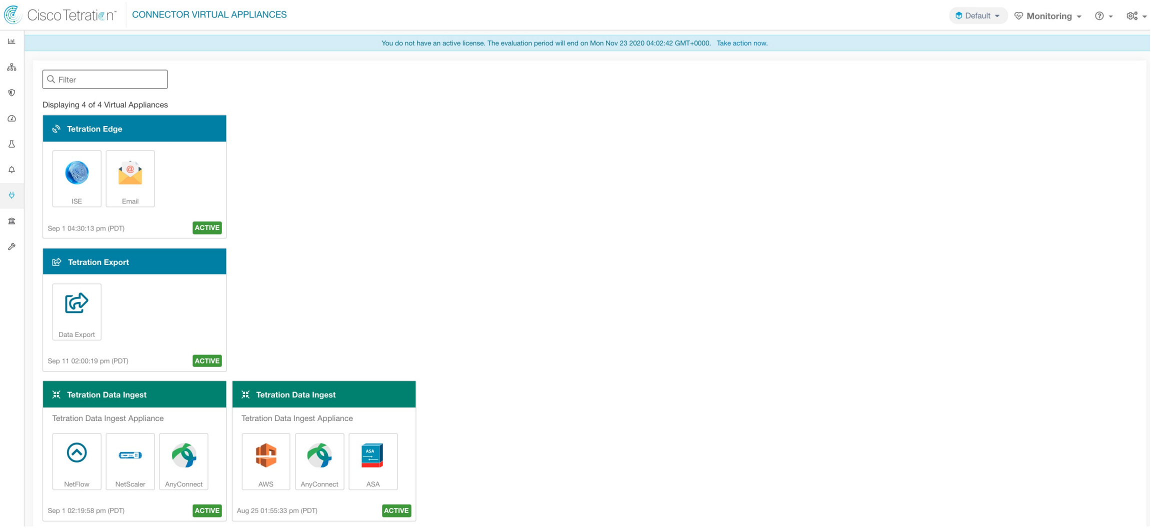
f. **Heartbeats:** periodically sends heartbeats and statistics to Secure Workload to report the health of the appliance. For more information, see Monitoring a Virtual Appliance.

g. **Pruning:** periodically prune all Docker resources that are unused or dangling in order to recover storage space. This task is executed once every 24 hours.

h. **Decommissioning the appliance:** decommissions and deletes all Docker instances from the appliance. For more information, see Decommissioning a Virtual Appliance.

The list of deployed virtual appliances can be found at: **Manage** > **Virtual Appliances**

Figure 100: List of deployed virtual appliances



You do not have an active license. The evaluation period will end on Mon Nov 23 2020 04:02:42 GMT+0000. Take action now.

Displaying 4 of 4 Virtual Appliances

Decommissioning a Virtual Appliance

A virtual appliance can be decommissioned from Secure Workload. When an appliance is decommissioned, the following actions are triggered.

1. All configurations on the appliance and the connectors enabled on the appliance are removed.
2. All the connectors enabled on the appliance are deleted.
3. The appliance is marked *Pending Delete*.
4. When the appliance replies back with a successful delete response, appliance Kafka topic and certs are deleted.

Note Decommissioning an appliance cannot be undone. To restore the appliance and the connectors, a new appliance should be deployed and the connectors should be enabled on the new appliance.

Monitoring a Virtual Appliance

Secure Workload virtual appliances periodically send heartbeats and statistics to Secure Workload. The heartbeat interval is 5 minutes. The heartbeat messages include statistics about the health of the appliance include system statistics, process statistics, and statistics about how many messages sent/received/error-ed over the Kafka topic that is used for the appliance management.

All metrics are available in *Digger* (OpenTSDB) and are labelled with appliance ID and root scope name. Additionally, Grafana dashboards for *Appliance Controller* are also available for important metrics from the appliance.

Security Considerations

The Ingest/Edge Virtual Machine's guest Operating System is CentOS 7.9, from which OpenSSL server/clients packages were removed. Therefore, the only way to access the appliance is via its console.

Note CentOS 7.9 is the guest operating system for Ingest and Edge virtual appliances in Secure Workload 3.8.1.19 and earlier releases. Starting Secure Workload 3.8.1.36, the operating system is AlmaLinux 9.2.

The containers run a centos:7.9.2009 based Docker image. Most the containers are run with the base privileges (no-privileged option), except for ERSPAN container, which has the NET_ADMIN capability.

Note Starting Secure Workload 3.8.1.36, the containers run almalinux/9-base:9.2.

In the unlikely case a container is compromised, the VM guest OS should not be compromisable from inside the container.

Life Cycle Management of Connectors

Connectors can be enabled, deployed, configured, troubleshooted, and deleted from Secure Workload directly.

Enabling a Connector

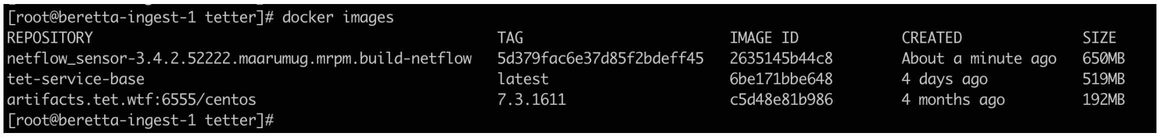
From the Connectors page (**Manage** > **Connectors**), a connector can be selected and enabled. The connector can be deployed on a new virtual appliance (which has to be provisioned first and become *Active* before a connector can be enabled on it) or an existing virtual appliance. Once the virtual appliance is chosen, Secure Workload sends the rpm package for the connector to the appliance.

When Appliance Controller on the chosen appliance receives the rpm, it does the following:

1. Construct a Docker image using the rpm package received from Secure Workload. This Docker image includes the configuration required to communicate with Kafka topic on which appliance management messages are sent. This enables the service instantiated from this image to be able to send and receive messages for managing the corresponding connector.
2. Create a Docker container from the Docker image.
3. On Secure Workload Ingest appliance, the following additional tasks are performed.
   - A free slot is identified and the corresponding IP address is determined.
   - Connector listening ports (for example, 4729 and 4739 ports on NetFlow connector to receive flow records from NetFlow V9 or IPFIX enabled switches and routers), are exposed to the host on IP corresponding to the chosen slot.
   - A Docker volume is created and added to the container.

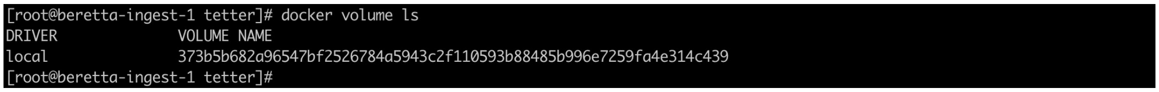
4. The Docker container is started and it executes the connector as a *supervisord* managed service. The service starts *Service Controller* as *tet-controller* which registers with Secure Workload and spawns the actual connector service.

Figure 101: Docker Images



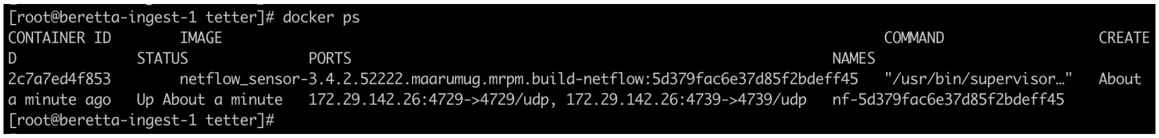
```
[root@beretta-ingest-1 tetter]# docker images
REPOSITORY                                               TAG                        IMAGE ID            CREATED               SIZE
netflow_sensor-3.4.2.52222.maarumug.mrpm.build-netflow   5d379fac6e37d85f2bdeff45   2635145b44c8        About a minute ago   650MB
tet-service-base                                         latest                     6be171bbe648        4 days ago           519MB
artifacts.tet.wtf:6555/centos                            7.3.1611                   c5d48e81b986        4 months ago         192MB
[root@beretta-ingest-1 tetter]#
```

Figure 102: Docker Volumes



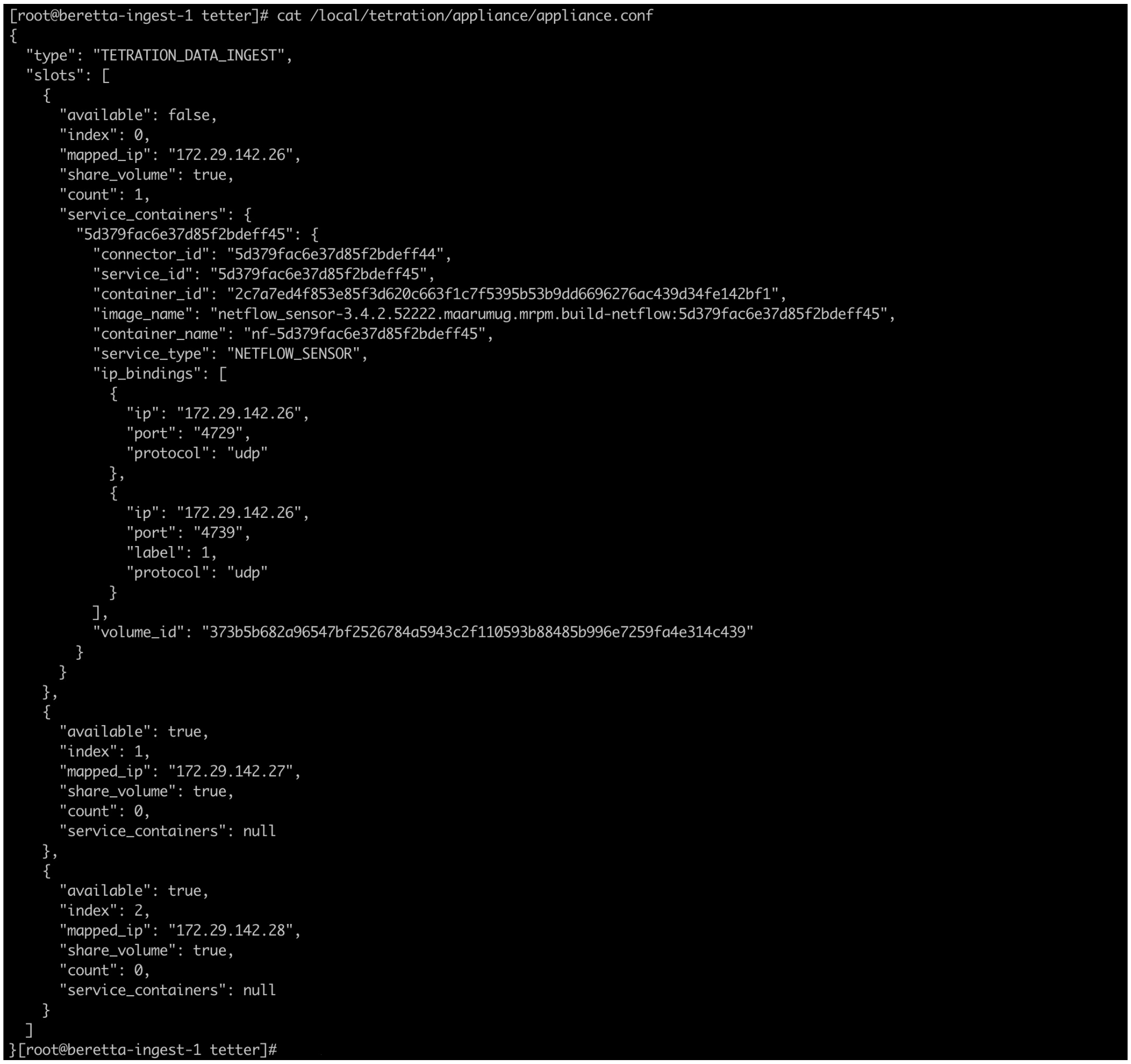
```
[root@beretta-ingest-1 tetter]# docker volume ls
DRIVER              VOLUME NAME
local               373b5b682a96547bf2526784a5943c2f110593b88485b996e7259fa4e314c439
[root@beretta-ingest-1 tetter]#
```

Figure 103: Docker containers



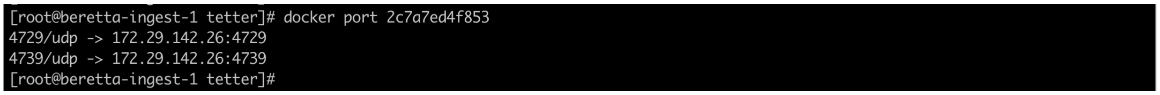
```
[root@beretta-ingest-1 tetter]# docker ps
CONTAINER ID        IMAGE                                                                             COMMAND                  CREATE
D              STATUS              PORTS                                                        NAMES
2c7a7ed4f853        netflow_sensor-3.4.2.52222.maarumug.mrpm.build-netflow:5d379fac6e37d85f2bdeff45   "/usr/bin/supervisor…"   About
a minute ago   Up About a minute   172.29.142.26:4729->4729/udp, 172.29.142.26:4739->4739/udp   nf-5d379fac6e37d85f2bdeff45
[root@beretta-ingest-1 tetter]#
```

Figure 104: Slot used by the Docker container and list of exposed ports



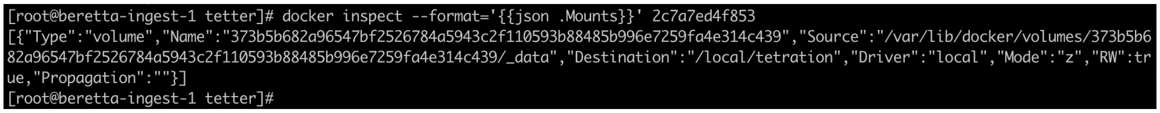
```
[root@beretta-ingest-1 tetter]# cat /local/tetration/appliance/appliance.conf
{
  "type": "TETRATION_DATA_INGEST",
  "slots": [
    {
      "available": false,
      "index": 0,
      "mapped_ip": "172.29.142.26",
      "share_volume": true,
      "count": 1,
      "service_containers": {
        "5d379fac6e37d85f2bdeff45": {
          "connector_id": "5d379fac6e37d85f2bdeff44",
          "service_id": "5d379fac6e37d85f2bdeff45",
          "container_id": "2c7a7ed4f853e85f3d620c663f1c7f5395b53b9dd6696276ac439d34fe142bf1",
          "image_name": "netflow_sensor-3.4.2.52222.maarumug.mrpm.build-netflow:5d379fac6e37d85f2bdeff45",
          "container_name": "nf-5d379fac6e37d85f2bdeff45",
          "service_type": "NETFLOW_SENSOR",
          "ip_bindings": [
            {
              "ip": "172.29.142.26",
              "port": "4729",
              "protocol": "udp"
            },
            {
              "ip": "172.29.142.26",
              "port": "4739",
              "label": 1,
              "protocol": "udp"
            }
          ],
          "volume_id": "373b5b682a96547bf2526784a5943c2f110593b88485b996e7259fa4e314c439"
        }
      }
    },
    {
      "available": true,
      "index": 1,
      "mapped_ip": "172.29.142.27",
      "share_volume": true,
      "count": 0,
      "service_containers": null
    },
    {
      "available": true,
      "index": 2,
      "mapped_ip": "172.29.142.28",
      "share_volume": true,
      "count": 0,
      "service_containers": null
    }
  ]
}[root@beretta-ingest-1 tetter]#
```

Figure 105: List of ports exposed by Docker container



```
[root@beretta-ingest-1 tetter]# docker port 2c7a7ed4f853
4729/udp -> 172.29.142.26:4729
4739/udp -> 172.29.142.26:4739
[root@beretta-ingest-1 tetter]#
```

Figure 106: Docker Volume mounted to a container



```
[root@beretta-ingest-1 tetter]# docker inspect --format='{{json .Mounts}}' 2c7a7ed4f853
[{"Type":"volume","Name":"373b5b682a96547bf2526784a5943c2f110593b88485b996e7259fa4e314c439","Source":"/var/lib/docker/volumes/373b5b6
82a96547bf2526784a5943c2f110593b88485b996e7259fa4e314c439/_data","Destination":"/local/tetration","Driver":"local","Mode":"z","RW":tr
ue,"Propagation":""}]
[root@beretta-ingest-1 tetter]#
```

Service Controller is responsible for the following functions:

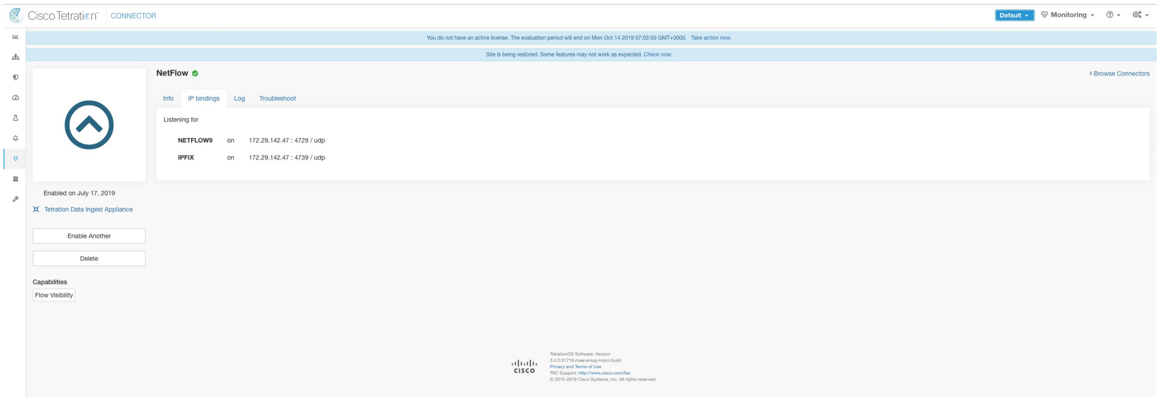
1. **Registration**: registers the connector with Secure Workload. Until the connector is registered and marked *Enabled*, no configuration updates can be pushed to the connector. When Secure Workload receives a registration request for a connector, it updates the state of the connector to *Enabled*.
2. **Configuration updates on connector**: tests and applies configuration updates on the connector. For more information, see Configuration Management on Connectors and Virtual Appliances.
3. **Troubleshooting commands on connector**: executes allowed commands on the connector service for troubleshooting and debugging issues on the connector service. For more information, see Troubleshooting.
4. **Heartbeats**: periodically sends heartbeats and statistics to Secure Workload to report the health of the connector. For more information, see Monitoring a Virtual Appliance.

Viewing Connector-Related Information

Enabled Connectors: A list of all enabled connectors can be found by clicking **Manage** > **Connectors** in the navigation bar at the left side of the window.

Connector Details: Details about the connector can be fetched by clicking on the connector. This page shows the port bindings -if any- that can be used to configure upstream network elements to send telemetry data to the correct IP and port.

Figure 107: Connector details



You do not have an active license. The evaluation period will end on Mon Oct 14 2019 07:03:50 GMT+0000. Take action now.

Site is being restored. Some features may not work as expected. Check now.

Listening for

NETFLOW9 on 172.29.142.47 : 4729 / udp

IPFIX on 172.29.142.47 : 4739 / udp

Enabled on July 17, 2019

Tetration Data Ingest Appliance

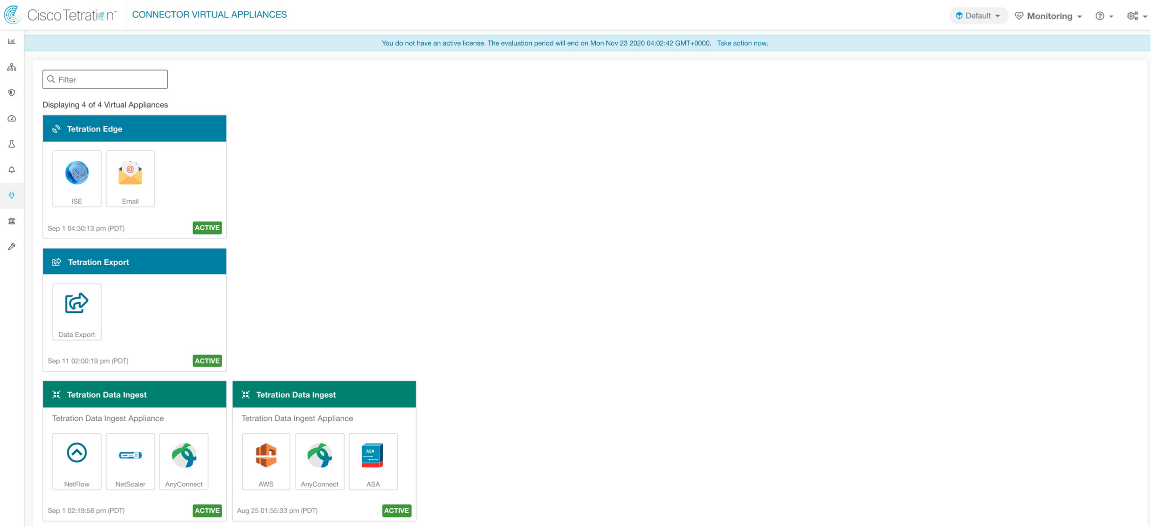
Capabilities

Flow Visibility

TetrationOS Software, Version
3.4.2.51716.maarumug.mrpm.build
Privacy and Terms of Use
TAC Support: http://www.cisco.com/tac
© 2015-2019 Cisco Systems, Inc. All rights reserved.

Deployed Virtual Appliances: A list of deployed virtual appliances can be found at: **Manage** > **Virtual Appliances**.

Figure 108: List of deployed virtual appliances



You do not have an active license. The evaluation period will end on Mon Nov 23 2020 04:02:42 GMT+0000. Take action now.

Displaying 4 of 4 Virtual Appliances

Sep 1 04:30:13 pm (PDT)

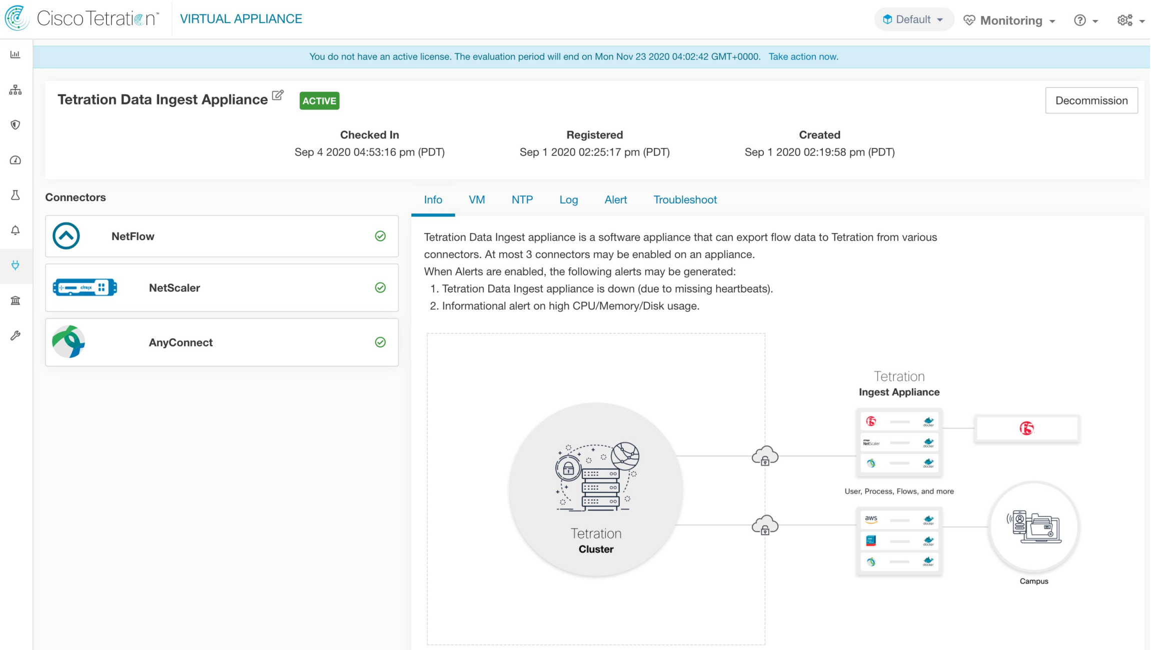
Sep 11 02:00:19 pm (PDT)

Tetration Data Ingest Appliance: NetFlow, NetScaler, AnyConnect — Sep 1 02:19:58 pm (PDT)

Tetration Data Ingest Appliance: AWS, AnyConnect, ASA — Aug 25 01:55:33 pm (PDT)

Virtual Appliance Details A detailed view of an appliance can be fetched by clicking on the appliance directly from *List of deployed virtual appliances*.

Figure 109: Appliance details and the connectors



You do not have an active license. The evaluation period will end on Mon Nov 23 2020 04:02:42 GMT+0000. Take action now.

Tetration Data Ingest Appliance ACTIVE

Checked In	Registered	Created
Sep 4 2020 04:53:16 pm (PDT)	Sep 1 2020 02:25:17 pm (PDT)	Sep 1 2020 02:19:58 pm (PDT)

Connectors

- NetFlow
- NetScaler
- AnyConnect

Tetration Data Ingest appliance is a software appliance that can export flow data to Tetration from various connectors. At most 3 connectors may be enabled on an appliance.

When Alerts are enabled, the following alerts may be generated:

1. Tetration Data Ingest appliance is down (due to missing heartbeats).
2. Informational alert on high CPU/Memory/Disk usage.

Deleting a Connector

When a connector is deleted, Appliance Controller on the appliance where the connector is enabled will receive a message to remove the services created for the connector. Appliance Controller does the following:

1. Stop the Docker container corresponding to the connector.

2. Remove the Docker container.
3. If the connector is deployed on a Secure Workload Ingest appliance and it exposes ports, then remove the Docker volume that was mounted to the container.
4. Remove the Docker image that was created for the connector.
5. Finally, send a message back to Secure Workload indicating the status of the delete request.

Monitoring a Connector

Connector services periodically send heartbeats and statistics to Secure Workload. The heartbeat interval is 5 minutes. The heartbeat messages include statistics about the health of the service include system statistics, process statistics, and statistics about how many messages sent/received/error-ed over the Kafka topic that is used for the appliance management. In addition, it includes statistics exported by the connector service itself.

All metrics are available in *Digger* (OpenTSDB) and are annotated with appliance ID, connector ID, and root scope name. Additionally, Grafana dashboards for connector services are also available for important metrics from the service.

Configuration Management on Connectors and Virtual Appliances

Configuration updates can be pushed to appliances and connectors from Secure Workload. The appliance should have registered successfully with Secure Workload and be *Active* before configuration updates can be initiated. Similarly, the connectors should have registered with Secure Workload before configuration updates can be initiated on the connector services.

There are three modes of configuration updates possible in appliances and connectors.

1. **Test and Apply**: Test the configuration and on successful test, commit the configuration.
2. **Discovery**: Test the configuration, and on successful test, discovery additional properties that can be enabled for the configuration.
3. **Remove**: Remove the configuration.

Note ERSPAN appliance and connector do not support configuration updates.

Test and Apply

Configurations that support *Test and Apply* mode verify the configuration before applying (committing) the configuration on the desired appliance and/or connector.

NTP Configuration

NTP configuration allows the appliance to synchronize the clock with the specified NTP server(s).

Parameter Name	Type	Description
Enable NTP	checkbox	Should NTP sync be enabled?
NTP Servers	listof strings	List of NTP servers. At least one server should be given and at most 5 servers may be provided.

Test: Test if a UDP connection can be made to the given NTP servers on port 123. If an error occurs for any of the NTP servers, do not accept the configuration.

Apply: Update `/etc/ntp.conf` and restart ntpd service using systemctl restart ntpd.service. Here is the template for generating the *ntp.conf*

```
# --- GENERAL CONFIGURATION ---
server <ntp-server>
...
server 127.127.1.0
fudge 127.127.1.0 stratum 10
# Drift file
driftfile /etc/ntp/drift
```

Note Applicable to Secure Workload 3.8.1.19 and earlier.

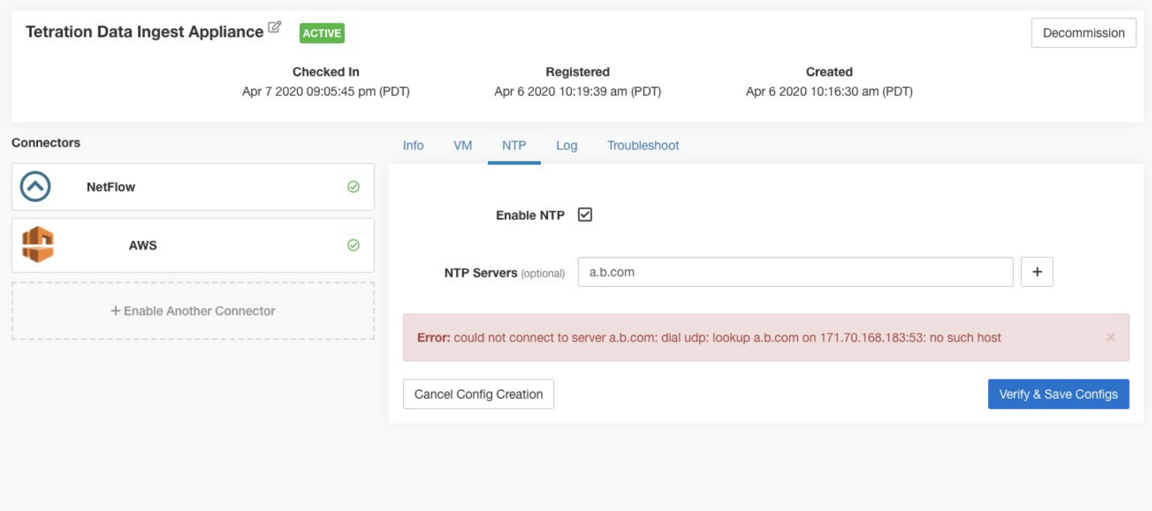
For Secure Workload 3.8.1.36 and later, update `/etc/chrony.conf` and restart chronyd service using systemctl restart chronyd.service. Here is the template for generating the *chrony.conf*

```
# Secure Workload appliance chrony.conf.
server <ntp-server> iburst
...
driftfile /var/lin/chrony/drift
makestep 1.0 3
rtcsync
```

Allowed Cisco Secure Workload virtual appliances: All

Allowed connectors: None

Figure 110: Error while testing NTP configuration



Tetration Data Ingest Appliance ACTIVE

Checked In: Apr 7 2020 09:05:45 pm (PDT)
Registered: Apr 6 2020 10:19:39 am (PDT)
Created: Apr 6 2020 10:16:30 am (PDT)

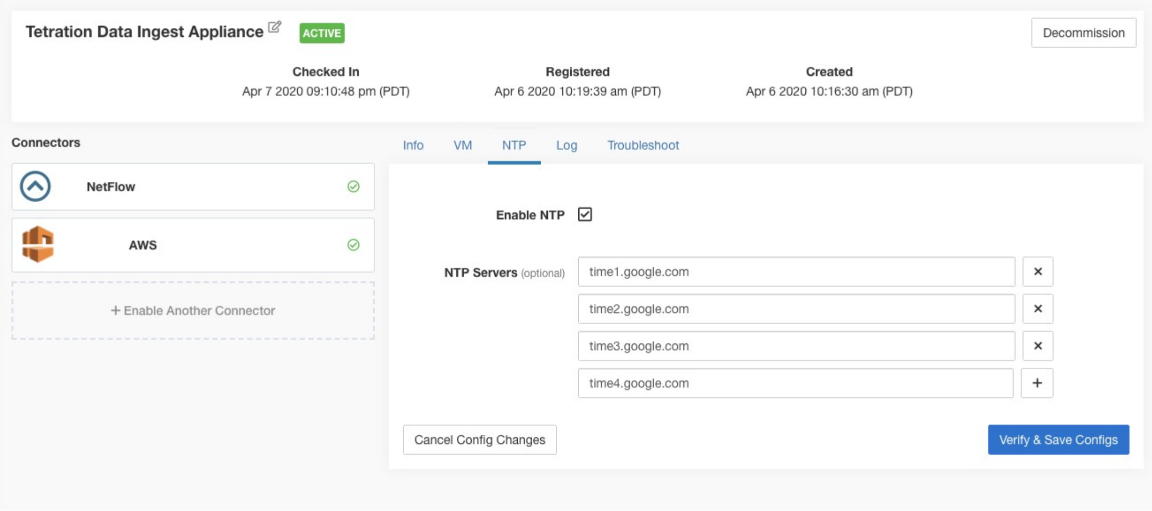
Connectors: NetFlow, AWS

Enable NTP ☑

NTP Servers (optional): a.b.com

Error: could not connect to server a.b.com: dial udp: lookup a.b.com on 171.70.168.183:53: no such host

Figure 111: NTP configuration with valid NTP servers



Tetration Data Ingest Appliance ACTIVE

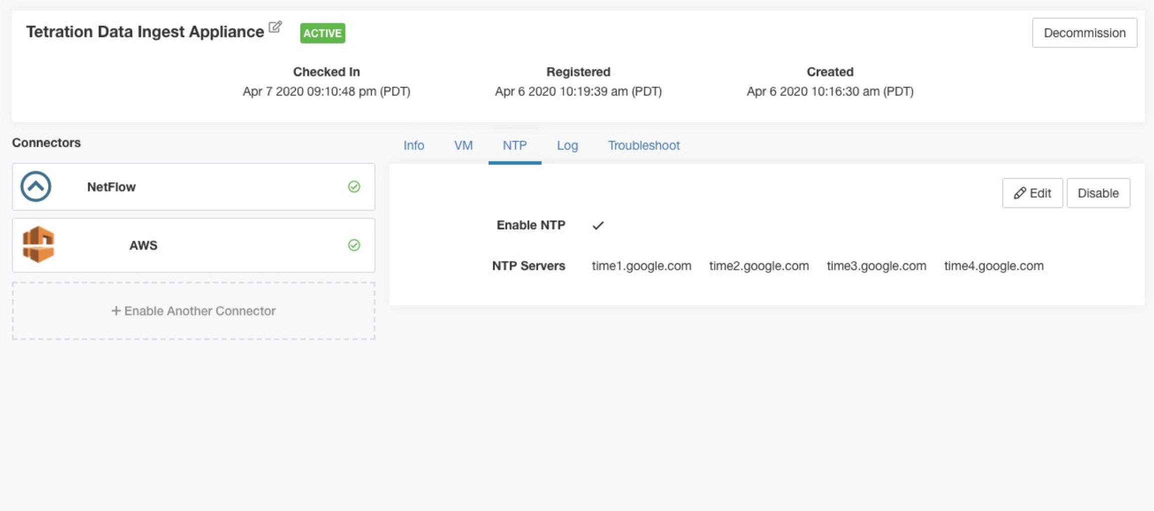
Checked In: Apr 7 2020 09:10:48 pm (PDT)
Registered: Apr 6 2020 10:19:39 am (PDT)
Created: Apr 6 2020 10:16:30 am (PDT)

Connectors: NetFlow, AWS

Enable NTP ☑

NTP Servers (optional):
time1.google.com
time2.google.com
time3.google.com
time4.google.com

Figure 112: NTP configuration verified and applied



Tetration Data Ingest Appliance

Checked In: Apr 7 2020 09:10:48 pm (PDT)

Registered: Apr 6 2020 10:19:39 am (PDT)

Created: Apr 6 2020 10:16:30 am (PDT)

Connectors

- NetFlow ✓
- AWS ✓

Enable NTP ✓

NTP Servers: time1.google.com time2.google.com time3.google.com time4.google.com

Log Configuration

Log configuration updates the log levels, maximum size of the log files, and log rotation parameters on the appliance and/or connector. If the configuration update is triggered on the appliance, appliance controller log settings are updated. On the other hand, if the configuration update is triggered on a connector, service controller and service log settings are updated.

Parameter Name	Type	Description
Logging level	dropdown	Logging level to be set
	• *debug*	Debug log level
	• *info*	Informational log level
	• *warn*	Warning log level
	• *error*	Error log level
Max log file size (in MB)	number	Maximum size of a log file before log rotation kicks in
Log rotation (in days)	number	Maximum age of a log file before log rotation kicks in
Log rotation (in instances)	number	Maximum instances of log files kept

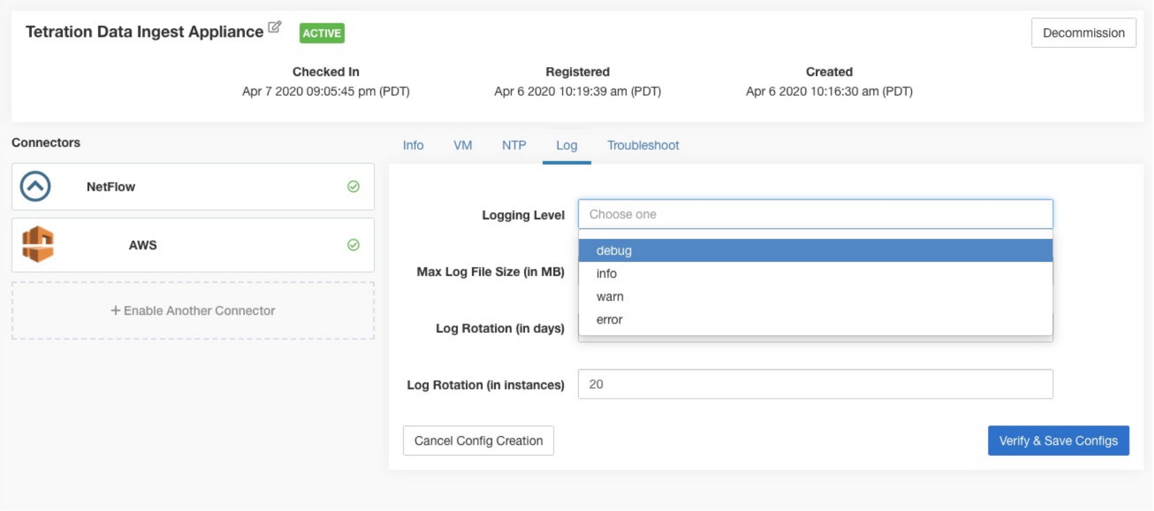
Test: No op.

Apply: If the configuration is trigged on an appliance, update the configuration file of *tet-controller* on the appliance. If the configuration is triggered on a connector, update the configuration files of *tet-controller* and the service managed by the controller on the Docker container responsible for the connector.

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, ISE, ASA, and Meraki.

Figure 113: Log configuration on the appliance



Tetration Data Ingest Appliance ACTIVE

Checked In: Apr 7 2020 09:05:45 pm (PDT)
Registered: Apr 6 2020 10:19:39 am (PDT)
Created: Apr 6 2020 10:16:30 am (PDT)

Logging Level: Choose one

Log Rotation (in instances): 20

Note Since all alert notifier Connectors (Syslog, Email, Slack, PagerDuty, and Kinesis) run on a single Docker service (Secure Workload Alert Notifier) on Secure Workload Edge, it is not possible to update the log config of a connector without impacting the config of another alert notifier connector. The log configurations of Secure Workload Alert Notifier (TAN) Docker service on Secure Workload Edge appliance can be updated using an allowed command.

See Update Alert Notifier Connector Log Configurationfor more details.

Endpoint Configuration

Endpoint configuration specifies the inactivity timeout for endpoints on AnyConnect and ISE connectors. When an endpoint times out, the connector stops checking in with Secure Workload and purges the local state for the endpoint on the connector.

Parameter Name	Type	Description
InactivityTimeout for Endpoints(in minutes)	number	Inactivity timeout for endpoints published by AnyConnect / ISE connectors. On timeout, the endpoint will not longer checkin Secure Workload. Default is 30 minutes.

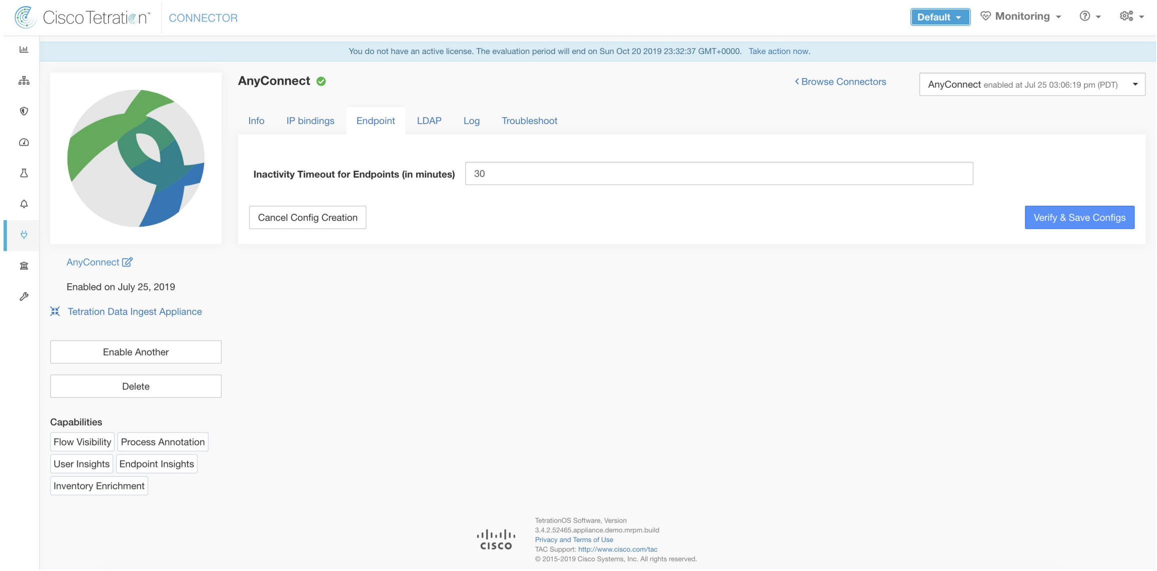
Test : No op.

Apply : Update the configuration file of the connector with the new value

Allowed Secure Workload virtual appliances: None

Allowed connectors: AnyConnect and ISE

Figure 114: Endpoint inactivity timeout configuration on AnyConnect connector



You do not have an active license. The evaluation period will end on Sun Oct 20 2019 23:32:37 GMT+0000. Take action now.

AnyConnect enabled at Jul 25 03:06:19 pm (PDT)

Inactivity Timeout for Endpoints (in minutes): 30

AnyConnect

Enabled on July 25, 2019

Tetration Data Ingest Appliance

TetrationOS Software, Version 3.4.2.52465.appliance.demo.mrpm.build
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TAC Support: http://www.cisco.com/tac
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Slack Notifier Configuration

Default configuration for publishing Secure Workload alerts on Slack.

Parameter Name	Type	Description
Slack Webhook URL	string	Slack webhook on which Secure Workload alerts should be published

Test: Send a test alert to Slack using the webhook. If the alert is posted successfully, the test passes.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: Slack

PagerDuty Notifier Configuration

Default configuration for publishing Secure Workload alerts on PagerDuty.

Parameter Name	Type	Description
PagerDuty Service Key	string	PagerDuty service key for pushing Secure Workload alerts on PagerDuty

Test: Send a test alert to PagerDuty using the service key. If the alert is published successfully, the test passes.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: PagerDuty

Kinesis Notifier Configuration

Default configuration for publishing Secure Workload alerts on Amazon Kinesis.

Parameter Name	Type	Description
AWS Access Key ID	string	AWS access key ID to communicate with AWS
AWS Secret Access Key	string	AWS secret access key to communicate with AWS
AWS Region	dropdown of AWS regions	Name of the AWS region where Kinesis stream is configured
Kinesis Stream	string	Name of the Kinesis stream
Stream Partition	string	Partition Name of the stream

Test: Send a test alert to the Kinesis stream using the given configuration. If the alert is published successfully, the test passes.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: Kinesis

Email Notifier Configuration

Default configuration for publishing Secure Workload alerts on Email.

Parameter Name	Type	Description
SMTP Username	string	SMTP server username. This parameter is optional.
SMTP Password	string	SMTP server password for the user (if given). This parameter is optional.
SMTP Server	string	IP address or hostname of the SMTP server
SMTP Port	number	Listening port of SMTP server. Default value is 587.
Secure Connection	checkbox	Should SSL be used for SMTP server connection?
From Email Address	string	Email address to use for sending alerts
Default Recipients	string	Comma separated list of recipient email addresses

Test: Send a test email using the given configuration. If the alert is published successfully, the test passes.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: Email

Syslog Notifier Configuration

Default configuration for publishing Secure Workload alerts on Syslog.

Parameter Name	Type	Description
Protocol	dropdown	Protocol to use to connect to server
	•*UDP*	
	• *TCP*	
Server Address	string	IP address or hostname of the Syslog server
Port	number	Listening port of Syslog server. Default port value is 514.

Test: Send a test alert to Syslog server using the given configuration. If the alert is published successfully, the test passes.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: Syslog

Syslog Severity Mapping Configuration

The following table shows the default severity mapping for Secure Workload alerts on Syslog

Secure Workload Alerts Severity	Syslog Severity
LOW	LOG_DEBUG
MEDIUM	LOG_WARNING
HIGH	LOG_ERR
CRITICAL	LOG_CRIT
IMMEDIATE ACTION	LOG_EMERG

You can modify this setting using this configuration.

Parameter Name	Dropdown of mappings
IMMEDIATE_ACTION	• *Emergency* • *Alert* • *Critical* • *Error* • *Warning* • *Notice* • *Informational* • *Debug*
CRITICAL	
HIGH	
MEDIUM	
LOW	

Test: No op.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: Syslog

ISE Instance Configuration

This configuration provides the parameters required to connect to the Cisco Identity Services Engine (ISE). By providing multiple instances of this configuration, the ISE connector can connect and pull metadata about endpoints from multiple ISE appliances. Up to 20 instances of ISE configuration may be provided.

Parameter Name	Type	Description
ISE Client Certificate	string	ISE client certificate to connect to ISE using pxGrid
ISE Client Key	string	ISE client key to connect to ISE
ISE Server CA Certificate	string	CA certificate of ISE
ISE Hostname	string	FQDN of ISE pxGrid
ISE Nodename	string	Node name of ISE pxGrid

Test: Connect to ISE using the given parameters. On successful connection, accept the configuration.

Apply: Update configuration file of the connector with the specified parameters.

Allowed Secure Workload virtual appliances: None

Allowed connectors: ISE

Discovery

Configurations that support *Discovery* mode do the following.

1. Collect a basic configuration from the user.

2. Verify the basic configuration.
3. Discovery additional properties about the configuration and present them to the user.
4. Let the user enhance the configuration using the discovered properties.
5. Verify and apply the enhanced configuration.

In the 3.3.1.x release, LDAP configuration supports discovery mode.

LDAP Configuration

LDAP configuration specifies how to connect to LDAP, what is the base Distinguished Name (DN) to use, what is the attribute that corresponds to username, and what attributes to fetch for each username. LDAP attributes are properties of LDAP that are specific to that environment.

Given the configuration of how to connect to LDAP and the base DN, it is possible to discover the attributes of users in LDAP. These discovered attributes can then be presented to the user in the UI. From these discovered attributes, the user selects the attribute that corresponds to the username and a list of up to six attributes to collect for each username from LDAP. As a result, this eliminates the manual configuration of the LDAP attributes and reduces errors.

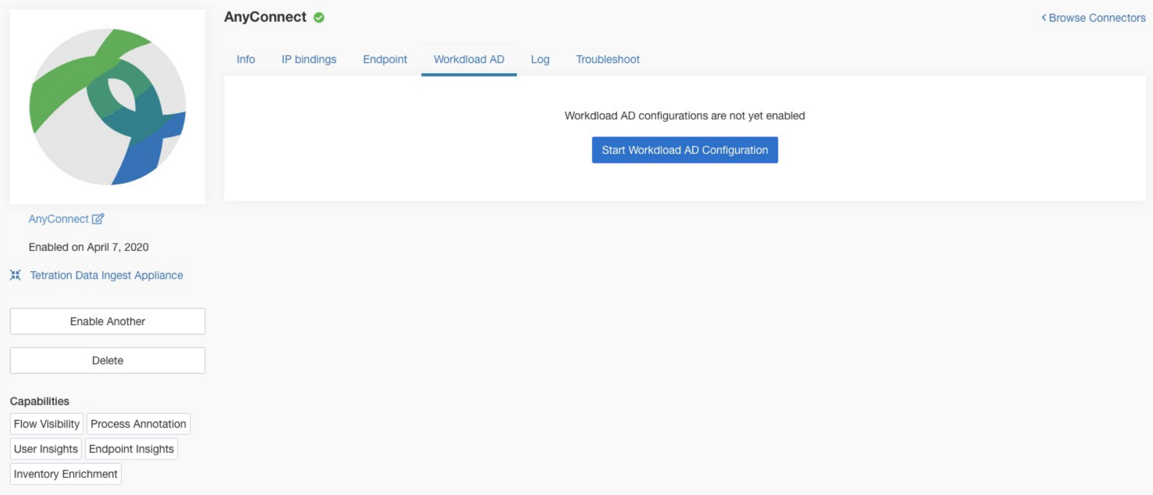
Here are the detailed steps for creating LDAP configuration through discovery.

Procedure

Step 1 **Start the LDAP Configuration**

Initiate an LDAP configuration for the connector.

Figure 115: Start the LDAP configuration discovery



Workload AD configurations are not yet enabled

Enabled on April 7, 2020

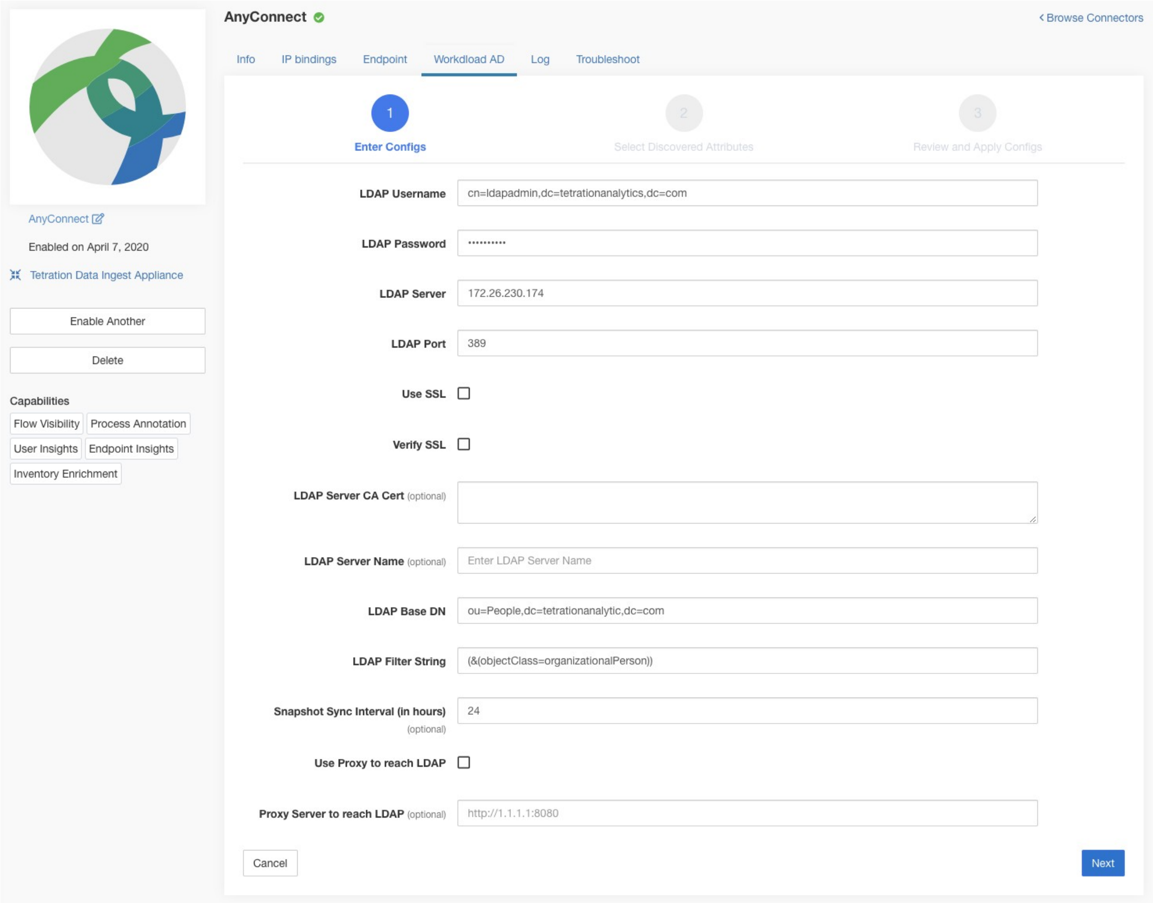
Step 2 **Provide Basic LDAP Configuration**

Specify the basic configuration for connecting to LDAP. In this configuration, the users provide the LDAP Bind DN or username to connect to LDAP server, LDAP password to use to connect to LDAP server, LDAP server address, LDAP server port, Base DN to connect to, and a filter string to fetch users that match this filer.

Parameter Name	Type	Description
LDAP Username	string	LDAP username or bind DN to access LDAP server*
LDAP Password	string	LDAP password for the username to access LDAP server*
LDAP Server	string	LDAP server address
LDAP Port	number	LDAP server port
Use SSL	checkbox	Should the connector connect to LDAP securely? Optional. Default is false.
Verify SSL	checkbox	Should the connector verify LDAP cert? Optional. Default is false.
LDAP Server CA Cert	string	Server CA certificate. Optional.
LDAP Server Name	string	Servername for which the LDAP cert is issued (mandatory if *Verify SSL* is checked.
LDAP Base DN	string	LDAP base DN, the starting point for directory searches in LDAP
LDAP Filter String	string	LDAP filter prefix string. Filter the search result that match only this condition.
Snapshot Sync Interval (in hours)	number	Specify the time interval in hours to (re)create LDAP snapshot. Optional. Default is 24 hours.
Use Proxy to reach LDAP	checkbox	Should the connector use proxy server to access LDAP server?
Proxy Server to reach LDAP	string	Proxy server to access LDAP

Minimum user permissions needed to configure LDAP on Connectors is a **standard domain User**.

Figure 116: Initial LDAP configuration



LDAP Username: cn=ldapadmin,dc=tetrationanalytics,dc=com

LDAP Password: ••••••••••

LDAP Server: 172.26.230.174

LDAP Port: 389

Use SSL ☐

Verify SSL ☐

LDAP Server CA Cert (optional):

LDAP Server Name (optional): Enter LDAP Server Name

LDAP Base DN: ou=People,dc=tetrationanalytic,dc=com

LDAP Filter String: (&(objectClass=organizationalPerson))

Snapshot Sync Interval (in hours) (optional): 24

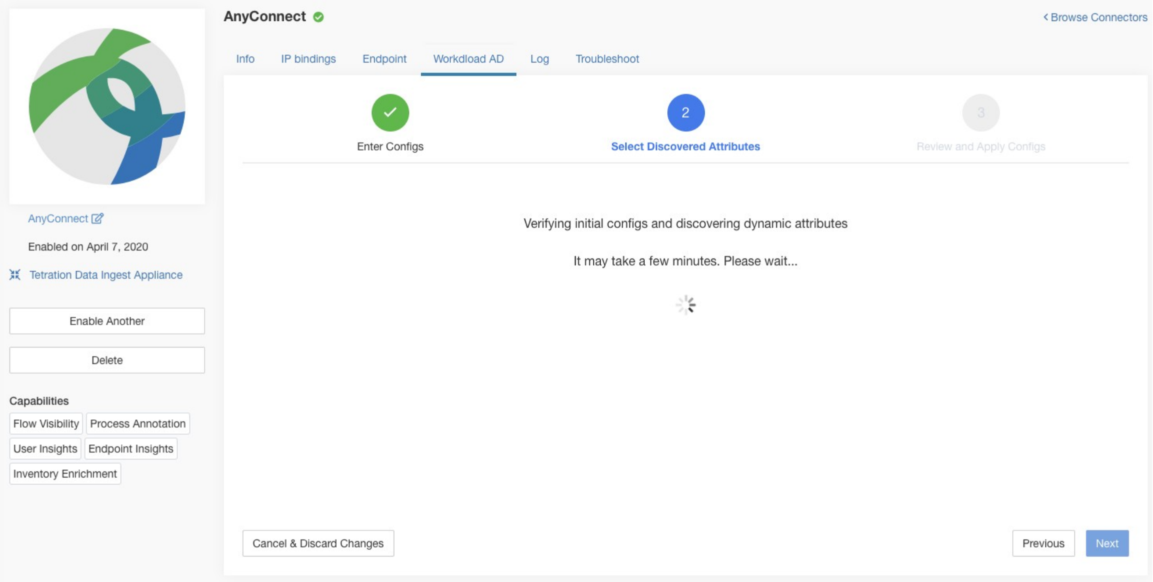
Use Proxy to reach LDAP ☐

Proxy Server to reach LDAP (optional): http://1.1.1.1:8080

Step 3 Discovery in Progress

Once the user clicks *Next*, this configuration is send to the connector. The connector establishes a connection with LDAP server using the given configuration. It fetches up to 1000 users from LDAP server and identifies all the attributes. Furthermore, it computes a list of all the single-valued attributes are common across all 1000 users. The connector returns this result back to Secure Workload.

Figure 117: Discovery in progress



Verifying initial configs and discovering dynamic attributes

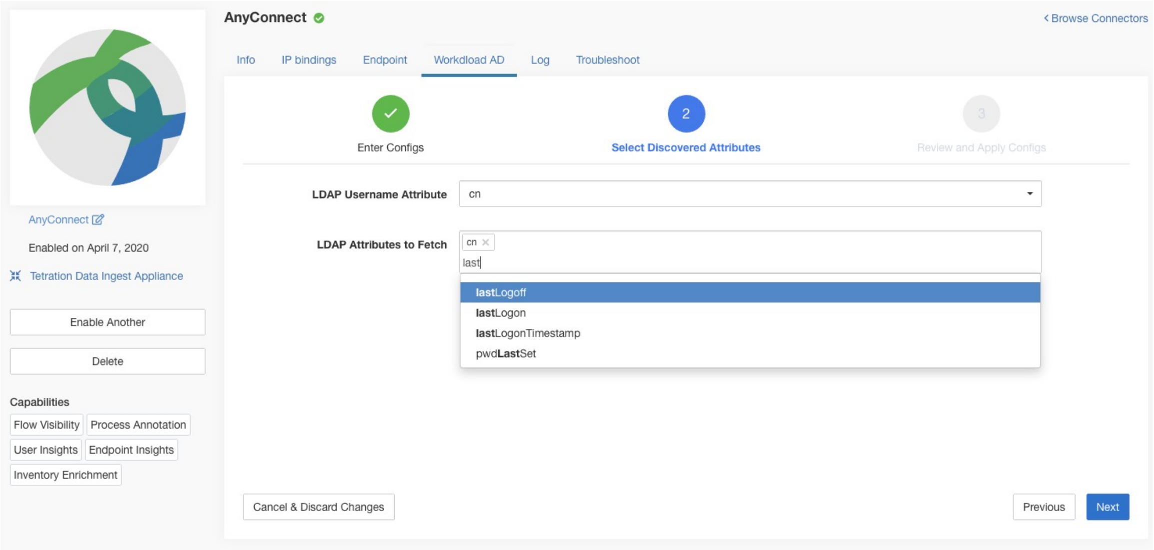
It may take a few minutes. Please wait...

Step 4 Enhance the Configuration with Discovered Attributes

The user has to pick which attribute corresponds to username and select up to six attributes that the connector has to fetch and snapshot for each user in the organization (i.e., users matching the filter string). This action is performed using a dropdown of list of discovered attributes. Thus, eliminating manual errors and misconfiguration.

Parameter Name	Type	Description
LDAP Username Attribute	string	LDAP attribute that contains the username
LDAP Attributes to Fetch	list of strings	List of LDAP attributes that should be fetched for a user

Figure 118: Discovered LDAP attributes



LDAP Username Attribute: cn

LDAP Attributes to Fetch: cn ×

last

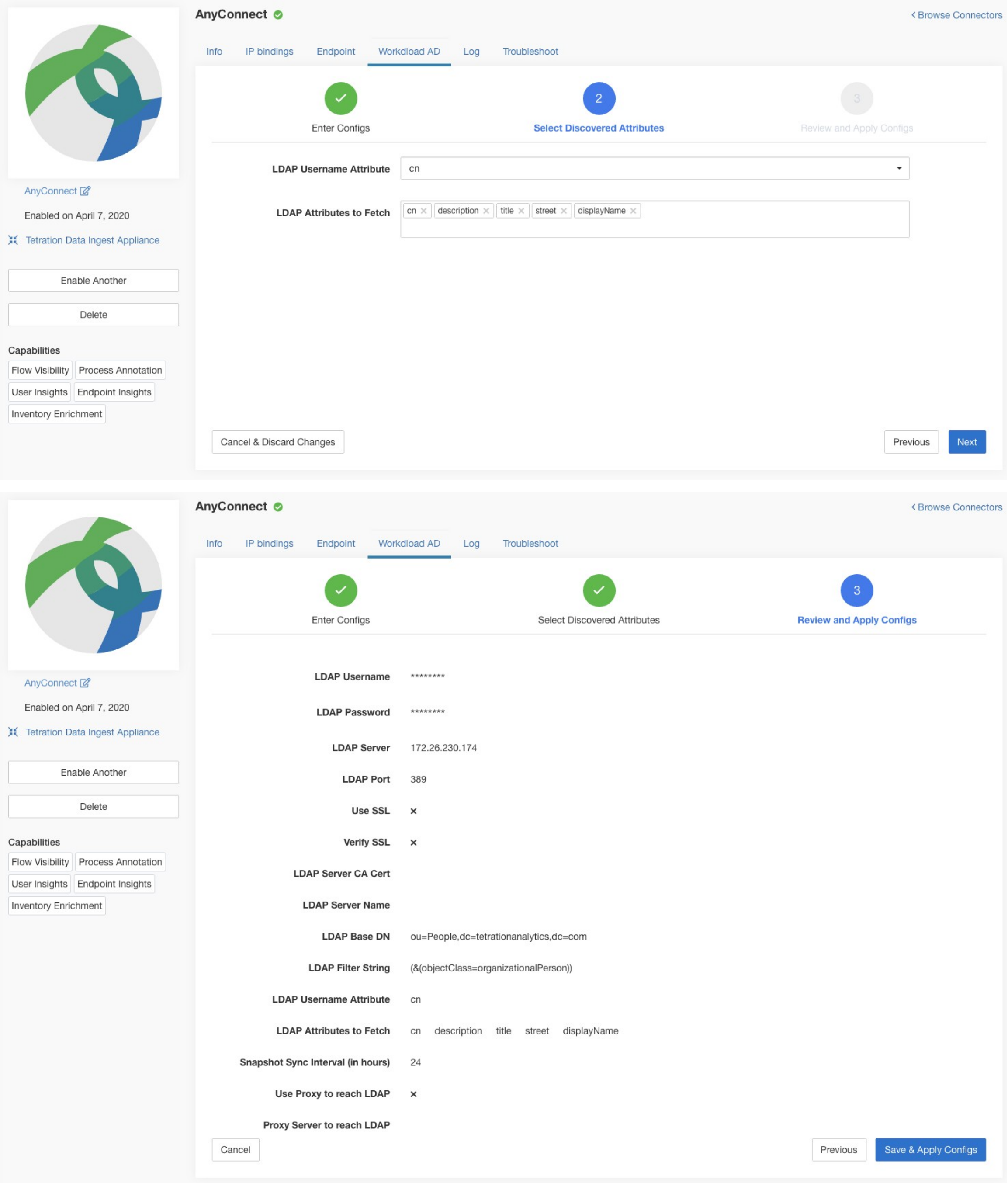
- **last**Logoff
- **last**Logon
- **last**LogonTimestamp
- pwd**Last**Set

Figure 119: Identify username attribute and attributes to collect for each username

Step 5 Finalize, Save, and Apply the Configuration

Finally, the configuration is completed by clicking *Save and Apply Changes*.

Figure 120: Complete LDAP configuration discovery and commit



LDAP Username Attribute: cn

LDAP Attributes to Fetch: cn × description × title × street × displayName ×

LDAP Username	********
LDAP Password	********
LDAP Server	172.26.230.174
LDAP Port	389
Use SSL	×
Verify SSL	×
LDAP Server CA Cert	
LDAP Server Name	
LDAP Base DN	ou=People,dc=tetrationanalytics,dc=com
LDAP Filter String	(&(objectClass=organizationalPerson))
LDAP Username Attribute	cn
LDAP Attributes to Fetch	cn description title street displayName
Snapshot Sync Interval (in hours)	24
Use Proxy to reach LDAP	×
Proxy Server to reach LDAP	

The connector receives the completed configuration. It creates a local snapshot of all users matching the filter string and fetches only the selected attributes. Once the snapshot is completed, the connector services can start using the snapshot for annotating users and their LDAP attributes in inventories.

Allowed Secure Workload virtual appliances: None

Allowed connectors: AnyConnect, ISE, and F5.

Remove

You can remove all the configurations that you have added from the connectors and/or appliances using the *Delete* button available for each configuration.

Troubleshooting

Connectors and virtual appliances support various troubleshooting mechanisms to debug possible issues.

Note This section does not apply to the following:

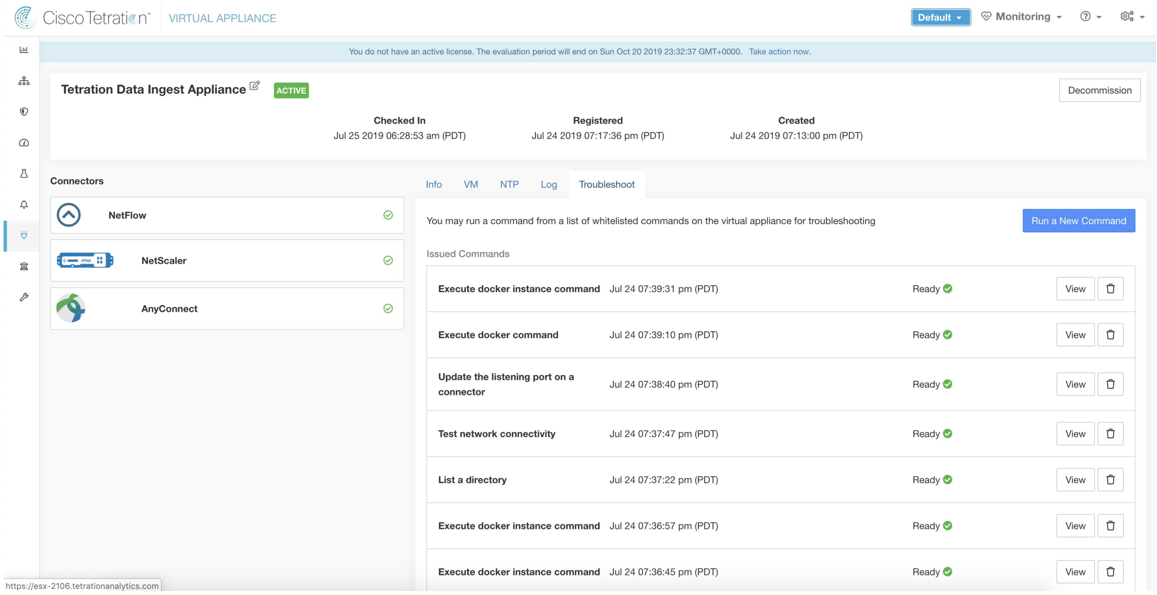
ERSPAN virtual appliance: Refer to the ERSPAN appliance page for the troubleshooting details.

Cloud connectors: To troubleshoot cloud connectors, see the section for your cloud connector, for example Troubleshoot AWS Connector Issues.

Allowed set of commands

The allowed set of commands enables you to run some debug commands on the appliances and Docker containers (for connectors). Allowed commands include the ability to retrieve logs and current running configuration, test network connectivity, and capture packets matching a specified port.

Figure 121: Troubleshoot page on Secure Workload virtual appliance



You do not have an active license. The evaluation period will end on Sun Oct 20 2019 23:32:37 GMT+0000. Take action now.

Tetration Data Ingest Appliance ACTIVE

Decommission

Checked In	Registered	Created
Jul 25 2019 06:28:53 am (PDT)	Jul 24 2019 07:17:36 pm (PDT)	Jul 24 2019 07:13:00 pm (PDT)

Connectors

- NetFlow ✓
- NetScaler ✓
- AnyConnect ✓

You may run a command from a list of whitelisted commands on the virtual appliance for troubleshooting

Run a New Command

Issued Commands

Execute docker instance command	Jul 24 07:39:31 pm (PDT)	Ready ✓	View 🗑
Execute docker command	Jul 24 07:39:10 pm (PDT)	Ready ✓	View 🗑
Update the listening port on a connector	Jul 24 07:38:40 pm (PDT)	Ready ✓	View 🗑
Test network connectivity	Jul 24 07:37:47 pm (PDT)	Ready ✓	View 🗑
List a directory	Jul 24 07:37:22 pm (PDT)	Ready ✓	View 🗑
Execute docker instance command	Jul 24 07:36:57 pm (PDT)	Ready ✓	View 🗑
Execute docker instance command	Jul 24 07:36:45 pm (PDT)	Ready ✓	View 🗑

https://esx-2106.tetrationanalytics.com

> **Note** Troubleshooting using the allowed set of commands is available on the appliances and connectors only for users with the *Customer Support* role.

Show Logs

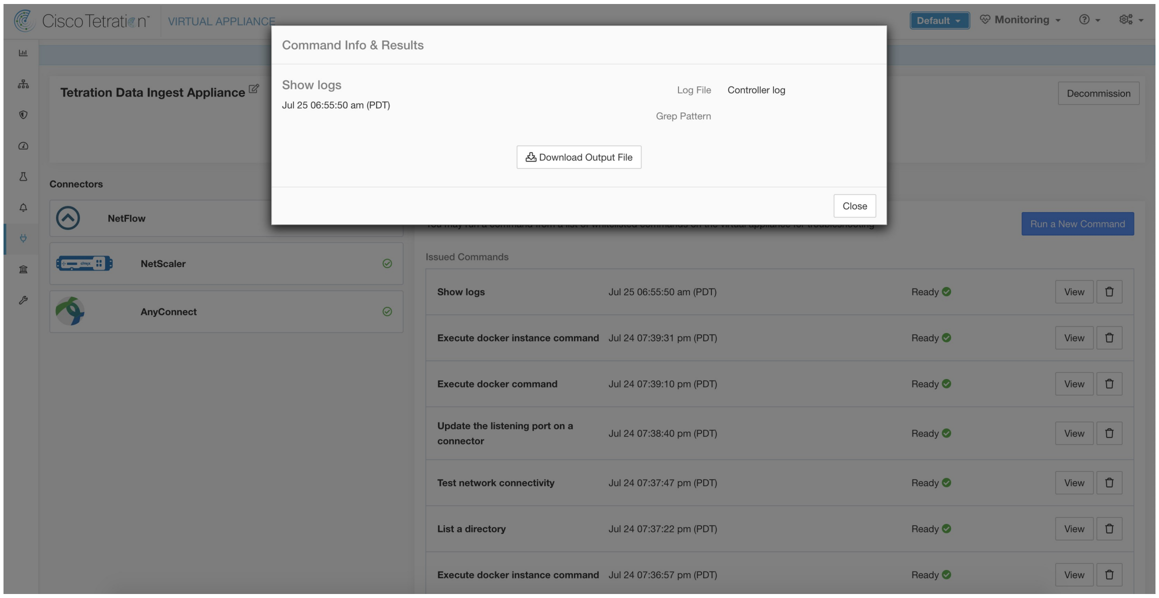
Show the contents of a controller log file and optionally grep the file for a specified pattern. Secure Workload sends the command to appliance/connector where the command was issued. The controller on the appliance/connector service returns the result (tailed for the last 5000 lines). When the result is available at Secure Workload, a download button is presented to download the file.

Argument Name	Type	Description
Grep Pattern	string	Pattern string to grep from the logfile

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 122: Download Show Logs output from Secure Workload Ingest appliance



Command Info & Results

Show logs
Jul 25 06:55:50 am (PDT)

Log File Controller log
Grep Pattern

Issued Commands

Show logs	Jul 25 06:55:50 am (PDT)	Ready ✓	View
Execute docker instance command	Jul 24 07:39:31 pm (PDT)	Ready ✓	View
Execute docker command	Jul 24 07:39:10 pm (PDT)	Ready ✓	View
Update the listening port on a connector	Jul 24 07:38:40 pm (PDT)	Ready ✓	View
Test network connectivity	Jul 24 07:37:47 pm (PDT)	Ready ✓	View
List a directory	Jul 24 07:37:22 pm (PDT)	Ready ✓	View
Execute docker instance command	Jul 24 07:36:57 pm (PDT)	Ready ✓	View

Show Service Logs

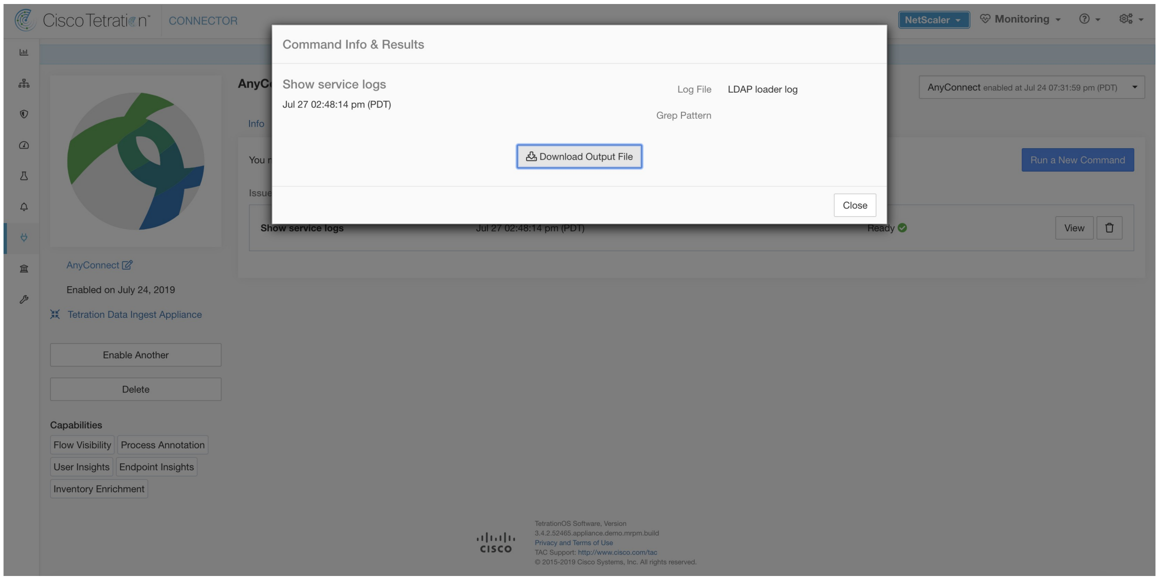
Show the contents of service log files and optionally grep the file for a specified pattern. Secure Workload sends the command to appliance/connector where the command was issued. The controller on the appliance/connector service returns the result (tailed for the last 5000 lines). When the result is available at Secure Workload, a download button is presented to download the file.

Argument Name	Type	Description
Log File	dropdown	The name of the logfile to collect
	• *Service log*	Logs of the connector service
	• *Upgrade log*	Upgrade logs of the service
	• *LDAP loader log*	Logs of the LDAP snapshot for connectors that have LDAP enabled
Grep Pattern	string	Pattern string to grep from the logfile

Allowed Secure Workload virtual appliances: None (only available on valid connector services)

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 123: Download Show Service Logs output from AnyConnect connector for LDAP loader log log file



Command Info & Results

Show service logs
Jul 27 02:48:14 pm (PDT)

Log File: LDAP loader log
Grep Pattern:

Download Output File

Close

Show service logs | Jul 27 02:48:14 pm (PDT) | Ready | View

Show Running Configuration

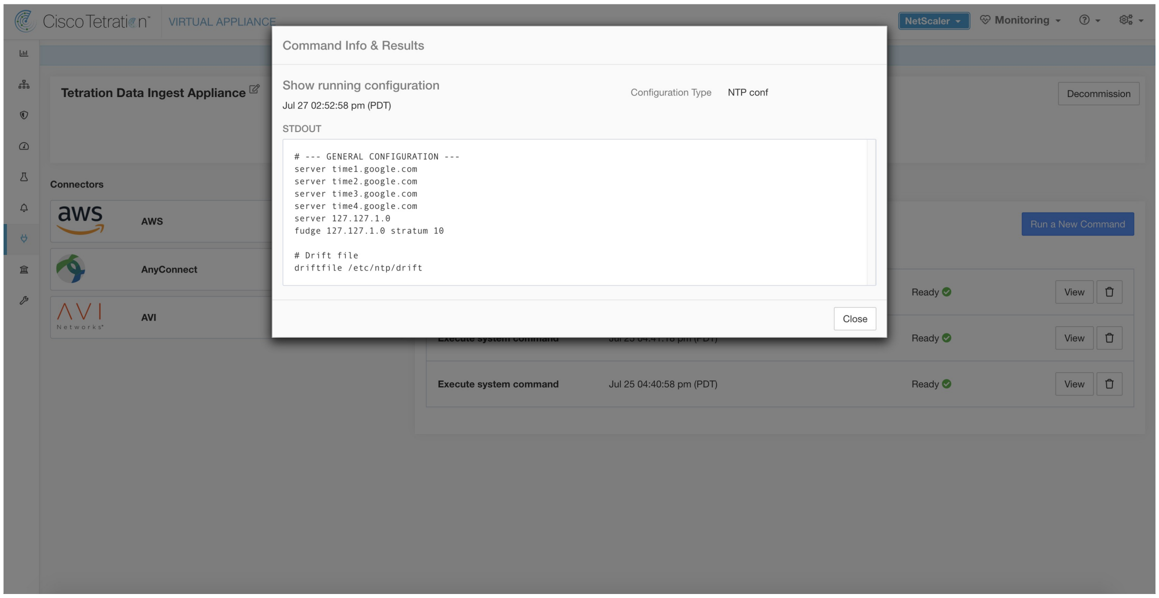
Show running configuration of an appliance/connector controllers. The controller on appliance/connector retrieves the configuration corresponding to the requested argument and returns the result. When the result is available at Secure Workload, the contents of the configuration are shown in a text box.

Argument Name	Type	Description
Configuration Type	dropdown	Configuration file to collect
	• *Controller conf*	Configuration file of the appliance controller
	• *Supervisor conf*	Configuration file of the supervisor that runs the controller
	• *NTP conf*	NTP configuration file
	• *Chrony conf*	/etc/chrony.conf

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 124: Show running configuration for NTP conf on a Secure Workload Ingest Appliance



Command Info & Results

Show running configuration

Jul 27 02:52:58 pm (PDT)

Configuration Type NTP conf

STDOUT

```
# --- GENERAL CONFIGURATION ---
server time1.google.com
server time2.google.com
server time3.google.com
server time4.google.com
server 127.127.1.0
fudge 127.127.1.0 stratum 10

# Drift file
driftfile /etc/ntp/drift
```

Execute system command Jul 25 04:40:58 pm (PDT) Ready

Show Service Running Configuration

Show running configuration of an services instantiated for connectors on the appliances. The controller on the service retrieves the configuration corresponding to the requested argument and returns the result. When the result is available at Secure Workload, the contents of the configuration are shown in a text box.

Argument Name	Type	Description
Configuration Type	dropdown	Configuration file to collect.
	• *Controller conf*	Configuration file of the service controller.
	• *Supervisor conf*	Configuration file of the supervisor that runs the controller.
	• *Service conf*	Service configuration file.
	• *LDAP conf*	LDAP configuration for connectors that have LDAP enabled.

Allowed Secure Workload virtual appliances: None (only available on valid connector services)

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Show System Commands

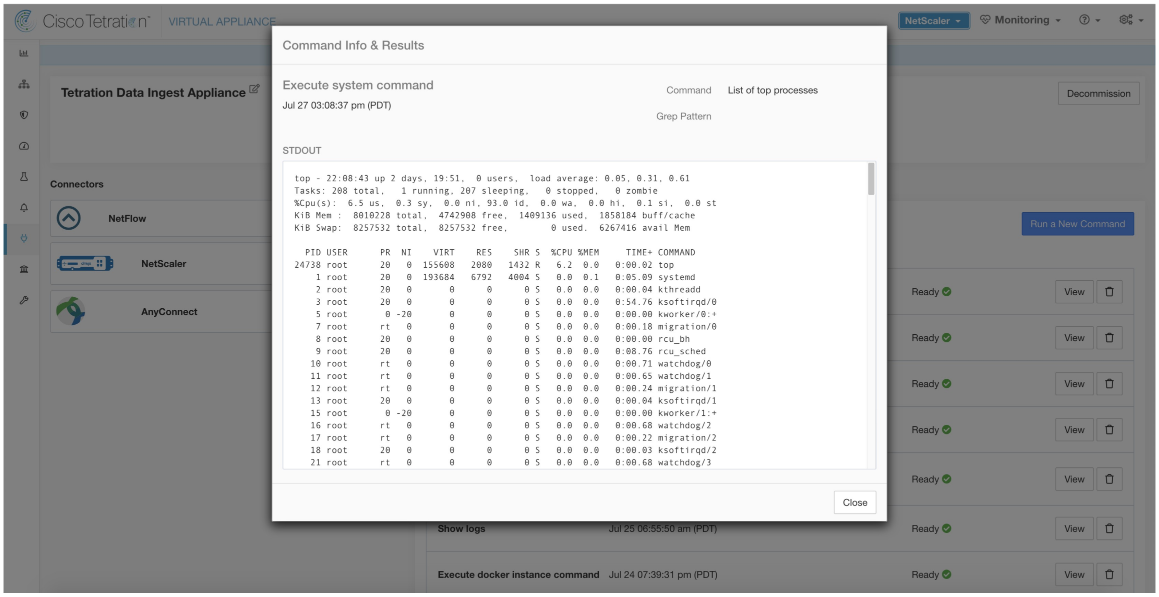
Execute a system command and optionally grep for a specified pattern. The controller on the appliance/connector service returns the result (tailed for the last 5000 lines). Optionally, a grep pattern can be provided as argument and the output is filtered accordingly. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
System Command	dropdown	System command to execute
	• *IP configuration*	**ifconfig**
	• *IP route configuration*	**ip route**
	• *IP packet filtering rules*	**iptables -L**
	• *Network status*	**netstat**
	• *Network status (EL9)*	**ss**
	• *Process status*	**ps -aux**
	• *List of top processes*	**top -b -n 1**
	• *NTP status*	**ntpstat**
	• *NTP query*	**ntpq -pn**
	• Chrony status (EL9)	**chronyc tracking**
	• Chrony query (EL9)	**chronyc sources**
	• *CPU info*	**lscpu**
	• *Memory info*	**lsmem**
	• *Disk free*	**df -H**
Grep Pattern	string	Pattern string to grep from the output

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 125: Show system command on Secure Workload Ingest appliance to retrieve list of top processes



Command Info & Results

Execute system command

Jul 27 03:08:37 pm (PDT)

Command List of top processes

Grep Pattern

STDOUT

```
top - 22:08:43 up 2 days, 19:51,  0 users,  load average: 0.05, 0.31, 0.61
Tasks: 208 total,   1 running, 207 sleeping,   0 stopped,   0 zombie
%Cpu(s):  6.5 us,  0.3 sy,  0.0 ni, 93.0 id,  0.0 wa,  0.0 hi,  0.1 si,  0.0 st
KiB Mem :  8010228 total,  4742908 free,  1409136 used,  1858184 buff/cache
KiB Swap:  8257532 total,  8257532 free,        0 used.  6267416 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
24738 root      20   0  155608   2080   1432 R   6.2  0.0   0:00.02 top
    1 root      20   0  193684   6792   4004 S   0.0  0.1   0:05.09 systemd
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.04 kthreadd
    3 root      20   0       0      0      0 S   0.0  0.0   0:54.76 ksoftirqd/0
    5 root       0 -20       0      0      0 S   0.0  0.0   0:00.00 kworker/0:+
    7 root      rt   0       0      0      0 S   0.0  0.0   0:00.18 migration/0
    8 root      20   0       0      0      0 S   0.0  0.0   0:00.00 rcu_bh
    9 root      20   0       0      0      0 S   0.0  0.0   0:08.76 rcu_sched
   10 root      rt   0       0      0      0 S   0.0  0.0   0:00.71 watchdog/0
   11 root      rt   0       0      0      0 S   0.0  0.0   0:00.65 watchdog/1
   12 root      rt   0       0      0      0 S   0.0  0.0   0:00.24 migration/1
   13 root      20   0       0      0      0 S   0.0  0.0   0:00.04 ksoftirqd/1
   15 root       0 -20       0      0      0 S   0.0  0.0   0:00.00 kworker/1:+
   16 root      rt   0       0      0      0 S   0.0  0.0   0:00.68 watchdog/2
   17 root      rt   0       0      0      0 S   0.0  0.0   0:00.22 migration/2
   18 root      20   0       0      0      0 S   0.0  0.0   0:00.03 ksoftirqd/2
   21 root      rt   0       0      0      0 S   0.0  0.0   0:00.68 watchdog/3
```

Show logs Jul 25 06:55:50 am (PDT) Ready

Execute docker instance command Jul 24 07:39:31 pm (PDT) Ready

Show Docker Commands

Execute a Docker command and optionally grep for a specified pattern. The command is executed on the appliance by the appliance controller. The result tailed for the last 5000 lines. Optionally, a grep pattern can be provided as argument and the output is filtered accordingly. When the result is available at Secure Workload, the result is shown in a text box.

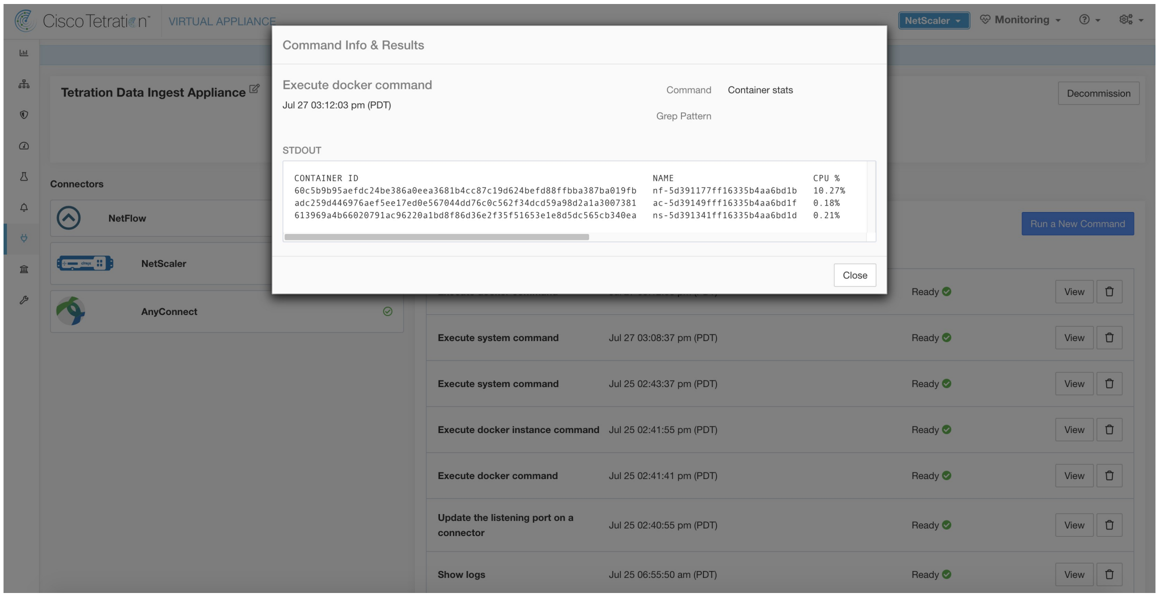
Argument Name	Type	Description
Docker Command	dropdown	Docker command to execute
	• *Docker info*	**docker info**
	• *List images*	**docker images --no-trunc**
	• *List containers*	**docker ps --no-trunc**
	• *List networks*	**docker network ls --no-trunc**
	• *List volumes*	**docker volume ls**
	• *Container stats*	**docker stats --no-trunc--no-stream**
	• *Docker disk usage*	`docker system df -v`
	• *Docker system events*	**docker system events --since '10m'**
	• *Version*	**docker version**

Argument Name	Type	Description
Grep Pattern	string	Pattern string to grep from the output

Allowed Secure Workload virtual appliances: All

Allowed connectors: None

Figure 126: Execute a docker command on Secure Workload Ingest appliance to show container stats



Command Info & Results

Execute docker command

Jul 27 03:12:03 pm (PDT)

Command: Container stats

Grep Pattern:

STDOUT

```
CONTAINER ID                                                        NAME                              CPU %
60c5b9b95aefdc24be386a0eea3681b4cc87c19d624befd88ffbba387ba019fb   nf-5d391177ff16335b4aa6bd1b   10.27%
adc259d446976aef5ee17ed0e567044dd76c0c562f34dcd59a98d2a1a3007381   ac-5d39149fff16335b4aa6bd1f   0.18%
613969a4b66020791ac96220a1bd8f86d36e2f35f51653e1e8d5dc565cb340ea   ns-5d391341ff16335b4aa6bd1d   0.21%
```

Execute system command	Jul 27 03:08:37 pm (PDT)	Ready ✓	View
Execute system command	Jul 25 02:43:37 pm (PDT)	Ready ✓	View
Execute docker instance command	Jul 25 02:41:55 pm (PDT)	Ready ✓	View
Execute docker command	Jul 25 02:41:41 pm (PDT)	Ready ✓	View
Update the listening port on a connector	Jul 25 02:40:55 pm (PDT)	Ready ✓	View
Show logs	Jul 25 06:55:50 am (PDT)	Ready ✓	View

Show Docker Instance Commands

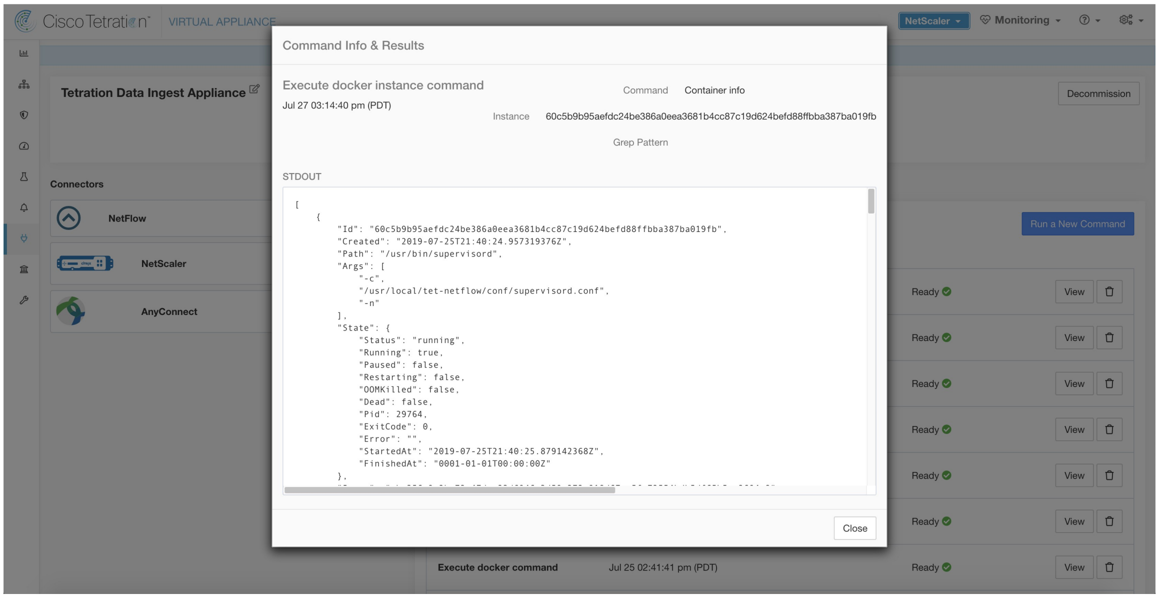
Execute a docker command on a specific instance of a Docker resource. The instance ID can be fetched using Show Docker Commands. The command is executed on the appliance by the appliance controller. The result tailed for the last 5000 lines. Optionally, a grep pattern can be provided as argument and the output is filtered accordingly. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
Docker Command	dropdown	Docker command to execute
	• *Image info*	**docker images --no-trunc <instance>**
	• *Network info*	**docker network inspect <instance>**
	• *Volume info*	**docker volume inspect <instance>**
	• *Container info*	**docker container inspect--size <instance>**
	• *Container logs*	**docker logs --tail 5000 <instance>**
	• *Container port mappings*	**docker port <instance>**
	• *Container resource usage stats*	**docker stats --no-trunc--no-stream <instance>**
	• *Container running processes*	**docker top <instance>**
Instance	string	Docker resource (image, network, volume, container) ID (See Show Docker Commands)
Grep Pattern	string	Pattern string to grep from the output

Allowed Secure Workload virtual appliances: All

Allowed connectors: None

Figure 127: Execute a docker instance command on Secure Workload Ingest appliance to retrieve container info



Command Info & Results

Execute docker instance command

Jul 27 03:14:40 pm (PDT)

Command Container info

Instance 60c5b9b95aefdc24be386a0eea3681b4cc87c19d624befd88ffbba387ba019fb

Grep Pattern

STDOUT

```
[
    {
        "Id": "60c5b9b95aefdc24be386a0eea3681b4cc87c19d624befd88ffbba387ba019fb",
        "Created": "2019-07-25T21:40:24.957319376Z",
        "Path": "/usr/bin/supervisord",
        "Args": [
            "-c",
            "/usr/local/tet-netflow/conf/supervisord.conf",
            "-n"
        ],
        "State": {
            "Status": "running",
            "Running": true,
            "Paused": false,
            "Restarting": false,
            "OOMKilled": false,
            "Dead": false,
            "Pid": 29764,
            "ExitCode": 0,
            "Error": "",
            "StartedAt": "2019-07-25T21:40:25.879142368Z",
            "FinishedAt": "0001-01-01T00:00:00Z"
        },
```

Close

Show Supervisor Commands

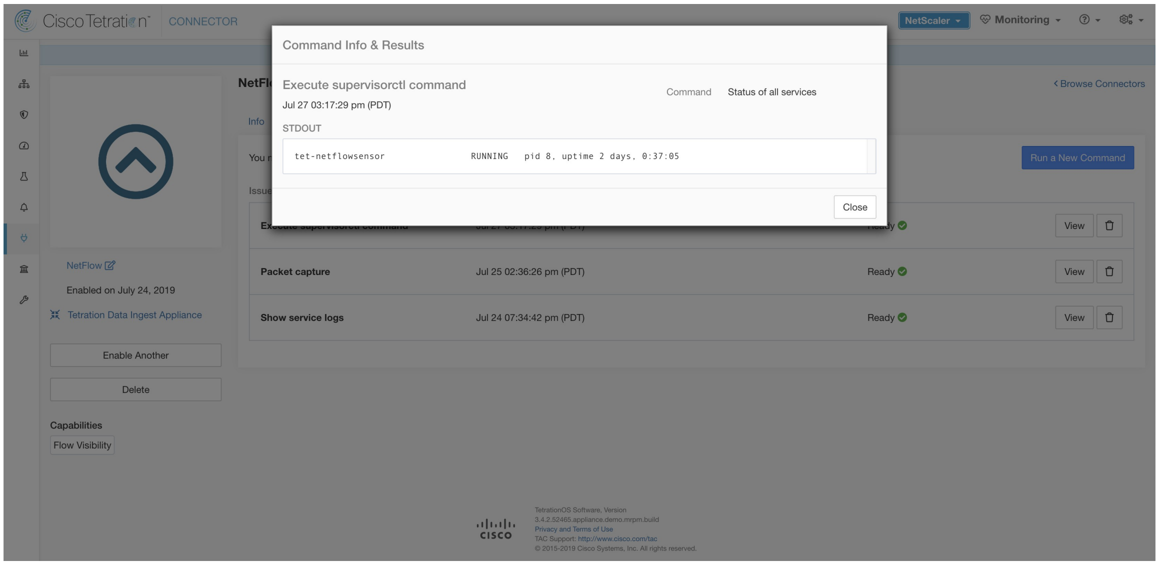
Execute a supervisorctl command and return the result. Secure Workload sends the command to appliance/connector where the command was issued. The controller on the appliance/connector service returns the result When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
SupervisorCtl Command	dropdown	*supervisorctl* command to execute
	• *Status of all services*	**supervisorctl status**
	• *PID of supervisor*	**supervisorctl pid**
	• *PID of all services*	**supervisorctl pid all**

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 128: Execute supervisorctl command on NetFlow connector to get the status of all services



Command Info & Results

Execute supervisorctl command
Jul 27 03:17:29 pm (PDT)

Command Status of all services

STDOUT

```
tet-netflowsensor                RUNNING   pid 8, uptime 2 days, 0:37:05
```

Enabled on July 24, 2019

Execute supervisorctl command	Jul 27 03:17:29 pm (PDT)	Ready
Packet capture	Jul 25 02:36:26 pm (PDT)	Ready
Show service logs	Jul 24 07:34:42 pm (PDT)	Ready

TetrationOS Software, Version
3.4.2.52465.appliance.demo.mrpm.build
Privacy and Terms of Use
TAC Support: http://www.cisco.com/tac
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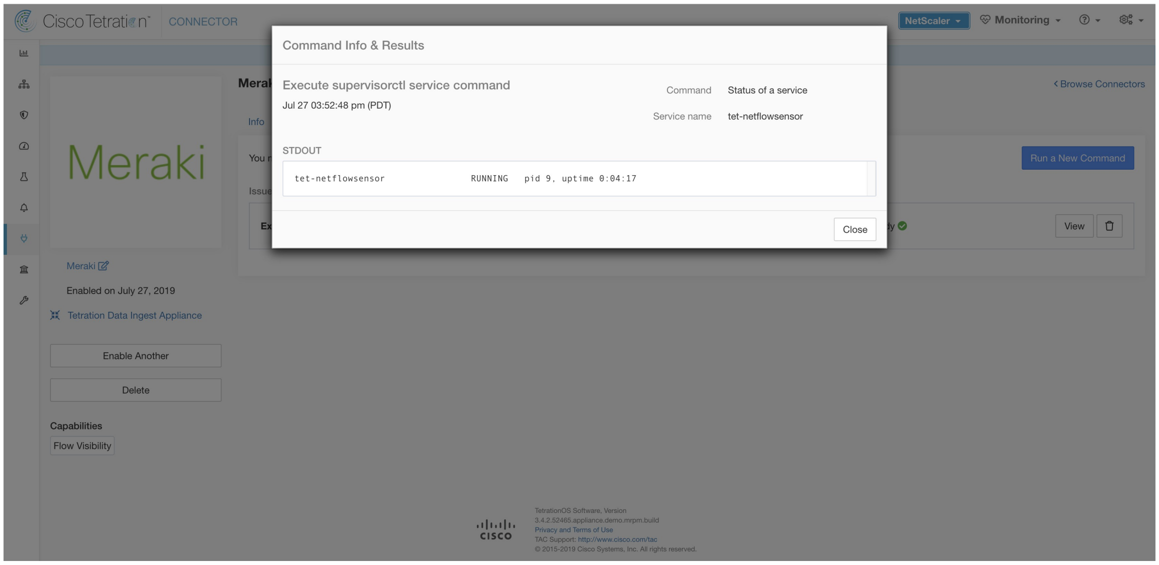
Show Supervisor Service Commands

Execute a supervisorctl command on a specific service. The service name can be fetched using Show Supervisor Commands. Secure Workload sends the command to appliance/connector where the command was issued. The controller on the appliance/connector service returns the resultWhen the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
SupervisorCtl Command	dropdown	*supervisorctl* command to execute
	- *Status of a service*	**supervisorctl status <service name>**
	- *PID of a service*	**supervisorctl pid <service name>**
Service name	string	Name of the supervisor controlled service (see Show Supervisor Commands)

Figure 129: Execute supervisorctl command on NetFlow connector to get the status of specified service name



Command Info & Results

Execute supervisorctl service command

Jul 27 03:52:48 pm (PDT)

Command: Status of a service

Service name: tet-netflowsensor

STDOUT

```
tet-netflowsensor              RUNNING   pid 9, uptime 0:04:17
```

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Network Connectivity Commands

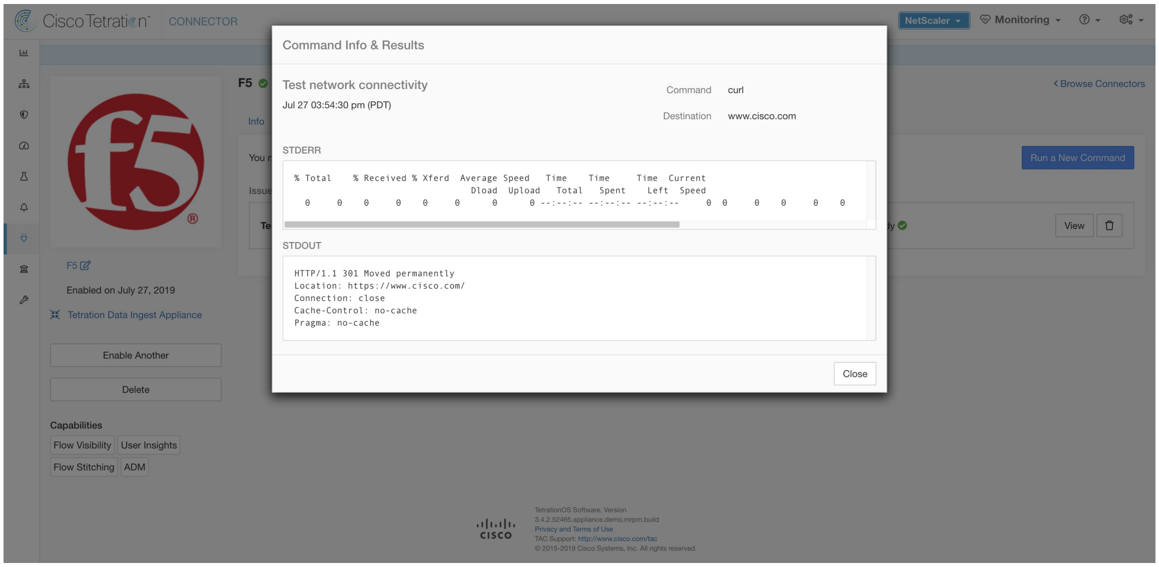
Test network connectivity from the appliance/connector. The command is executed on the appliance by the appliance controller. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
Network Command	dropdown	Network connectivity command to execute
	• *ping*	**ping -c 5 <destination>**
	• *curl*	**curl -I <destination>**
Destination	string	Destination to use for the test

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 130: Test network connectivity on F5 connector by running a curl



Command Info & Results

Test network connectivity

Jul 27 03:54:30 pm (PDT)

Command curl

Destination www.cisco.com

STDERR

```
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0     0    0     0    0     0      0      0 --:--:-- --:--:-- --:--:--     0 0     0    0     0    0
```

STDOUT

```
HTTP/1.1 301 Moved permanently
Location: https://www.cisco.com/
Connection: close
Cache-Control: no-cache
Pragma: no-cache
```

List Files

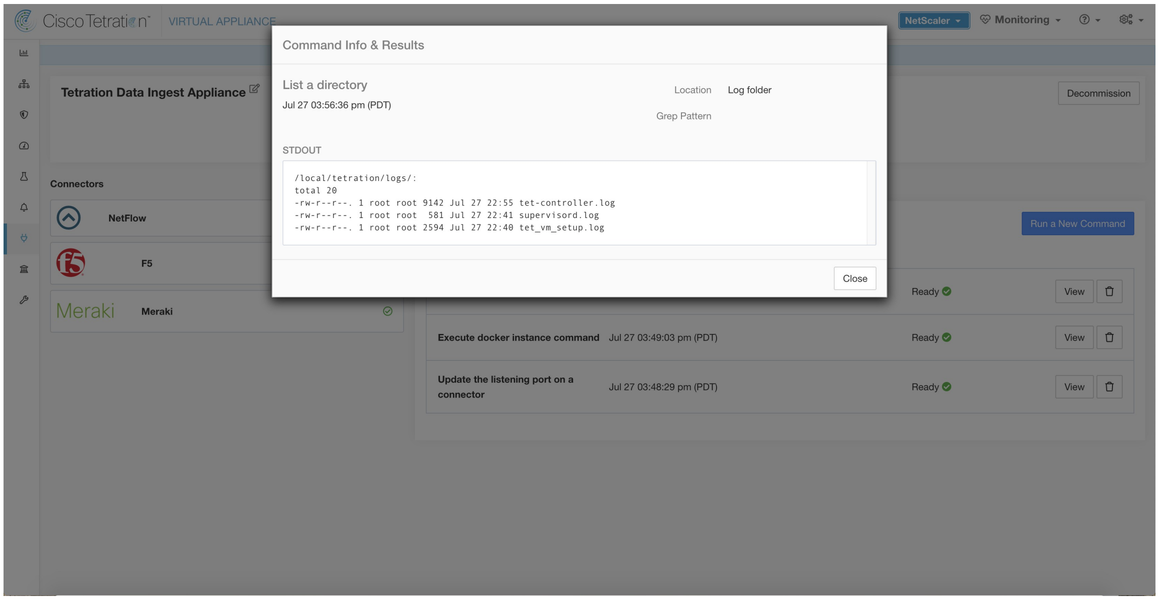
List the files in well known locations of the appliance. Optionally, grep for a specified pattern. Secure Workload sends the command to appliance where the command was issued. The controller on the appliance returns the result. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
Location	dropdown	List files in a target location
	• *Controller configuration folder*	List the contents in the folder where controller configuration files are kept.
	• *Controller cert folder*	List the contents in the folder where controller certs are kept.
	• *Log folder*	List the contents in the folder where log files are present.
Grep Pattern	string	Pattern string to grep from the output

Allowed Secure Workload virtual appliances: All

Allowed connectors: None

Figure 131: List the files in log folder in Secure Workload Ingest appliance



Command Info & Results

List a directory

Jul 27 03:56:36 pm (PDT)

Location Log folder

Grep Pattern

STDOUT

```
/local/tetration/logs/:
total 20
-rw-r--r--. 1 root root 9142 Jul 27 22:55 tet-controller.log
-rw-r--r--. 1 root root  581 Jul 27 22:41 supervisord.log
-rw-r--r--. 1 root root 2594 Jul 27 22:40 tet_vm_setup.log
```

	Ready ✓	
Execute docker instance command	Jul 27 03:49:03 pm (PDT)	Ready ✓
Update the listening port on a connector	Jul 27 03:48:29 pm (PDT)	Ready ✓

List Service Files

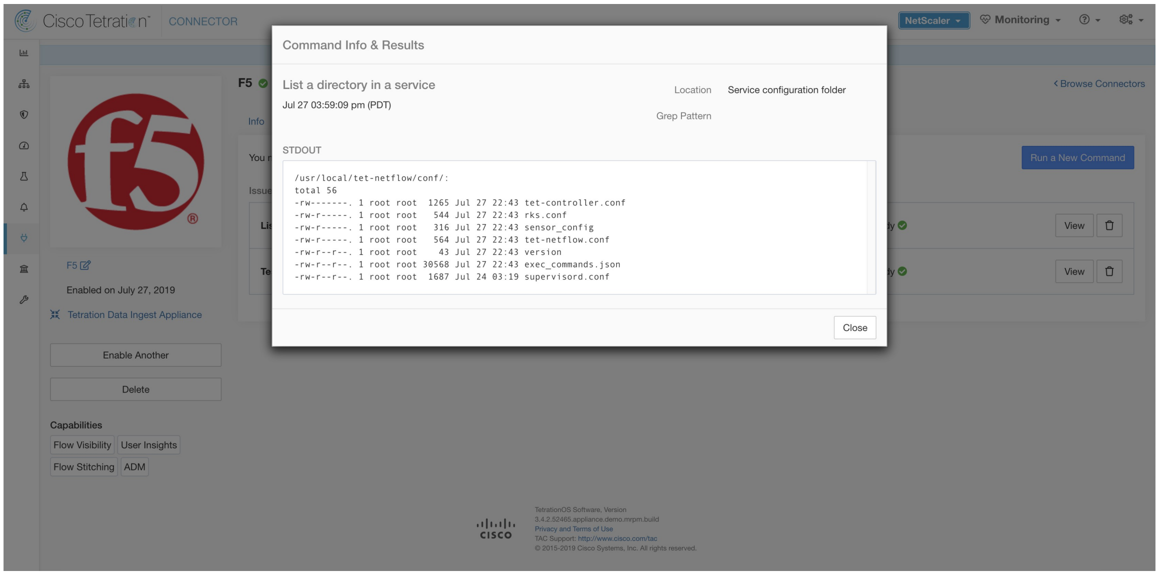
List the files in well known locations of the connector service. Optionally, grep for a specified pattern. Secure Workload sends the command to connector where the command was issued. The controller on the connector service returns the result. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
Location	dropdown	List files in a target location.
	• *Service configuration folder*	List the contents in the folder where service configuration files are kept.
	• *Service cert folder*	List the contents in the folder where service certs are kept.
	• *Log folder*	List the contents in the folder where log files are present.
	• *DB folder*	List the contents in the folder where state of endpoints (esp. for AnyConnect and ISE connectors) are kept.
Grep Pattern	string	Pattern string to grep from the output

Allowed Secure Workload virtual appliances: None

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 132: List the files in configuration folder of F5 connector in Secure Workload Ingest appliance



Command Info & Results

List a directory in a service

Jul 27 03:59:09 pm (PDT)

Location: Service configuration folder

Grep Pattern

STDOUT

```
/usr/local/tet-netflow/conf/:
total 56
-rw-------. 1 root root  1265 Jul 27 22:43 tet-controller.conf
-rw-r-----. 1 root root   544 Jul 27 22:43 rks.conf
-rw-r-----. 1 root root   316 Jul 27 22:43 sensor_config
-rw-r-----. 1 root root   564 Jul 27 22:43 tet-netflow.conf
-rw-r--r--. 1 root root    43 Jul 27 22:43 version
-rw-r--r--. 1 root root 30568 Jul 27 22:43 exec_commands.json
-rw-r--r--. 1 root root  1687 Jul 24 03:19 supervisord.conf
```

Packet Capture

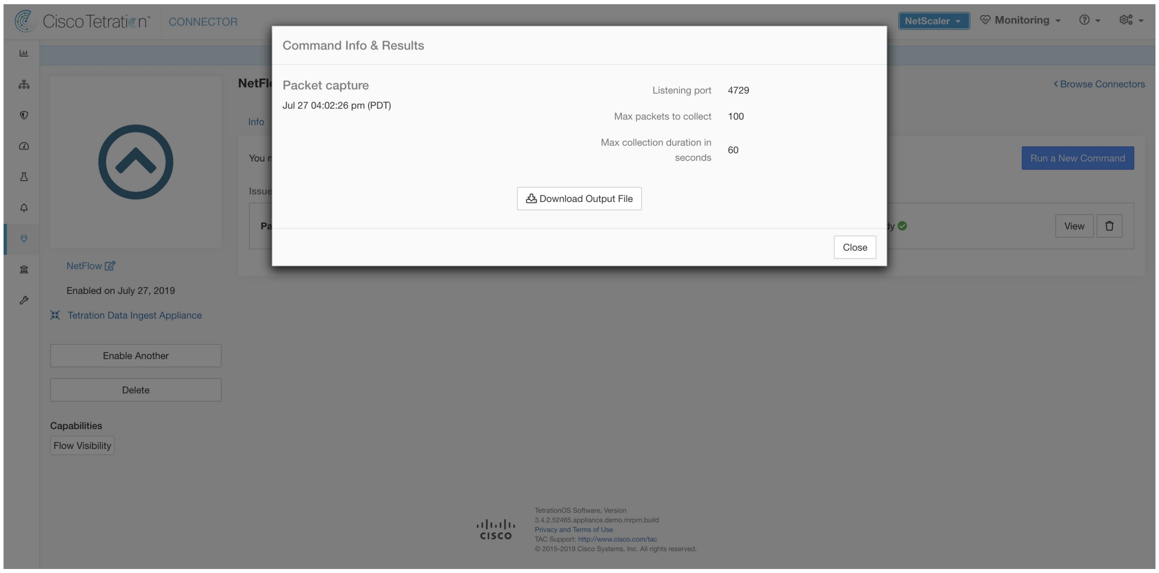
Capture incoming packets on an appliance/connector. Secure Workload sends the command to the appliance/connector where the command was issued. The controller on the appliance/connector service captures packets, encodes them and returns the result to Secure Workload. When the result is available at Secure Workload, a download button is presented to download the file in `.pcap` format.

Argument Name	Type	Description
Listening port	number	Capture packets that are sent/received on this port
Max packets to collect	number	Maximum packets to collect before returning the result. Should be <1000
Max collection duration in seconds	number	Maximum duration to collect before return the result. Should be <600 seconds.

Allowed Secure Workload virtual appliances: All

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, and Meraki.

Figure 133: Capture packets on a given port on NetFlow connector



Command Info & Results

Packet capture
Jul 27 04:02:26 pm (PDT)

Listening port 4729
Max packets to collect 100
Max collection duration in seconds 60

NetFlow
Enabled on July 27, 2019
Tetration Data Ingest Appliance

Capabilities
Flow Visibility

TetrationOS Software, Version 3.4.2.52465.appliance.demo.mrpm.build
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Update Listening Ports of Connectors

Update the listening port on a connector in Secure Workload Ingest appliance. Secure Workload sends the command to the appliance controller on the appliance where the command is issued. The controller does the following actions:

- Stops the Docker service corresponding to the connector.
- Collect the current running configuration of the service.
- Remove the Docker service.
- Update the running configuration of the service to use the new ports.
- Start a new container from the same Docker image that was used in the removed container with new exposed ports. Also, if a Docker volume was mounted to the removed container earlier, the same volume is mounted to the new container.
- Return the new IP bindings of the connector to Secure Workload.
- Secure Workload shows the result in a text box.

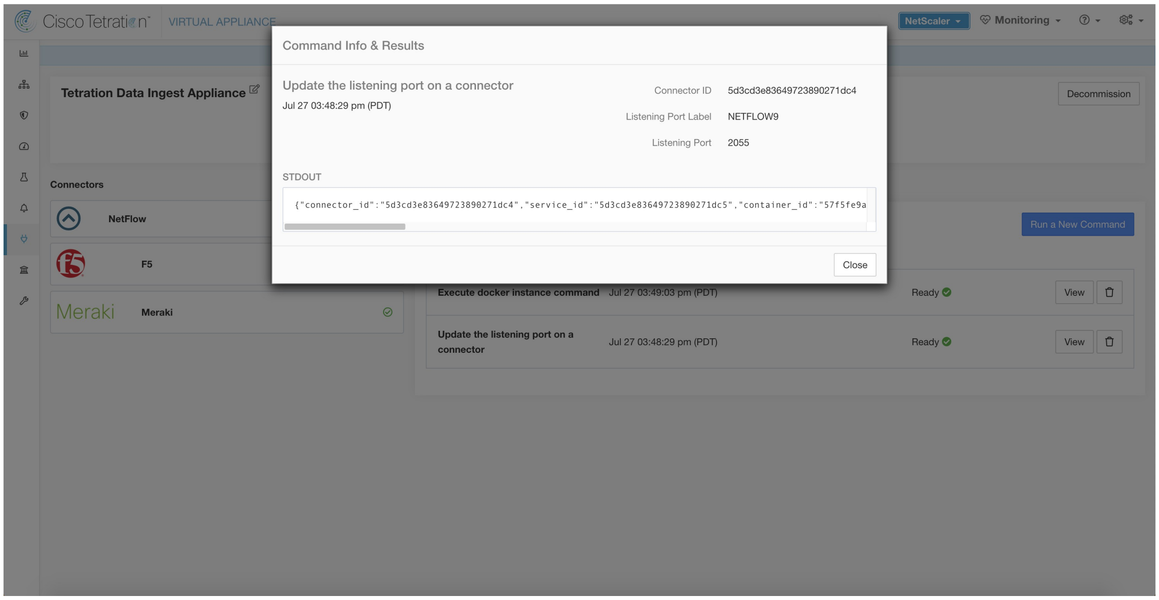
Argument Name	Type	Description
Connector ID	string	Connector ID of the connector for which listening ports need to be updated
Listening port label	dropdown	The type of port that is updated.
	NET-FLOW9	NetFlow v9 listening port
	IPFIX	IPFIX listening port

Argument Name	Type	Description
Listening port	string	New port for the connector

Allowed Secure Workload virtual appliances: Secure Workload Ingest

Allowed connectors None

Figure 134: Update listening port on Meraki connector to 2055 in Secure Workload Ingest appliance



Command Info & Results

Update the listening port on a connector

Jul 27 03:48:29 pm (PDT)

Connector ID 5d3cd3e83649723890271dc4

Listening Port Label NETFLOW9

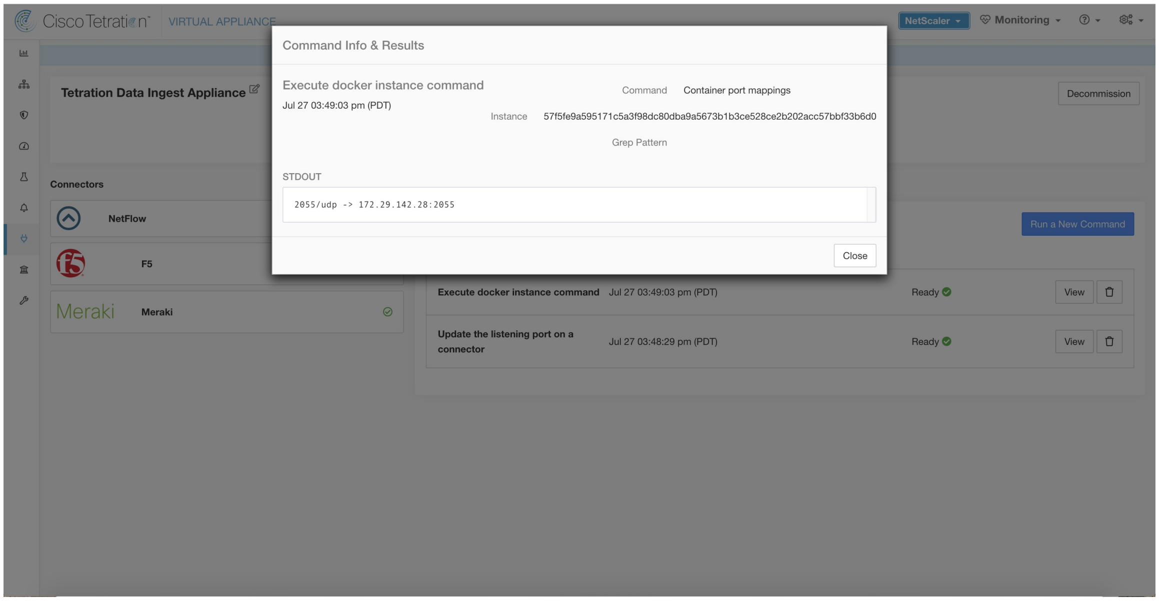
Listening Port 2055

STDOUT

```
{"connector_id":"5d3cd3e83649723890271dc4","service_id":"5d3cd3e83649723890271dc5","container_id":"57f5fe9a
```

Close

Figure 135: Retrieve the port mappings on Meraki connector in Secure Workload Ingest appliance



Command Info & Results

Execute docker instance command

Jul 27 03:49:03 pm (PDT)

Command Container port mappings

Instance 57f5fe9a595171c5a3f98dc80dba9a5673b1b3ce528ce2b202acc57bbf33b6d0

Grep Pattern

STDOUT

```
2055/udp -> 172.29.142.28:2055
```

Close

Update Alert Notifier Connector Log Configuration

Update log configuration for Secure Workload Alert Notifier (TAN) service that hosts Syslog, Email, Slack, PagerDuty, and Kinesis alert notifier connectors. Since TAN hosts multiple connectors, log configuration cannot be updated from connector page directly. This allowed command allows the user to update the log configuration.

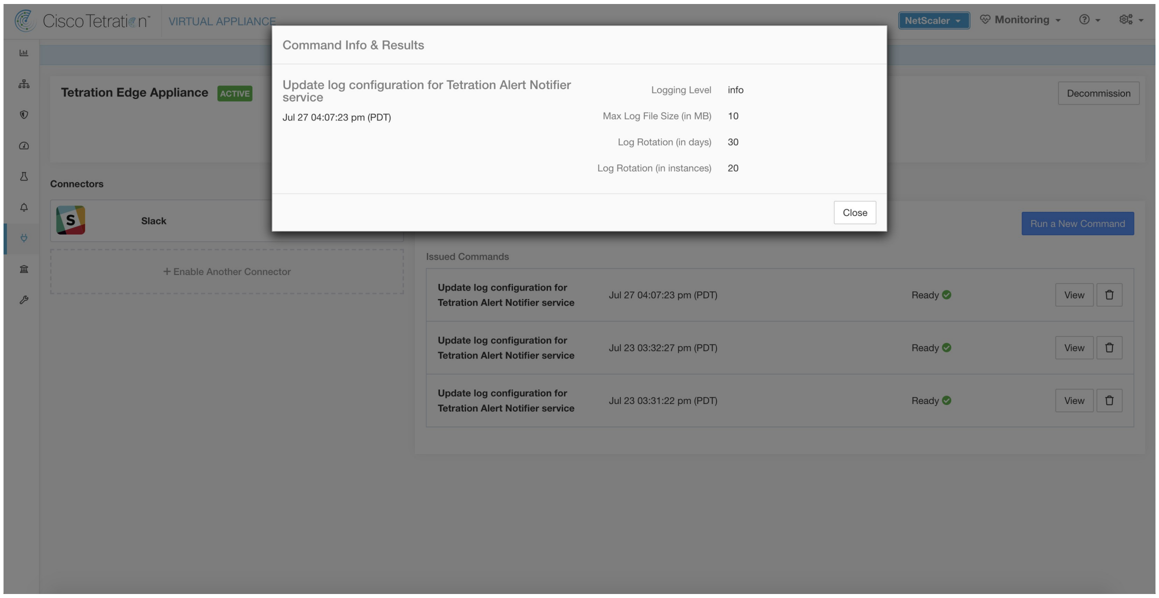
Secure Workload sends the command to the service controller on TAN Docker service of Secure Workload Edge appliance. The controller applies the configuration on the service and returns the status of the configuration update.

Argument Name	Type	Description
Logging level	dropdown	Logging level to be used by the service
	• *debug*	Debug log level
	• *info*	Informational log level
	• *warn*	Warning log level
	• *error*	Error log level
Max log file size (in MB)	number	Maximum size of a log file before log rotation kicks in
Log rotation (in days)	number	Maximum age of a log file before log rotation kicks in
Log rotation (in instances)	number	Maximum instances of log files kept

Allowed Secure Workload virtual appliances: Secure Workload Edge

Allowed connectors: None

Figure 136: Update the log configuration on Secure Workload Alert Notifier Docker service in Secure Workload Edge appliance



Command Info & Results

Update log configuration for Tetration Alert Notifier service

Jul 27 04:07:23 pm (PDT)

Logging Level	info
Max Log File Size (in MB)	10
Log Rotation (in days)	30
Log Rotation (in instances)	20

Issued Commands

Update log configuration for Tetration Alert Notifier service	Jul 27 04:07:23 pm (PDT)	Ready ✓
Update log configuration for Tetration Alert Notifier service	Jul 23 03:32:27 pm (PDT)	Ready ✓
Update log configuration for Tetration Alert Notifier service	Jul 23 03:31:22 pm (PDT)	Ready ✓

Collect Snapshot From Appliance

Secure Workload sends the command to the appliance where the command was issued. When the controller on the appliance receives this command from Secure Workload, it collects appliance snapshot, encodes them and returns the result to Secure Workload. When the result is available at Secure Workload, a download button is presented to download the file in `.tar.gz` format.

Files included in the snapshot:

- /local/tetration/appliance/appliance.conf
- /local/tetration/{logs, sqlite, user.cfg}
- /opt/tetration/tet_vm_setup/conf/tet-vm-setup.conf
- /opt/tetration/tet_vm_setup/docker/Dockerfile
- /opt/tetration/ova/version
- /usr/local/tet-controller/conf
- /usr/local/tet-controller/cert/{topic.txt, kafkaBrokerIps.txt}
- /var/run/supervisord.pid
- /etc/resolv.conf

Command outputs included in the snapshot:

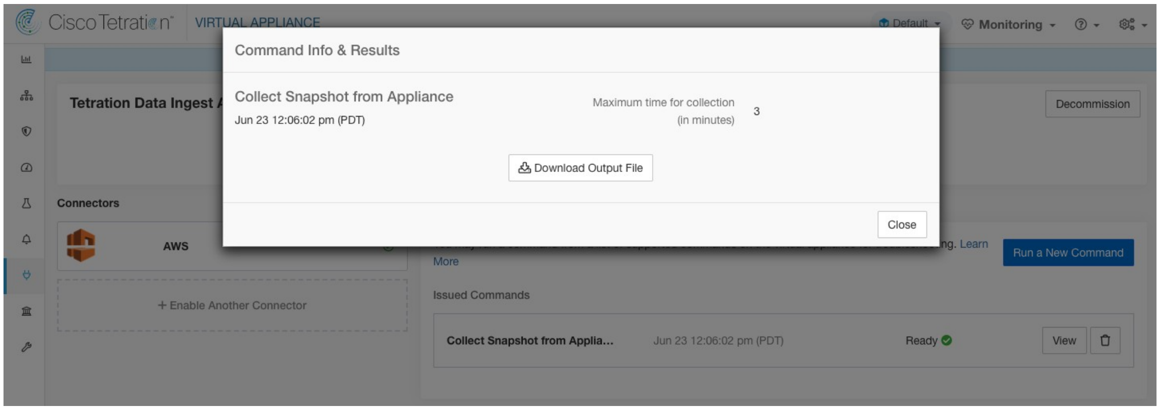
- ps aux
- iptables -L
- netstat {-nat, -rn, -suna, -stna, -tunlp}
- ss {-nat, -rn, -suna, -stna, -tunlp}

- /usr/local/tet-controller/tet-controller -version
- supervisorctl status
- rpm -qi tet-nic-driver tet-controller
- du -shc /local/tetration/logs
- ls {/usr/local/tet-controller/cert/, -l /local/tetration/sqlite/, -l /opt/tetration/tet_vm_setup/.tet_vm.done, -l/opt/tetration/tet_vm_setup/templates/}
- docker {images, ps -a}
- blkid/ifconfig/lscpu/uptime
- free -m
- df -h

Argument Name	Type	Description
Max time for collection in minutes	number	Maximum duration to collect before returning the results. Should be <20 minutes.

Allowed Secure Workload virtual appliances : Secure Workload Ingest and Secure Workload Edge

Figure 137: Collect snapshot from Secure Workload appliance



Command Info & Results

Collect Snapshot from Appliance
Jun 23 12:06:02 pm (PDT)

Maximum time for collection (in minutes): 3

Issued Commands

Collect Snapshot from Applia...	Jun 23 12:06:02 pm (PDT)	Ready ✓

Collect Snapshot From Connector

Secure Workload sends the command to the appliance where the connector is deployed. According to connector ID, the controller collects connector snapshot, encodes them and returns the result to Secure Workload. When the result is available at Secure Workload, a download button is presented to download the file in .tar.gz format.

Files included in the snapshot:

- /usr/local/tet-netflow/conf
- /local/tetration/{logs, sqlite}
- /var/run/{supervisord.pid, tet-netflow.pid}

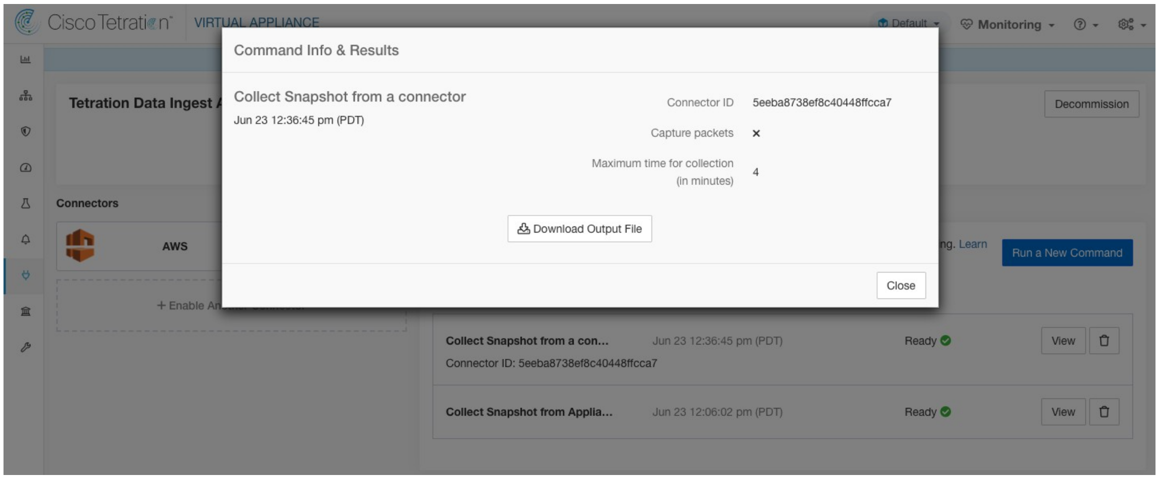
Command outputs included in the snapshot:

- ps aux
- netstat {-nat, -rn, -suna, -stna, -tunlp}
- ss {-nat, -rn, -suna, -stna, -tunlp}

Argument Name	Type	Description
Connector ID	string	Connector ID of the connector for which the snapshot command is run.
Capture packets	check-box	Should packets be captured?
Max time for collection in minutes	number	Maximum duration to collect before returning the results. Should be < 20 minutes.

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Figure 138: Collect snapshot from Secure Workload connector on designated connector ID



Command Info & Results

Collect Snapshot from a connector
Jun 23 12:36:45 pm (PDT)

Connector ID 5eeba8738ef8c40448ffcca7

Capture packets ✕

Maximum time for collection (in minutes) 4

Collect Snapshot from a con... Jun 23 12:36:45 pm (PDT) Ready ✓
Connector ID: 5eeba8738ef8c40448ffcca7

Collect Snapshot from Applia... Jun 23 12:06:02 pm (PDT) Ready ✓

Collect Controller Profile

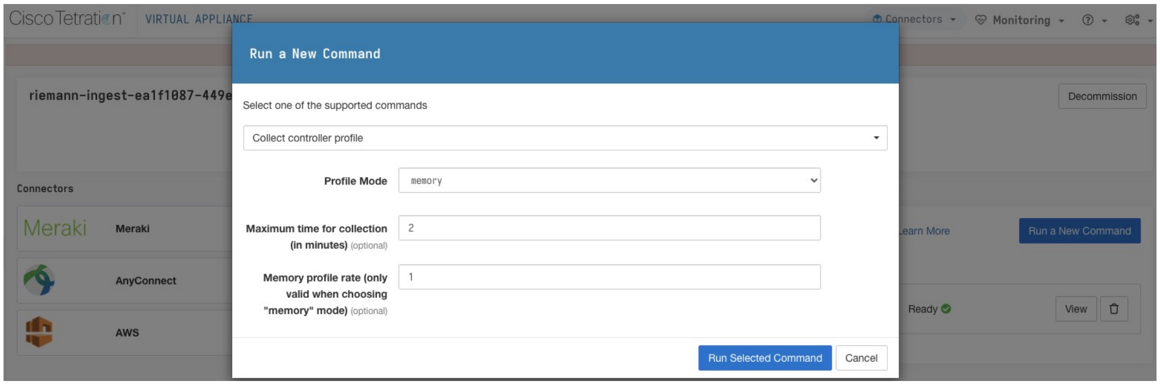
Collect controller process profiling result on appliance or connectors. Secure Workload sends the command to the connector where the command was issued. The service controller restarts the connector service in the specified profiling mode. After collecting the profiling result, service controller restarts the service in normal mode and send the result to Secure Workload. When the result is available at Secure Workload, a download button is presented to download the file in `.tar.gz` format.

Argument Name	Type	Description
Profile Mode	dropdown	Profiling mode.
	• *memory*	Memory profiling mode.
	• *cpu*	CPU profiling mode.
	• *block*	Block profiling mode.
	• *mutex*	Mutex profiling mode.
	• *goroutine*	Goroutine profiling mode.
Maximum time for collection (in minutes)	number	Maximum duration to collect before returning the result.
Memory profile rate (only valid when choosing "memory" mode)	number	Memory profiling rate. This field is optional. If not provided, default value in Golang will be used.

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, and Meraki.

Figure 139: Collect controller profile from Secure Workload appliance



Run a New Command

Select one of the supported commands

Collect controller profile

Profile Mode: memory

Maximum time for collection (in minutes) (optional): 2

Memory profile rate (only valid when choosing "memory" mode) (optional): 1

Collect Connector Profile

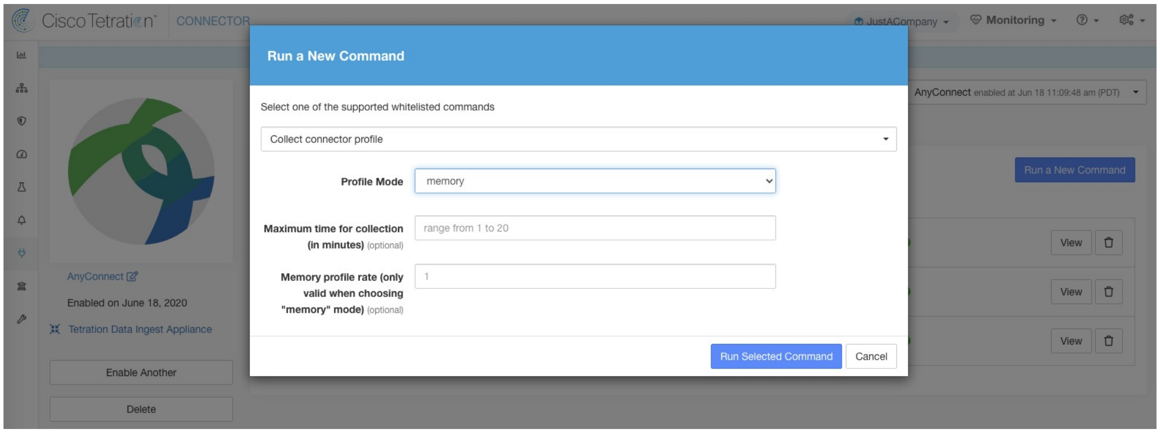
Collect connector process profiling result on connectors. Secure Workload sends the command to the connector where the command was issued. The service controller restart the connector service in the specified profiling mode. After collecting the profiling result, service controller restart the service in normal mode and send the result to Secure Workload. When the result is available at Secure Workload, a download button is presented to download the file in `.tar.gz` format.

Argument Name	Type	Description
Profile Mode	dropdown	Profiling mode.
	• *memory*	Memory profiling mode.
	• *cpu*	CPU profiling mode.
	• *block*	Block profiling mode.
	• *mutex*	Mutex profiling mode.
	• *goroutine*	Goroutine profiling mode.
Maximum time for collection (in minutes)	number	Maximum duration to collect before returning the result.
Memory profile rate (only valid when choosing “memory” mode)	number	Memory profiling rate. This field is optional. If not provided, default value in Golang will be used.

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, and Meraki.

Figure 140: Collect connector profile from Secure Workload connector



Run a New Command

Select one of the supported whitelisted commands

Collect connector profile

Profile Mode: memory

Maximum time for collection (in minutes) (optional): range from 1 to 20

Memory profile rate (only valid when choosing "memory" mode) (optional): 1

AnyConnect

Enabled on June 18, 2020

Tetration Data Ingest Appliance

AnyConnect enabled at Jun 18 11:09:48 am (PDT)

Override connector alert interval for Appliance

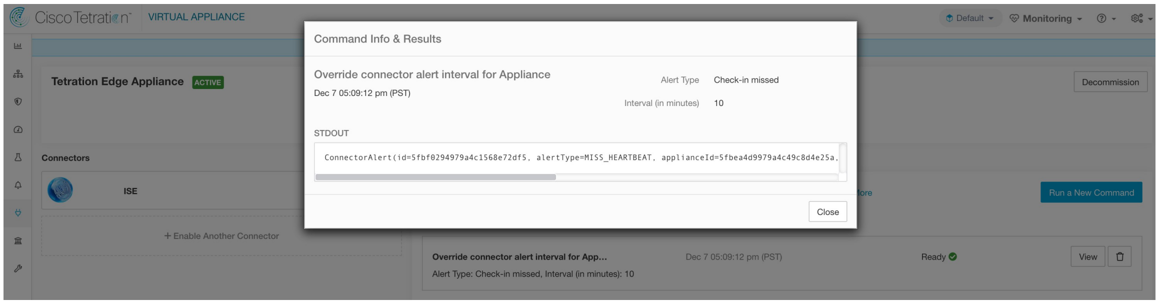
Override default connector alert interval for appliance. Secure Workload restricts same connector alert to send only once a day in default. This command is for administrator to override interval when they think once a day is too long. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
Alert Type	dropdown	The connector alert type to override.
	• *Check-in missed*	Miss appliance’s check-in.
	• *CPU usage*	High CPU usage.
	• *Memory usage*	High memory usage.
	• *Disk usage*	High disk usage.
Interval (in minutes)	number	Duration to override interval in minutes.

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: None

Figure 141: Override connector alert interval for Secure Workload appliance



Command Info & Results

Override connector alert interval for Appliance
Dec 7 05:09:12 pm (PST)

Alert Type: Check-in missed
Interval (in minutes): 10

STDOUT

```
ConnectorAlert(id=5fbf0294979a4c1568e72df5, alertType=MISS_HEARTBEAT, applianceId=5fbea4d9979a4c49c8d4e25a,
```

Override connector alert interval for App... Dec 7 05:09:12 pm (PST) Ready
Alert Type: Check-in missed, Interval (in minutes): 10

Override connector alert interval for Connector

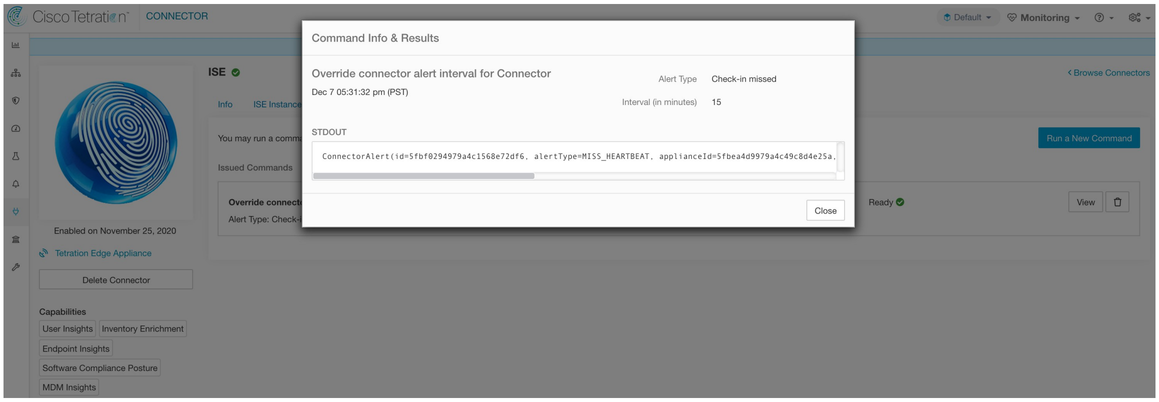
Override default connector alert interval for connector. Secure Workload restricts same connector alert to send only once a day in default. This command is for administrator to override interval when they think once a day is too long. When the result is available at Secure Workload, the result is shown in a text box.

Argument Name	Type	Description
Alert Type	dropdown	The connector alert type to override.
	• *Check-in missed*	Miss connector’s check-in.
Interval (in minutes)	number	Duration to override interval in minutes.

Allowed Secure Workload virtual appliances: None

Allowed connectors: NetFlow, NetScaler, F5, AnyConnect, Syslog, Email, Slack, PagerDuty, Kinesis, ISE, ASA, Meraki, ServiceNow, WAD.

Figure 142: Override connector alert interval for Secure Workload connector



Command Info & Results

Override connector alert interval for Connector

Dec 7 05:31:32 pm (PST)

Alert Type: Check-in missed

Interval (in minutes): 15

STDOUT

```
ConnectorAlert(id=5fbf0294979a4c1568e72df6, alertType=MISS_HEARTBEAT, applianceId=5fbea4d9979a4c49c8d4e25a,
```

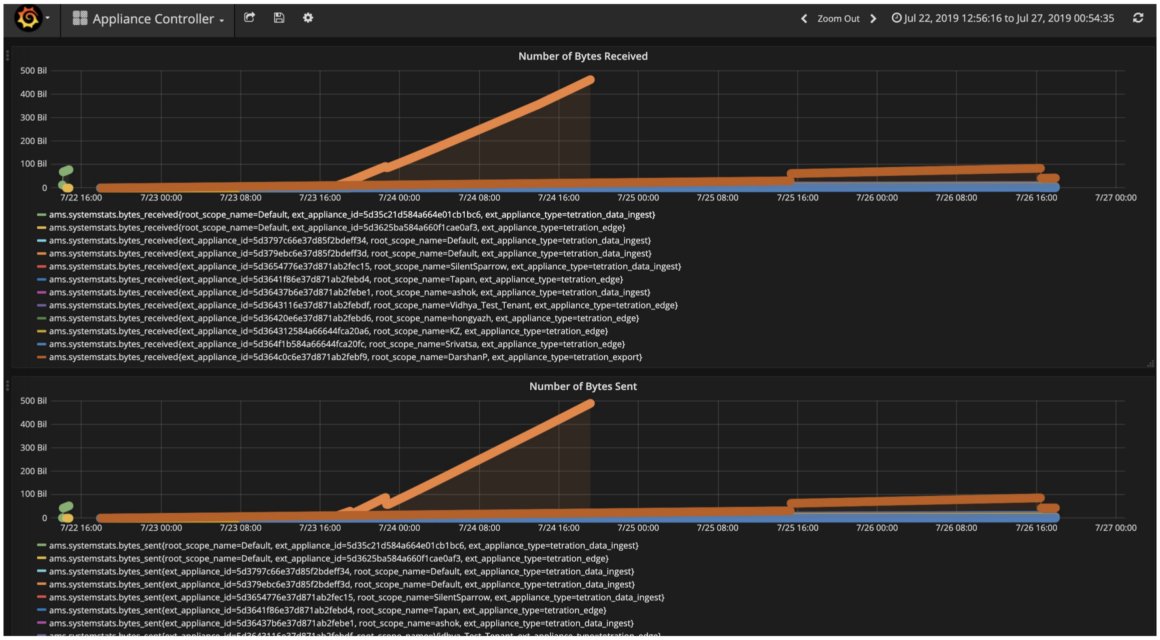
Hawkeye Dashboards

Hawkeye dashboards provide insights about health of the connectors and virtual appliances where the connectors are enabled.

Appliance Controller Dashboard

Appliance controller dashboard provides information about network statistics, system metrics such as CPU usage percentage, memory usage percentage, disk usage percentage, and number of open file descriptors.

Figure 143: Appliance controller dashboard

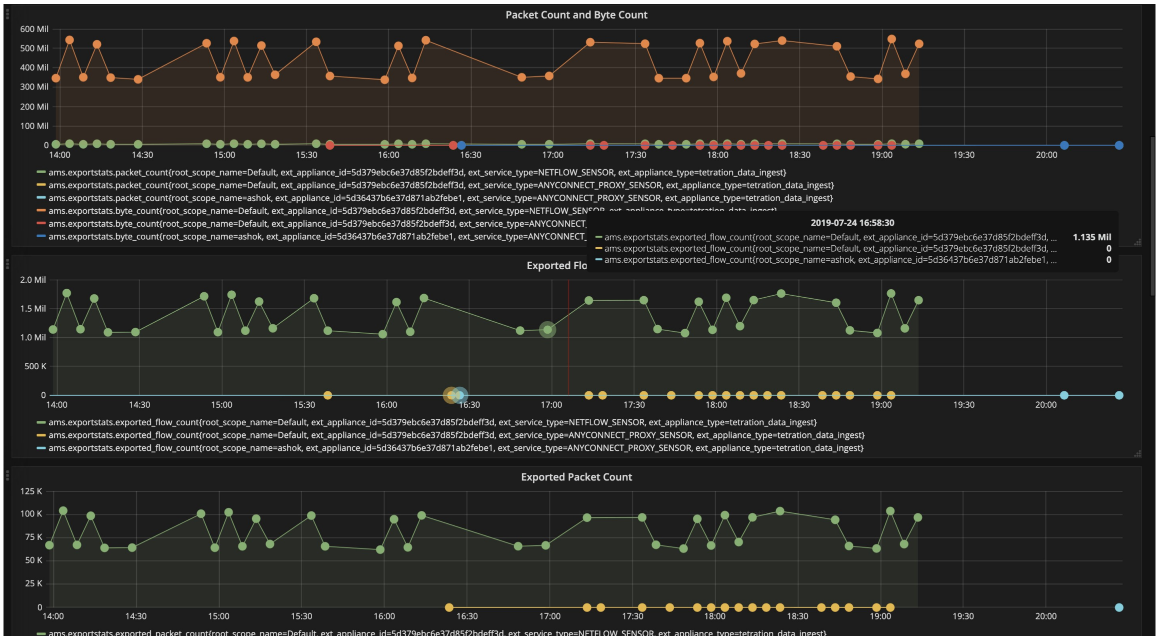


Appliance Controller
Zoom Out
Jul 22, 2019 12:56:16 to Jul 27, 2019 00:54:35
Number of Bytes Received
500 Bil
400 Bil
300 Bil
200 Bil
100 Bil
0
7/22 16:00
7/23 00:00
7/23 08:00
7/23 16:00
7/24 00:00
7/24 08:00
7/24 16:00
7/25 00:00
7/25 08:00
7/25 16:00
7/26 00:00
7/26 08:00
7/26 16:00
7/27 00:00
ams.systemstats.bytes_received{root_scope_name=Default, ext_appliance_id=5d35c21d584a664e01cb1bc6, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_received{root_scope_name=Default, ext_appliance_id=5d3625ba584a660f1cae0af3, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_received{ext_appliance_id=5d3797c66e37d85f2bdeff34, root_scope_name=Default, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_received{ext_appliance_id=5d379ebc6e37d85f2bdeff3d, root_scope_name=Default, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_received{ext_appliance_id=5d3654776e37d871ab2fec15, root_scope_name=SilentSparrow, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_received{ext_appliance_id=5d3641f86e37d871ab2febd4, root_scope_name=Tapan, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_received{ext_appliance_id=5d36437b6e37d871ab2febe1, root_scope_name=ashok, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_received{ext_appliance_id=5d3643116e37d871ab2febdf, root_scope_name=Vidhya_Test_Tenant, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_received{ext_appliance_id=5d36420e6e37d871ab2febd6, root_scope_name=hongyazh, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_received{ext_appliance_id=5d364312584a66644fca20a6, root_scope_name=KZ, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_received{ext_appliance_id=5d364f1b584a66644fca20fc, root_scope_name=Srivatsa, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_received{ext_appliance_id=5d364c0c6e37d871ab2febf9, root_scope_name=DarshanP, ext_appliance_type=tetration_export}
Number of Bytes Sent
500 Bil
400 Bil
300 Bil
200 Bil
100 Bil
0
7/22 16:00
7/23 00:00
7/23 08:00
7/23 16:00
7/24 00:00
7/24 08:00
7/24 16:00
7/25 00:00
7/25 08:00
7/25 16:00
7/26 00:00
7/26 08:00
7/26 16:00
7/27 00:00
ams.systemstats.bytes_sent{root_scope_name=Default, ext_appliance_id=5d35c21d584a664e01cb1bc6, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_sent{root_scope_name=Default, ext_appliance_id=5d3625ba584a660f1cae0af3, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_sent{ext_appliance_id=5d3797c66e37d85f2bdeff34, root_scope_name=Default, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_sent{ext_appliance_id=5d379ebc6e37d85f2bdeff3d, root_scope_name=Default, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_sent{ext_appliance_id=5d3654776e37d871ab2fec15, root_scope_name=SilentSparrow, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_sent{ext_appliance_id=5d3641f86e37d871ab2febd4, root_scope_name=Tapan, ext_appliance_type=tetration_edge}
ams.systemstats.bytes_sent{ext_appliance_id=5d36437b6e37d871ab2febe1, root_scope_name=ashok, ext_appliance_type=tetration_data_ingest}
ams.systemstats.bytes_sent{ext_appliance_id=5d3643116e37d871ab2febdf, root_scope_name=Vidhya_Test_Tenant, ext_appliance_type=tetration_edge}

Service Dashboard

Service dashboard provides information about export metrics -if applicable- including number of flow observations exported to Secure Workload, number of packets exported to Secure Workload, and number of bytes exported to Secure Workload. In addition, this dashboard also provides information about protocol processing and decoding (for example, services that process NetFlow v9, and IPFIX). Metrics such as decoded count, decoded error count, flow count, packet count, and byte count are available in this dashboard. Furthermore, system metrics for the Docker container where the service is running are also included in this dashboard. Metrics such as CPU usage percentage, memory usage percentage, disk usage percentage, and number of open file descriptors are part of this dashboard.

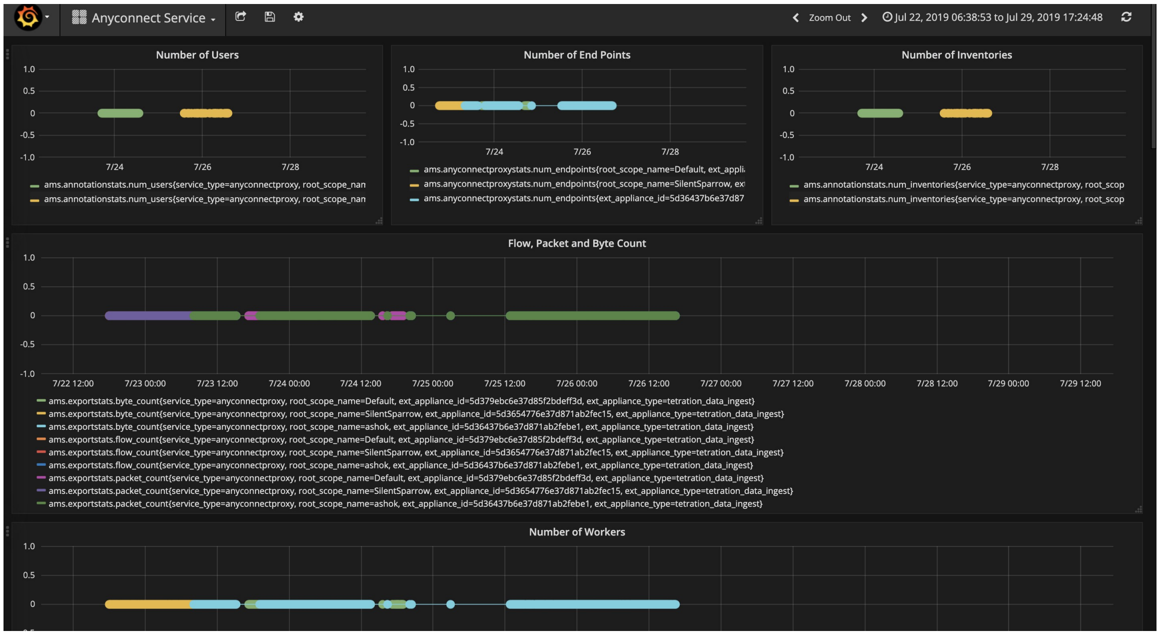
Figure 144: Service dashboard


Packet Count and Byte Count
600 Mil
500 Mil
400 Mil
300 Mil
200 Mil
100 Mil
0
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
ams.exportstats.packet_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=NETFLOW_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.exportstats.packet_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=ANYCONNECT_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.exportstats.packet_count{root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ext_service_type=ANYCONNECT_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.exportstats.byte_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=NETFLOW_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.exportstats.byte_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=ANYCONNECT_
ams.exportstats.byte_count{root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ext_service_type=ANYCONNECT_
2019-07-24 16:58:30
ams.exportstats.exported_flow_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ... 1.135 Mil
ams.exportstats.exported_flow_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ... 0
ams.exportstats.exported_flow_count{root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ... 0
Exported Flo
2.0 Mil
1.5 Mil
1.0 Mil
500 K
0
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
ams.exportstats.exported_flow_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=NETFLOW_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.exportstats.exported_flow_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=ANYCONNECT_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.exportstats.exported_flow_count{root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ext_service_type=ANYCONNECT_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
Exported Packet Count
125 K
100 K
75 K
50 K
25 K
0
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
ams.exportstats.exported_packet_count{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=NETFLOW_SENSOR, ext_appliance_type=tetration_data_ingest}

AnyConnect Service Dashboard

AnyConnect service dashboard provides information about AnyConnect specific service information. Metrics such as number of endpoints, number of inventories, number of users reported by AnyConnect connector to Secure Workload are available in this dashboard. In addition, this dashboard also provides information about IPFIX protocol processing and decoding. Metrics such as decoded count, decoded error count, flow count, packet count, and byte count are available in this dashboard.

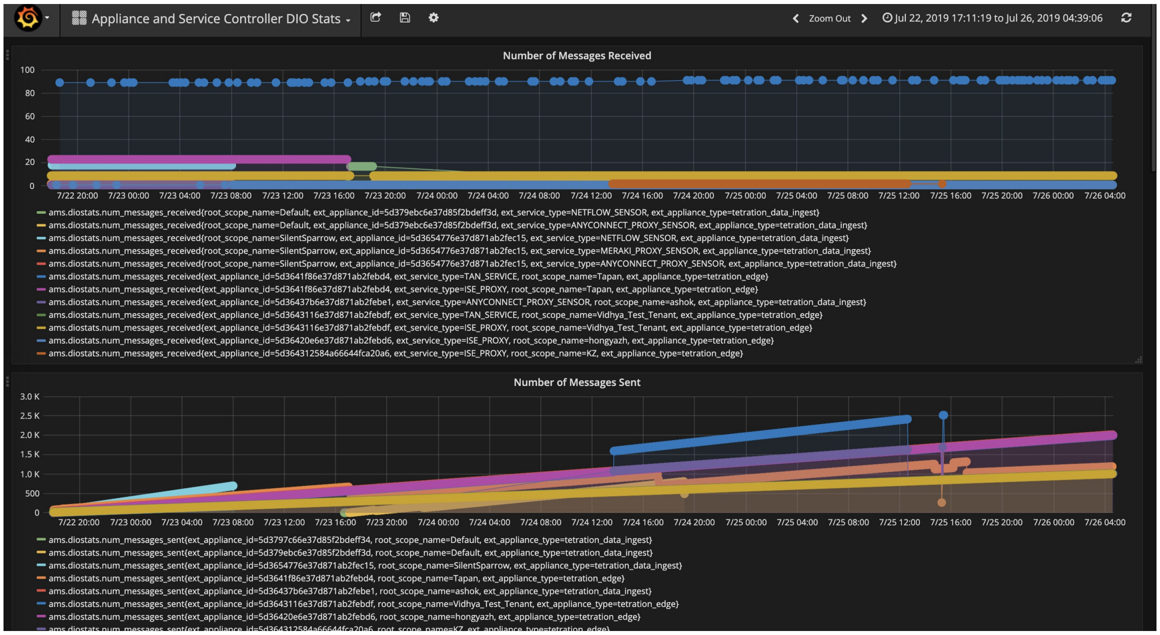
Figure 145: AnyConnect dashboard


Anyconnect Service
Zoom Out
Jul 22, 2019 06:38:53 to Jul 29, 2019 17:24:48
Number of Users
Number of End Points
Number of Inventories
1.0
0.5
0
-0.5
-1.0
7/24
7/26
7/28
ams.annotationstats.num_users{service_type=anyconnectproxy, root_scope_nan
ams.annotationstats.num_users{service_type=anyconnectproxy, root_scope_nan
ams.anyconnectproxystats.num_endpoints{root_scope_name=Default, ext_appli
ams.anyconnectproxystats.num_endpoints{root_scope_name=SilentSparrow, ext
ams.anyconnectproxystats.num_endpoints{ext_appliance_id=5d36437b6e37d87
ams.annotationstats.num_inventories{service_type=anyconnectproxy, root_scop
ams.annotationstats.num_inventories{service_type=anyconnectproxy, root_scop
Flow, Packet and Byte Count
7/22 12:00
7/23 00:00
7/23 12:00
7/24 00:00
7/24 12:00
7/25 00:00
7/25 12:00
7/26 00:00
7/26 12:00
7/27 00:00
7/27 12:00
7/28 00:00
7/28 12:00
7/29 00:00
7/29 12:00
ams.exportstats.byte_count{service_type=anyconnectproxy, root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_appliance_type=tetration_data_ingest}
ams.exportstats.byte_count{service_type=anyconnectproxy, root_scope_name=SilentSparrow, ext_appliance_id=5d3654776e37d871ab2fec15, ext_appliance_type=tetration_data_ingest}
ams.exportstats.byte_count{service_type=anyconnectproxy, root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ext_appliance_type=tetration_data_ingest}
ams.exportstats.flow_count{service_type=anyconnectproxy, root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_appliance_type=tetration_data_ingest}
ams.exportstats.flow_count{service_type=anyconnectproxy, root_scope_name=SilentSparrow, ext_appliance_id=5d3654776e37d871ab2fec15, ext_appliance_type=tetration_data_ingest}
ams.exportstats.flow_count{service_type=anyconnectproxy, root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ext_appliance_type=tetration_data_ingest}
ams.exportstats.packet_count{service_type=anyconnectproxy, root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_appliance_type=tetration_data_ingest}
ams.exportstats.packet_count{service_type=anyconnectproxy, root_scope_name=SilentSparrow, ext_appliance_id=5d3654776e37d871ab2fec15, ext_appliance_type=tetration_data_ingest}
ams.exportstats.packet_count{service_type=anyconnectproxy, root_scope_name=ashok, ext_appliance_id=5d36437b6e37d871ab2febe1, ext_appliance_type=tetration_data_ingest}
Number of Workers

Appliance and Service DIO Dashboard

Appliance and service DIO dashboard provides information about number of messages exchanged in the Kafka topic on which the appliance manager and appliance/service controllers communicate. Metrics such as number of messages received, number of messages sent, number of messages failed are included in this dashboard. In addition, the last offset read by the controllers are also provided to understand whether the controller is lagging behind in processing the control messages from the manager.

Figure 146: Appliance and service DIO dashboard


Appliance and Service Controller DIO Stats
Zoom Out
Jul 22, 2019 17:11:19 to Jul 26, 2019 04:39:06
Number of Messages Received
100
80
60
40
20
0
7/22 20:00
7/23 00:00
7/23 04:00
7/23 08:00
7/23 12:00
7/23 16:00
7/23 20:00
7/24 00:00
7/24 04:00
7/24 08:00
7/24 12:00
7/24 16:00
7/24 20:00
7/25 00:00
7/25 04:00
7/25 08:00
7/25 12:00
7/25 16:00
7/25 20:00
7/26 00:00
7/26 04:00
ams.diostats.num_messages_received{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=NETFLOW_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_received{root_scope_name=Default, ext_appliance_id=5d379ebc6e37d85f2bdeff3d, ext_service_type=ANYCONNECT_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_received{root_scope_name=SilentSparrow, ext_appliance_id=5d3654776e37d871ab2fec15, ext_service_type=NETFLOW_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_received{root_scope_name=SilentSparrow, ext_appliance_id=5d3654776e37d871ab2fec15, ext_service_type=MERAKI_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_received{root_scope_name=SilentSparrow, ext_appliance_id=5d3654776e37d871ab2fec15, ext_service_type=ANYCONNECT_PROXY_SENSOR, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_received{ext_appliance_id=5d3641f86e37d871ab2febd4, ext_service_type=TAN_SERVICE, root_scope_name=Tapan, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_received{ext_appliance_id=5d3641f86e37d871ab2febd4, ext_service_type=ISE_PROXY, root_scope_name=Tapan, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_received{ext_appliance_id=5d36437b6e37d871ab2febe1, ext_service_type=ANYCONNECT_PROXY_SENSOR, root_scope_name=ashok, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_received{ext_appliance_id=5d3643116e37d871ab2febdf, ext_service_type=TAN_SERVICE, root_scope_name=Vidhya_Test_Tenant, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_received{ext_appliance_id=5d3643116e37d871ab2febdf, ext_service_type=ISE_PROXY, root_scope_name=Vidhya_Test_Tenant, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_received{ext_appliance_id=5d36420e6e37d871ab2febd6, ext_service_type=ISE_PROXY, root_scope_name=hongyazh, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_received{ext_appliance_id=5d364312584a66644fca20a6, ext_service_type=ISE_PROXY, root_scope_name=KZ, ext_appliance_type=tetration_edge}
Number of Messages Sent
3.0 K
2.5 K
2.0 K
1.5 K
1.0 K
500
0
ams.diostats.num_messages_sent{ext_appliance_id=5d3797c66e37d85f2bdeff34, root_scope_name=Default, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_sent{ext_appliance_id=5d379ebc6e37d85f2bdeff3d, root_scope_name=Default, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_sent{ext_appliance_id=5d3654776e37d871ab2fec15, root_scope_name=SilentSparrow, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_sent{ext_appliance_id=5d3641f86e37d871ab2febd4, root_scope_name=Tapan, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_sent{ext_appliance_id=5d36437b6e37d871ab2febe1, root_scope_name=ashok, ext_appliance_type=tetration_data_ingest}
ams.diostats.num_messages_sent{ext_appliance_id=5d3643116e37d871ab2febdf, root_scope_name=Vidhya_Test_Tenant, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_sent{ext_appliance_id=5d36420e6e37d871ab2febd6, root_scope_name=hongyazh, ext_appliance_type=tetration_edge}
ams.diostats.num_messages_sent{ext_appliance_id=5d364312584a66644fca20a6, root_scope_name=KZ, ext_appliance_type=tetration_edge}

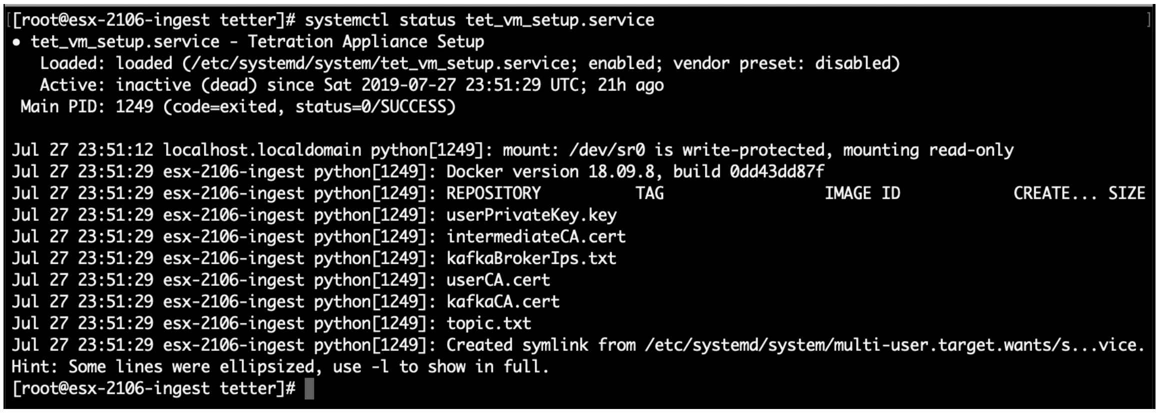
General Troubleshooting Guidelines

Once a connector show in active state in connectors page in Secure Workload, no action is needed on the appliance where the connector is enabled; user does not need to log into it. If that is not happening, following information helps to troubleshoot such problems.

In normal conditions, on the appliance:

- `systemctl status tet_vm_setup.service` reports an *inactive* service with *SUCCESS* exit status.
- `systemctl status tet-nic-driver` reports an *active* service.
- `supervisorctl status tet-controller` reports *RUNNING* service. This indicates that the appliance controller is up and running.
- `docker network ls` reports three networks: `bridge`, `host`, and `none`.
- `docker ps` reports the containers that are running on the appliance. Typically, when a connector is enabled successfully on an appliance, a Docker container is instantiated on the appliance. For Syslog, Email, Slack, PagerDuty and Kinesis connectors, a Secure Workload alert notifier service is instantiated as a Docker container on Secure Workload edge appliance.
- `docker logs <cid>` for each container should report that tet-netflowsensor entered RUNNING state.
- `docker exec <cid> ifconfig` reports only one interface, besides the loopback.
- `docker exec <cid> netstat -rn` reports the default gateway.
- `cat /local/tetration/appliance/appliance.conf` on the appliance to see the list of Docker services running on the appliance. It includes details about service ID, connector ID, container, image ID and port mappings (if applicable). On a Secure Workload Ingest appliance, at most three services be running on the appliance. The port mappings and Docker volumes that are mounted on the containers are available in this file.

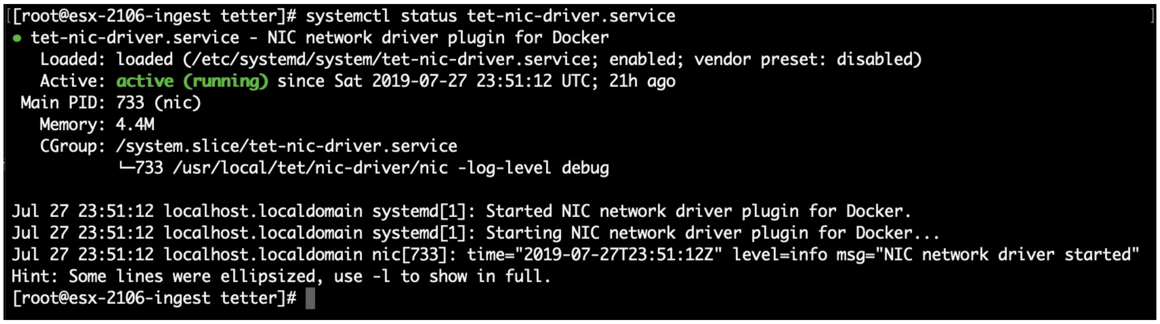
Figure 147: Secure Workload appliance deployment service and status



```
[root@esx-2106-ingest tetter]# systemctl status tet_vm_setup.service
● tet_vm_setup.service - Tetration Appliance Setup
   Loaded: loaded (/etc/systemd/system/tet_vm_setup.service; enabled; vendor preset: disabled)
   Active: inactive (dead) since Sat 2019-07-27 23:51:29 UTC; 21h ago
 Main PID: 1249 (code=exited, status=0/SUCCESS)

Jul 27 23:51:12 localhost.localdomain python[1249]: mount: /dev/sr0 is write-protected, mounting read-only
Jul 27 23:51:29 esx-2106-ingest python[1249]: Docker version 18.09.8, build 0dd43dd87f
Jul 27 23:51:29 esx-2106-ingest python[1249]: REPOSITORY          TAG                 IMAGE ID            CREATE... SIZE
Jul 27 23:51:29 esx-2106-ingest python[1249]: userPrivateKey.key
Jul 27 23:51:29 esx-2106-ingest python[1249]: intermediateCA.cert
Jul 27 23:51:29 esx-2106-ingest python[1249]: kafkaBrokerIps.txt
Jul 27 23:51:29 esx-2106-ingest python[1249]: userCA.cert
Jul 27 23:51:29 esx-2106-ingest python[1249]: kafkaCA.cert
Jul 27 23:51:29 esx-2106-ingest python[1249]: topic.txt
Jul 27 23:51:29 esx-2106-ingest python[1249]: Created symlink from /etc/systemd/system/multi-user.target.wants/s...vice.
Hint: Some lines were ellipsized, use -l to show in full.
[root@esx-2106-ingest tetter]#
```

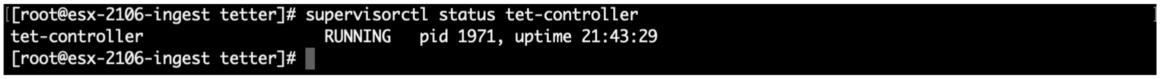
Figure 148: Secure Workload network driver service status



```
[root@esx-2106-ingest tetter]# systemctl status tet-nic-driver.service
● tet-nic-driver.service - NIC network driver plugin for Docker
   Loaded: loaded (/etc/systemd/system/tet-nic-driver.service; enabled; vendor preset: disabled)
   Active: active (running) since Sat 2019-07-27 23:51:12 UTC; 21h ago
 Main PID: 733 (nic)
   Memory: 4.4M
   CGroup: /system.slice/tet-nic-driver.service
           └─733 /usr/local/tet/nic-driver/nic -log-level debug

Jul 27 23:51:12 localhost.localdomain systemd[1]: Started NIC network driver plugin for Docker.
Jul 27 23:51:12 localhost.localdomain systemd[1]: Starting NIC network driver plugin for Docker...
Jul 27 23:51:12 localhost.localdomain nic[733]: time="2019-07-27T23:51:12Z" level=info msg="NIC network driver started"
Hint: Some lines were ellipsized, use -l to show in full.
[root@esx-2106-ingest tetter]#
```

Figure 149: Appliance controller status



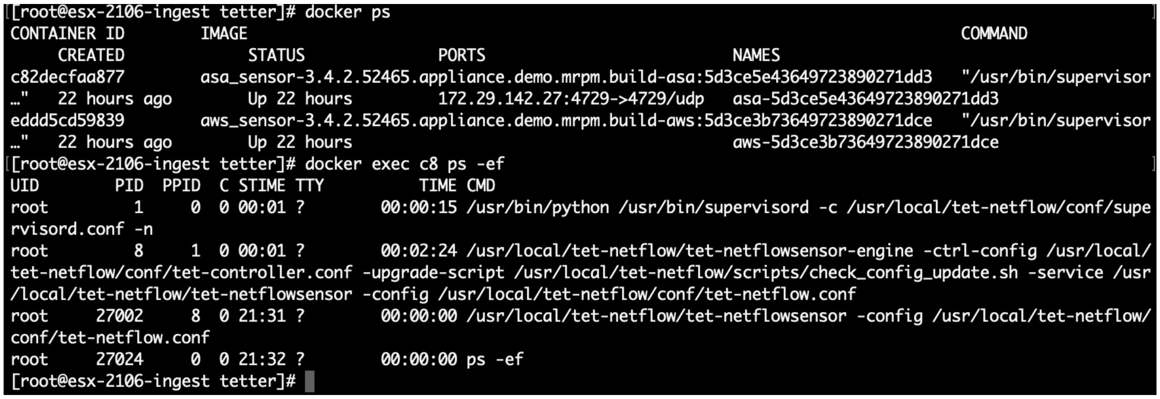
```
[root@esx-2106-ingest tetter]# supervisorctl status tet-controller
tet-controller                   RUNNING   pid 1971, uptime 21:43:29
[root@esx-2106-ingest tetter]#
```

If any of the preceding doesn't hold true, check the deployment script logs in /local/tetration/logs for the reason why the appliance and/or the connector deployment failed.

You can troubleshoot any other connector registration/connectivity issues as follows.

`docker exec <cid> ps -ef` reports tet-netflowsensor-engine, `/usr/local/tet/ tet-netflowsensor -config /usr/local/tet-netflow/conf/tet-netflow.conf` instances, along with the process manager `/usr/bin/supervisord -c /usr/local/tet-netflow/ conf/supervisord.conf -n` instance.

Figure 150: Running processes on Secure Firewall ASA connector in Secure Workload Ingest appliance



```
[root@esx-2106-ingest tetter]# docker ps
CONTAINER ID        IMAGE                                                                       COMMAND
     CREATED             STATUS              PORTS                          NAMES
c82decfaa877        asa_sensor-3.4.2.52465.appliance.demo.mrpm.build-asa:5d3ce5e43649723890271dd3   "/usr/bin/supervisor
…"   22 hours ago        Up 22 hours         172.29.142.27:4729->4729/udp   asa-5d3ce5e43649723890271dd3
eddd5cd59839        aws_sensor-3.4.2.52465.appliance.demo.mrpm.build-aws:5d3ce3b73649723890271dce   "/usr/bin/supervisor
…"   22 hours ago        Up 22 hours                                        aws-5d3ce3b73649723890271dce
[root@esx-2106-ingest tetter]# docker exec c8 ps -ef
UID        PID  PPID  C STIME TTY          TIME CMD
root         1     0  0 00:01 ?        00:00:15 /usr/bin/python /usr/bin/supervisord -c /usr/local/tet-netflow/conf/supe
rvisord.conf -n
root         8     1  0 00:01 ?        00:02:24 /usr/local/tet-netflow/tet-netflowsensor-engine -ctrl-config /usr/local/
tet-netflow/conf/tet-controller.conf -upgrade-script /usr/local/tet-netflow/scripts/check_config_update.sh -service /usr
/local/tet-netflow/tet-netflowsensor -config /usr/local/tet-netflow/conf/tet-netflow.conf
root     27002     8  0 21:31 ?        00:00:00 /usr/local/tet-netflow/tet-netflowsensor -config /usr/local/tet-netflow/
conf/tet-netflow.conf
root     27024     0  0 21:32 ?        00:00:00 ps -ef
[root@esx-2106-ingest tetter]#
```

Log Files

The following commands can be used to view the logs from various services on the appliance.

- **/local/tetration/logs/tet-controller.log** shows the logs of the appliance controller.
- **docker exec <cid> cat /local/tetration/logs/tet-controller.log** shows the logs of the service controller on the connector.
- **docker exec <cid> cat /local/tetration/logs/tet-netflow.log** shows the logs of the connector service.
- **docker exec <cid> cat /local/tetration/logs/tet-ldap-loader.log** shows the logs of LDAP snapshot creation (if LDAP config is applicable for the connector).

- **docker exec <cid> cat /local/tetration/logs/check_conf_update.log** shows the configuration update polling logs (for connectors on the Ingest appliance).

Note There are allowed set of commands on Secure Workload that can pull these logs from the appliance and/or connectors directly. For more information, see Allowed set of commands.

Debug Mode

The default logging level for the appliance/service controller and connector service is set to *info* level. For troubleshooting issues, we may need to set the agent in *debug* mode. To do this, update the log configuration on the appliance/connector on Secure Workload directly for the desired appliance/connector. The log levels for both the controller and services are updated if the configuration is updated on the connector. For more information, see Log Configuration.

Connector Alerts

An appliance/service creates a connector alert when it experiences abnormal behavior.

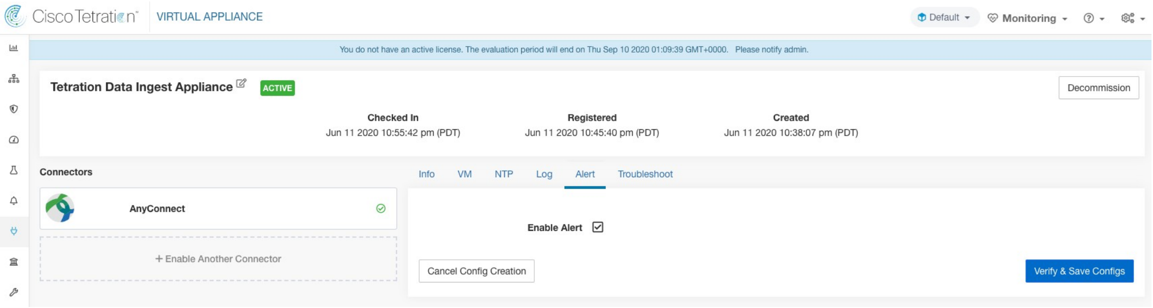
Alert Configuration

The alert configuration for appliances and connectors enables you to generate alerts for various events. In the 3.4 release, this configuration enables all types of alerts that are potentially possible for the configured appliance/connector.

Parameter Name	Type	Description
Enable Alert	checkbox	Should alert be enabled?

Note The default value for *Enable Alert* is *true*.

Figure 151: Show alert configuration on a Secure Workload Data Ingest Appliance



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Tetration Data Ingest Appliance ACTIVE

Checked In	Registered	Created
Jun 11 2020 10:55:42 pm (PDT)	Jun 11 2020 10:45:40 pm (PDT)	Jun 11 2020 10:38:07 pm (PDT)

Connectors

AnyConnect ✓

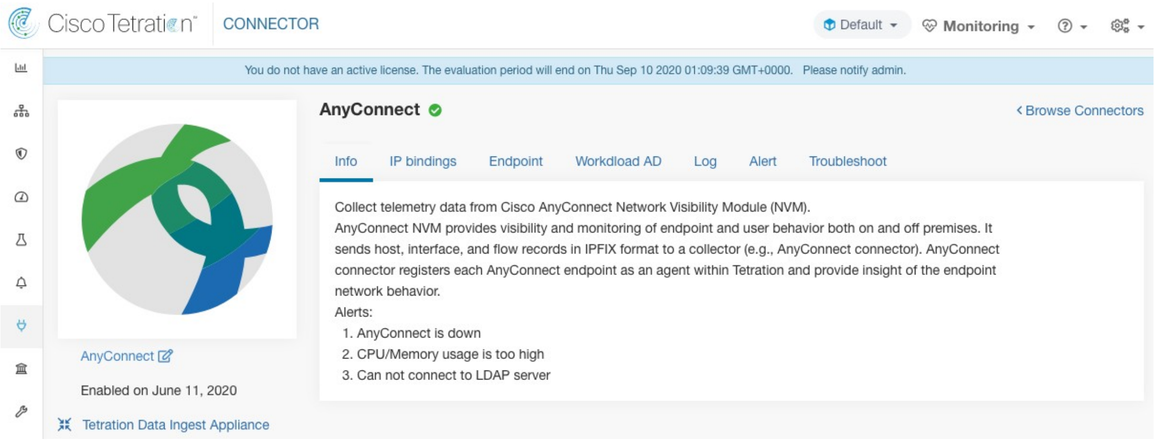
+ Enable Another Connector

Enable Alert ☑

Alert Type

The Info Tab on the appliance and connector pages contains various alert types specific to each appliance and connector.

Figure 152: Alert list info



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Collect telemetry data from Cisco AnyConnect Network Visibility Module (NVM).
AnyConnect NVM provides visibility and monitoring of endpoint and user behavior both on and off premises. It sends host, interface, and flow records in IPFIX format to a collector (e.g., AnyConnect connector). AnyConnect connector registers each AnyConnect endpoint as an agent within Tetration and provide insight of the endpoint network behavior.
Alerts:

1. AnyConnect is down
2. CPU/Memory usage is too high
3. Can not connect to LDAP server

Enabled on June 11, 2020

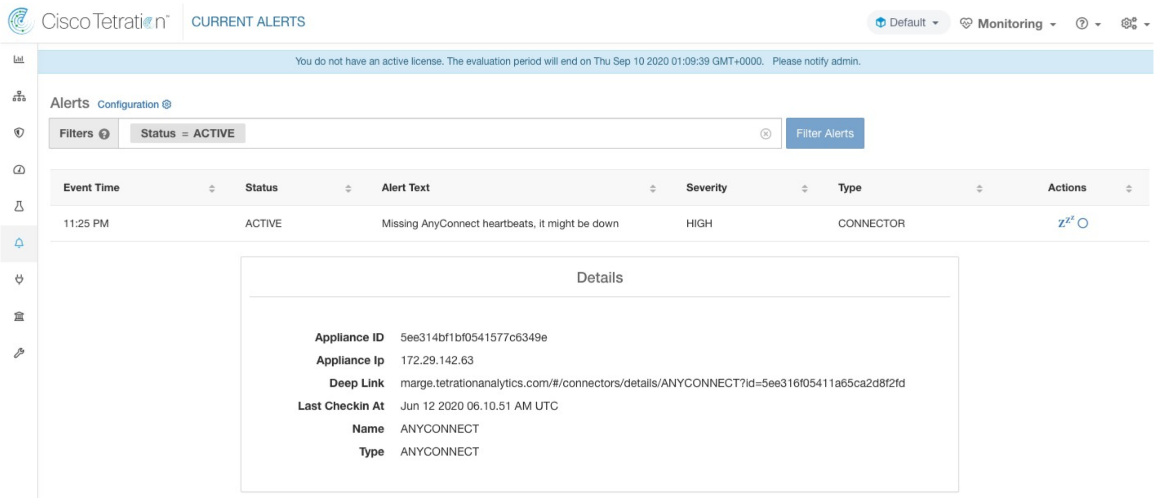
Appliance/Connector down

An alert generates when an appliance (or a connector) is potentially down due to missing heartbeats from the appliance/connector.

Alert text: Missing <Appliance/Connector> heartbeats, it might be down.

Severity: High

Figure 153: Alert for connector down



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Status = ACTIVE

Event Time	Status	Alert Text	Severity	Type	Actions
11:25 PM	ACTIVE	Missing AnyConnect heartbeats, it might be down	HIGH	CONNECTOR	zzz ○

Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 06.10.51 AM UTC
Name	ANYCONNECT
Type	ANYCONNECT

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: All

Appliance/Connector system usage

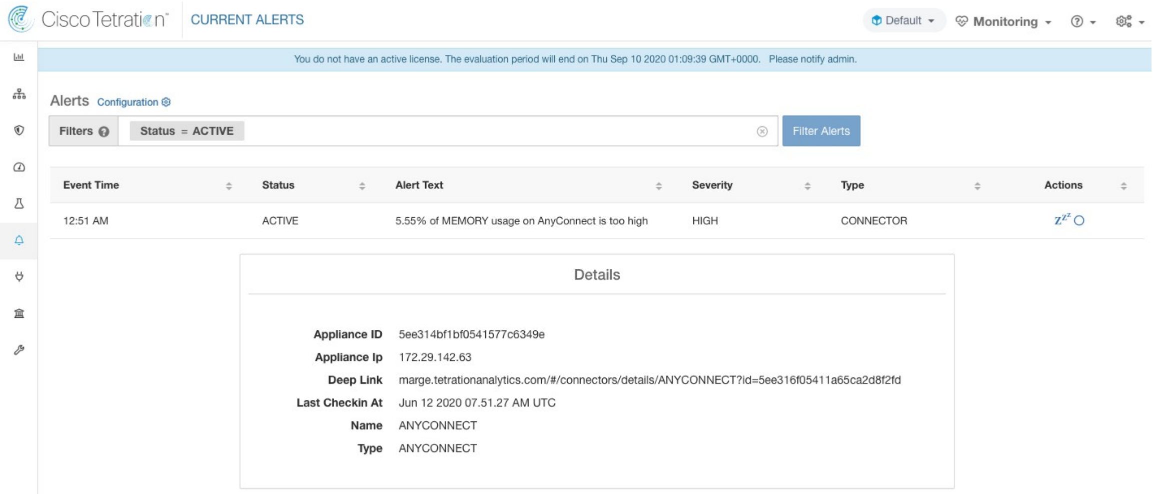
When system usage (CPU, memory, and disk) is more than 90% on an appliance (and a connector). The appliance (and/or connector) generates an informational alert to indicate that it’s currently handling an increased system load.

It’s normal for appliances and connectors to consume more than 90% of system resources during heavy processing activity.

Alert text: <Number> of CPU/Memory/Disk usage on <Appliance/Connector> is too high.

Severity: High

Figure 154: Alert for connector system usage too high



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Event Time	Status	Alert Text	Severity	Type	Actions
12:51 AM	ACTIVE	5.55% of MEMORY usage on AnyConnect is too high	HIGH	CONNECTOR	zᶻᶻ ○

Details

Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 07.51.27 AM UTC
Name	ANYCONNECT
Type	ANYCONNECT

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: All

Connector config error

When a configuration for a connector can’t connect to the configured server, the system generates the alert to indicate a potential issue with the configuration after accepting and deploying it.

For example, The AnyConnect connector can take an LDAP configuration, validate and accept the configuration. However, during the normal operation, it’s possible that the configuration is no longer valid.

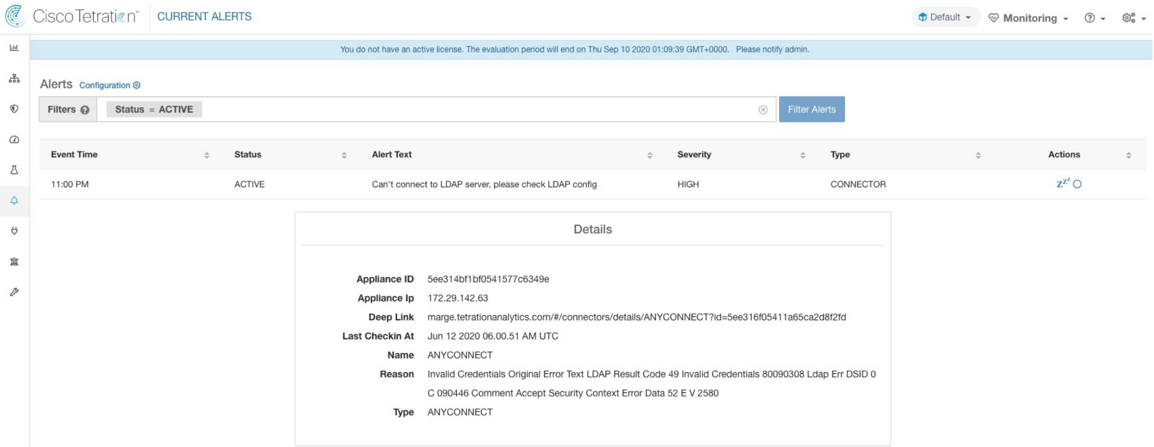
Alert captures the scenario and indicates that you have to take corrective action to update the configuration.

Alert text: Cannot connect to <Appliance/Connector> server, check <Appliance/Connector> config.

Severity: High, Low

Server	Connector
LDAP server	AnyConnect, F5, ISE, WDC
ISE server	ISE
ServiceNow server	ServiceNow

Figure 155: Alert for config status error



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Alerts Configuration

Status = ACTIVE

Event Time	Status	Alert Text	Severity	Type	Actions
11:00 PM	ACTIVE	Can't connect to LDAP server, please check LDAP config	HIGH	CONNECTOR	zᶻᶻ ○

Details

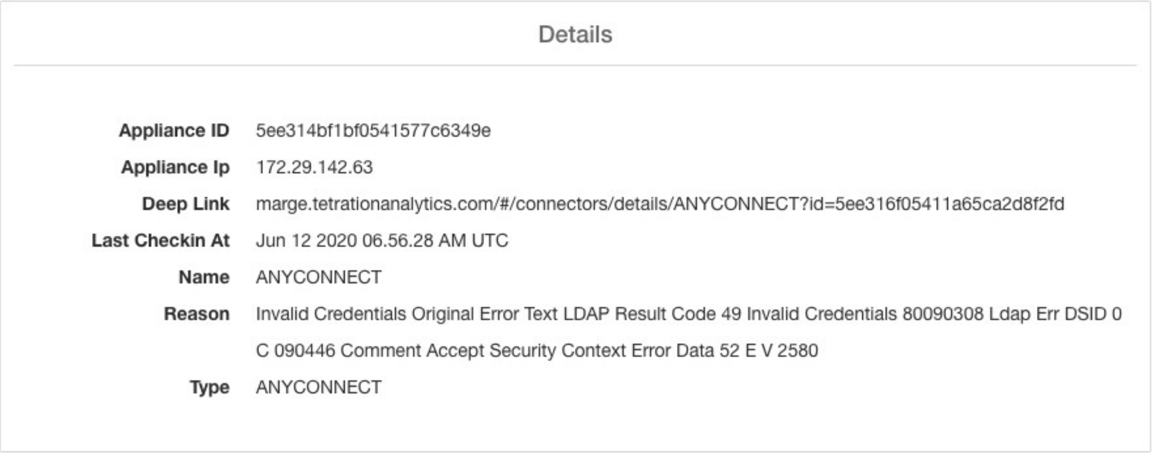
Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 06.00.51 AM UTC
Name	ANYCONNECT
Reason	Invalid Credentials Original Error Text LDAP Result Code 49 Invalid Credentials 80090308 Ldap Err DSID 0 C 090446 Comment Accept Security Context Error Data 52 E V 2580
Type	ANYCONNECT

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge.

Allowed connectors: AnyConnect, F5, ISE, WDC, and ServiceNow.

Connector UI Alert Details

Figure 156: Connector UI Alert details



Details

Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 06.56.28 AM UTC
Name	ANYCONNECT
Reason	Invalid Credentials Original Error Text LDAP Result Code 49 Invalid Credentials 80090308 Ldap Err DSID 0 C 090446 Comment Accept Security Context Error Data 52 E V 2580
Type	ANYCONNECT

Alert Details

See Common Alert Structure for general alert structure and information about fields. The *alert_details* fields structure contains the following subfields for connector alerts.

Field	Type	Description
Appliance ID	String	Appliance ID
Appliance IP	String	Appliance IP
Connector ID	String	Connector ID

Field	Type	Description
Connector IP	String	Connector IP
Deep Link	Hyperlink	Redirect to appliance/connector page
Last CheckIn At	String	Last checkin time
Name	String	Appliance/Connector name
Reason	String	The reason that Appliance/Connector can’t connect to Secure Workload
Type	String	Appliance/Connector type

Example of Alert Details

After parsing alert_details as JSON (unstringified), it will display as follows.

```
    {
      "Appliance ID": "5f1f3d26d674b01832c6792a",
      "Connector ID": "5f1f3e47baba512a70abee43",
      "Connector IP": "172.29.142.22",
      "Deep Link":
"bingo.tetrationanalytics.com/#/connectors/details/F5?id=5f1f3e47baba512a70abee43",
      "Last checkin at": "Aug 04 2020 20.37.33 PM UTC",
      "Name": "F5",
      "Reason": "Invalid Credentials (Original error text: LDAP Result Code 49 \"Invalid
Credentials\": )",
      "Type": "F5"
    }
```

Cisco Secure Firewall Management Center

Combine the power of Secure Workload with the power of Cisco Secure Firewall (formerly known as Cisco Firepower) for a security solution that makes use of:

- Segmentation

  Firewall-based segmentation is suitable for workloads where software agents are not installed. However, you can also use this method for agent-based workloads. You can easily and broadly apply different sets of policies for traffic entering your network, for traffic exiting your network, and for traffic between workloads within your network.

- Virtual Patching

  Virtual patching adds Intrusion Prevention System (IPS) protection to workloads where software agents are installed. You can use this method to protect your application from malicious traffic entering the system. When you configure virtual patching on Secure Workload, it publishes the Common Vulnerabilities and Exposures (CVEs) to the Cisco Secure Firewall to consider while creating the IPS policies.

With this integration, Secure Workload automatically enforces and manages segmentation policies on the Secure Firewall Threat Defense (formerly known as Firepower Threat Defense) firewalls managed by the Secure Firewall Management Center instance. Policies are updated dynamically, and the set of workloads to which policies apply is refreshed continually as the application environment changes.

Network inventory is dynamically updated by Secure Workload inventory filters on which your segmentation policies are based; when workloads are added, changed, or removed from your network, Secure Workload automatically updates the Dynamic Objects in the Secure Firewall Management Center on which the corresponding access control rules are based. All enforced policy changes are automatically deployed to managed Secure Firewall Threat Defense (formerly known as Firepower Threat Defense or FTD) devices; you never need to redeploy changes in Secure Firewall Management Center.

For complete information about this integration, including more details about how it works, supported platforms, limitations, setup instructions for both products, and troubleshooting information, see the Cisco Secure Workload and Cisco Secure Firewall Management Center Integration Guide.

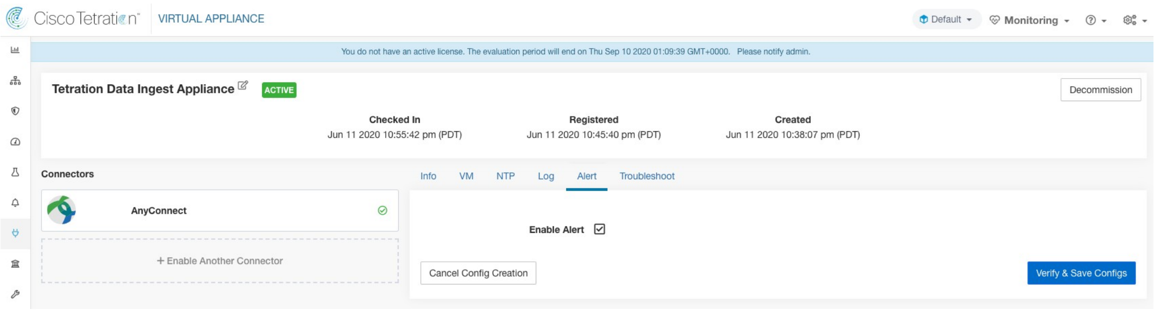
Alert Configuration

The alert configuration for appliances and connectors enables you to generate alerts for various events. In the 3.4 release, this configuration enables all types of alerts that are potentially possible for the configured appliance/connector.

Parameter Name	Type	Description
Enable Alert	checkbox	Should alert be enabled?

Note The default value for *Enable Alert* is *true*.

Figure 157: Show alert configuration on a Secure Workload Data Ingest Appliance



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Tetration Data Ingest Appliance ACTIVE

Checked In	Registered	Created
Jun 11 2020 10:55:42 pm (PDT)	Jun 11 2020 10:45:40 pm (PDT)	Jun 11 2020 10:38:07 pm (PDT)

Connectors

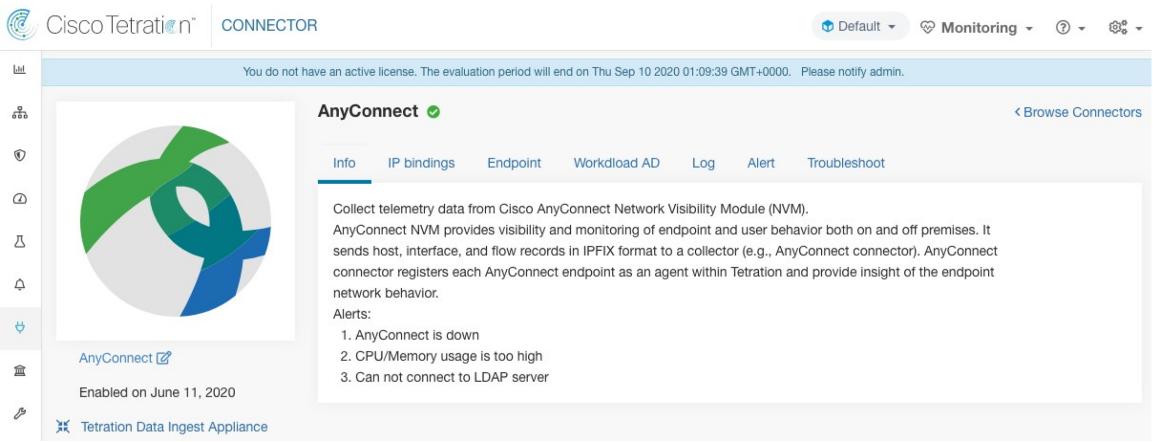
AnyConnect ✓

Enable Alert ☑

Alert Type

The Info Tab on the appliance and connector pages contains various alert types specific to each appliance and connector.

Figure 158: Alert list info



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Collect telemetry data from Cisco AnyConnect Network Visibility Module (NVM). AnyConnect NVM provides visibility and monitoring of endpoint and user behavior both on and off premises. It sends host, interface, and flow records in IPFIX format to a collector (e.g., AnyConnect connector). AnyConnect connector registers each AnyConnect endpoint as an agent within Tetration and provide insight of the endpoint network behavior.

Alerts:

1. AnyConnect is down
2. CPU/Memory usage is too high
3. Can not connect to LDAP server

Enabled on June 11, 2020

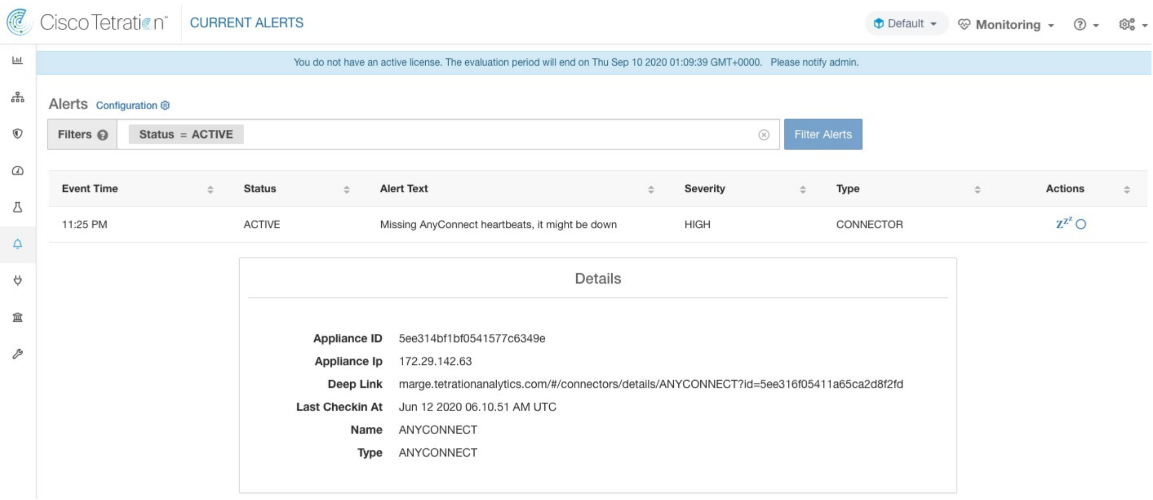
Appliance/Connector down

An alert generates when an appliance (or a connector) is potentially down due to missing heartbeats from the appliance/connector.

Alert text: Missing <Appliance/Connector> heartbeats, it might be down.

Severity: High

Figure 159: Alert for connector down



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Status = ACTIVE

Event Time	Status	Alert Text	Severity	Type	Actions
11:25 PM	ACTIVE	Missing AnyConnect heartbeats, it might be down	HIGH	CONNECTOR	zᶻᶻ ○

Details

Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 06.10.51 AM UTC
Name	ANYCONNECT
Type	ANYCONNECT

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: All

Appliance/Connector system usage

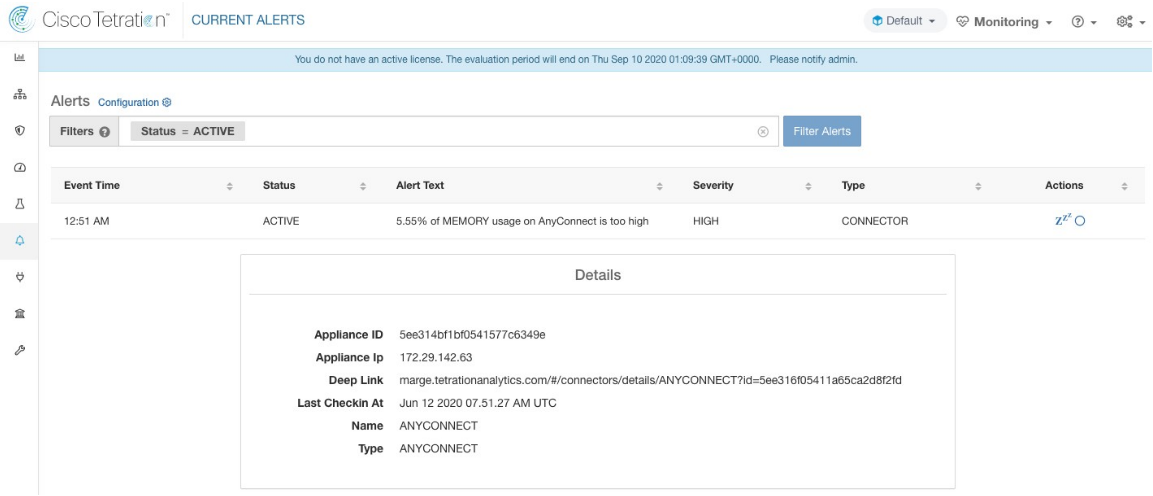
When system usage (CPU, memory, and disk) is more than 90% on an appliance (and a connector). The appliance (and/or connector) generates an informational alert to indicate that it's currently handling an increased system load.

It’s normal for appliances and connectors to consume more than 90% of system resources during heavy processing activity.

Alert text: <Number> of CPU/Memory/Disk usage on <Appliance/Connector> is too high.

Severity: High

Figure 160: Alert for connector system usage too high



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Alerts Configuration

Status = ACTIVE

Event Time	Status	Alert Text	Severity	Type	Actions
12:51 AM	ACTIVE	5.55% of MEMORY usage on AnyConnect is too high	HIGH	CONNECTOR	

Details

Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 07.51.27 AM UTC
Name	ANYCONNECT
Type	ANYCONNECT

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge

Allowed connectors: All

Connector config error

When a configuration for a connector can’t connect to the configured server, the system generates the alert to indicate a potential issue with the configuration after accepting and deploying it.

For example, The AnyConnect connector can take an LDAP configuration, validate and accept the configuration. However, during the normal operation, it’s possible that the configuration is no longer valid.

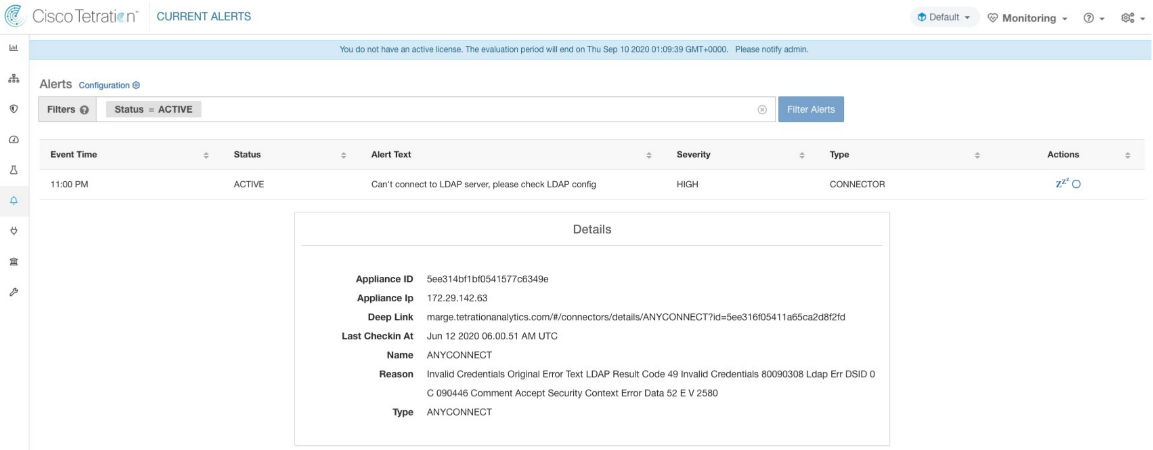
Alert captures the scenario and indicates that you have to take corrective action to update the configuration.

Alert text: Cannot connect to <Appliance/Connector> server, check <Appliance/Connector> config.

Severity: High, Low

Server	Connector
LDAP server	AnyConnect, F5, ISE, WDC
ISE server	ISE
ServiceNow server	ServiceNow

Figure 161: Alert for config status error



You do not have an active license. The evaluation period will end on Thu Sep 10 2020 01:09:39 GMT+0000. Please notify admin.

Alerts Configuration

Filters Status = ACTIVE Filter Alerts

Event Time	Status	Alert Text	Severity	Type	Actions
11:00 PM	ACTIVE	Can't connect to LDAP server, please check LDAP config	HIGH	CONNECTOR	zzz ○

Details

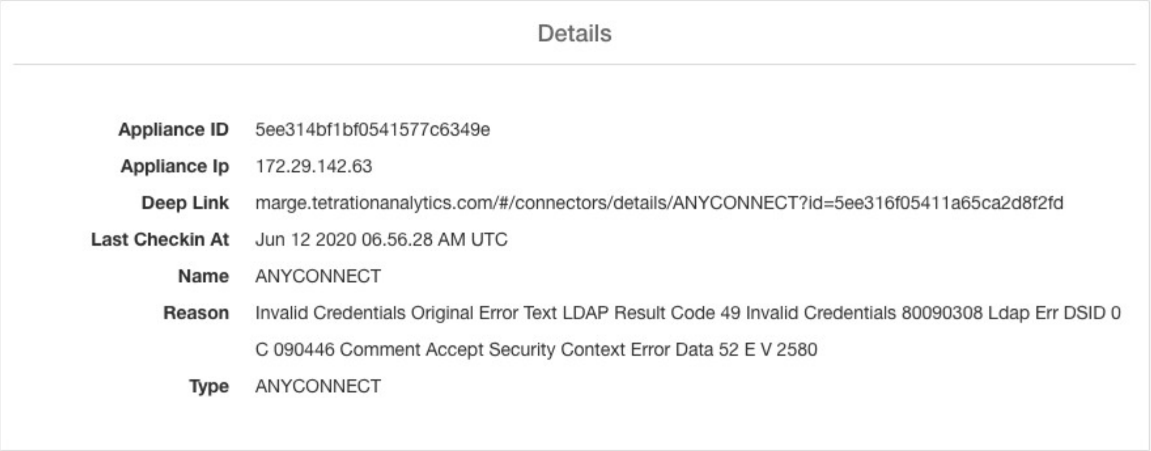
Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 06.00.51 AM UTC
Name	ANYCONNECT
Reason	Invalid Credentials Original Error Text LDAP Result Code 49 Invalid Credentials 80090308 Ldap Err DSID 0 C 090446 Comment Accept Security Context Error Data 52 E V 2580
Type	ANYCONNECT

Allowed Secure Workload virtual appliances: Secure Workload Ingest and Secure Workload Edge.

Allowed connectors: AnyConnect, F5, ISE, WDC, and ServiceNow.

Connector UI Alert Details

Figure 162: Connector UI Alert details



Details

Appliance ID	5ee314bf1bf0541577c6349e
Appliance Ip	172.29.142.63
Deep Link	marge.tetrationanalytics.com/#/connectors/details/ANYCONNECT?id=5ee316f05411a65ca2d8f2fd
Last Checkin At	Jun 12 2020 06.56.28 AM UTC
Name	ANYCONNECT
Reason	Invalid Credentials Original Error Text LDAP Result Code 49 Invalid Credentials 80090308 Ldap Err DSID 0 C 090446 Comment Accept Security Context Error Data 52 E V 2580
Type	ANYCONNECT

Alert Details

See Common Alert Structure for general alert structure and information about fields. The *alert_details* fields structure contains the following subfields for connector alerts.

Field	Type	Description
Appliance ID	String	Appliance ID
Appliance IP	String	Appliance IP
Connector ID	String	Connector ID

Field	Type	Description
Connector IP	String	Connector IP
Deep Link	Hyperlink	Redirect to appliance/connector page
Last CheckIn At	String	Last checkin time
Name	String	Appliance/Connector name
Reason	String	The reason that Appliance/Connector can't connect to Secure Workload
Type	String	Appliance/Connector type

Example of Alert Details

After parsing alert_details as JSON (unstringified), it will display as follows.

```
    {
      "Appliance ID": "5f1f3d26d674b01832c6792a",
      "Connector ID": "5f1f3e47baba512a70abee43",
      "Connector IP": "172.29.142.22",
      "Deep Link":
"bingo.tetrationanalytics.com/#/connectors/details/F5?id=5f1f3e47baba512a70abee43",
      "Last checkin at": "Aug 04 2020 20.37.33 PM UTC",
      "Name": "F5",
      "Reason": "Invalid Credentials (Original error text: LDAP Result Code 49 \"Invalid
Credentials\": )",
      "Type": "F5"
    }
```

CHAPTER 5

Inventory

Inventory is the IP addresses of all the workloads on your network, annotated with labels and other data that describes them. Your inventory includes workloads running on bare metal or virtual machines, in containers, and in the cloud. If applicable, it may also include workloads running on partner networks.

Collecting inventory data is an iterative process. Data from different sources for a single IP address can be merged, and new and changed IP addresses can be updated. Over time, management of your inventory should become increasingly dynamic.

You will work with and group your inventory using searches, filters, and scopes, based on the labels and annotations that are associated with each inventory item. Policies are applied to groups of workloads that are defined by the filters and scopes you define for your inventory.

Options for working with inventory vary depending on your role but may include **Search**, **Filters**, and **Upload**.

Workload Labels

Labels (sometimes called tags, annotations, attributes, metadata, or context, though these terms are not necessarily always completely synonymous) are key to the power of Secure Workload.

Human-readable labels describe your workloads in terms of their function, location, and other criteria.

Secure Workload supports the following methods for adding user labels:

- Discovery by Secure Workload agents running on inventory items
- Manual import from uploading Comma Separated Value (CSV) files

- Manual assignment through the user interface
- Automated import through Connectors for Endpoints
- Automated import through Connectors for Inventory Enrichment
- Automated import of orchestrator generated and custom labels (See External Orchestrators)
- Automated import from cloud connectors (See Cloud Connectors)
- You can specify inventory labels when creating the installer script. All agents installed using the script are automatically tagged with such labels. Only Linux and Windows workload deployments support this feature.

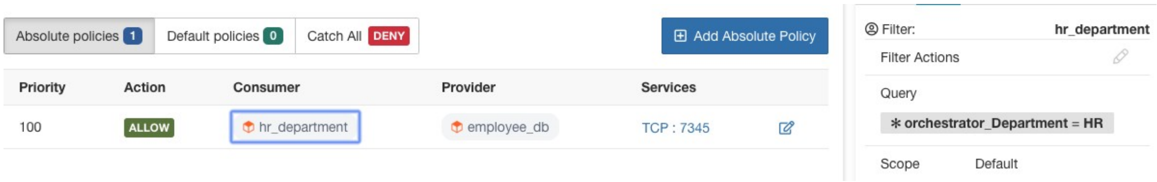
Importance of Labels

Labels allow you to define a logical policy. For example:

allow traffic from consumer hr_department to provider employee_db

Instead of specifying the members of the consumer and provider workload groups, we can define the logical policy using the labels as shown in the following figure. Note that this allows the membership of the consumer and provider groups to be dynamically modified without the need to modify the logical policy. As workloads are added and removed from the fleet, Secure Workload is notified by services you have configured, such as external orchestrators and cloud connectors. This enables Secure Workload to evaluate the membership of the consumer group *hr_department* and the provider group *employee_db*.

Figure 163: Example policy with labels



Priority	Action	Consumer	Provider	Services
100	ALLOW	hr_department	employee_db	TCP : 7345

Filter: hr_department

Query

* orchestrator_Department = HR

Scope Default

Subnet-based Label Inheritance

Subnet-based label inheritance is supported. The smaller subnets and IP addresses inherit labels from larger subnets they fall under when one of the following conditions is satisfied:

- The label is missing from the list of labels for the smaller subnet/address.
- The label value for the smaller subnet/address is empty.

Consider the following example:

IP	Name	Purpose	Environment	Spirit-Animal
10.0.0.1	server-1	webtraffic	production	
10.0.0.2				frog
10.0.0.3				eagle

IP	Name	Purpose	Environment	Spirit-Animal
10.0.0.0/24	web-vlan		integration	
10.0.0.0/16		webtraffic		badger
10.0.0.0/8			test	bear

The labels for IP address *10.0.0.3* are *{“name”: “web-vlan”, “purpose”: “webtraffic”, “environment”: “integra- tion”, “spirit-animal”: “eagle”}*.

Label Prefixes

Labels are automatically displayed with a prefix that identifies the source of the information.

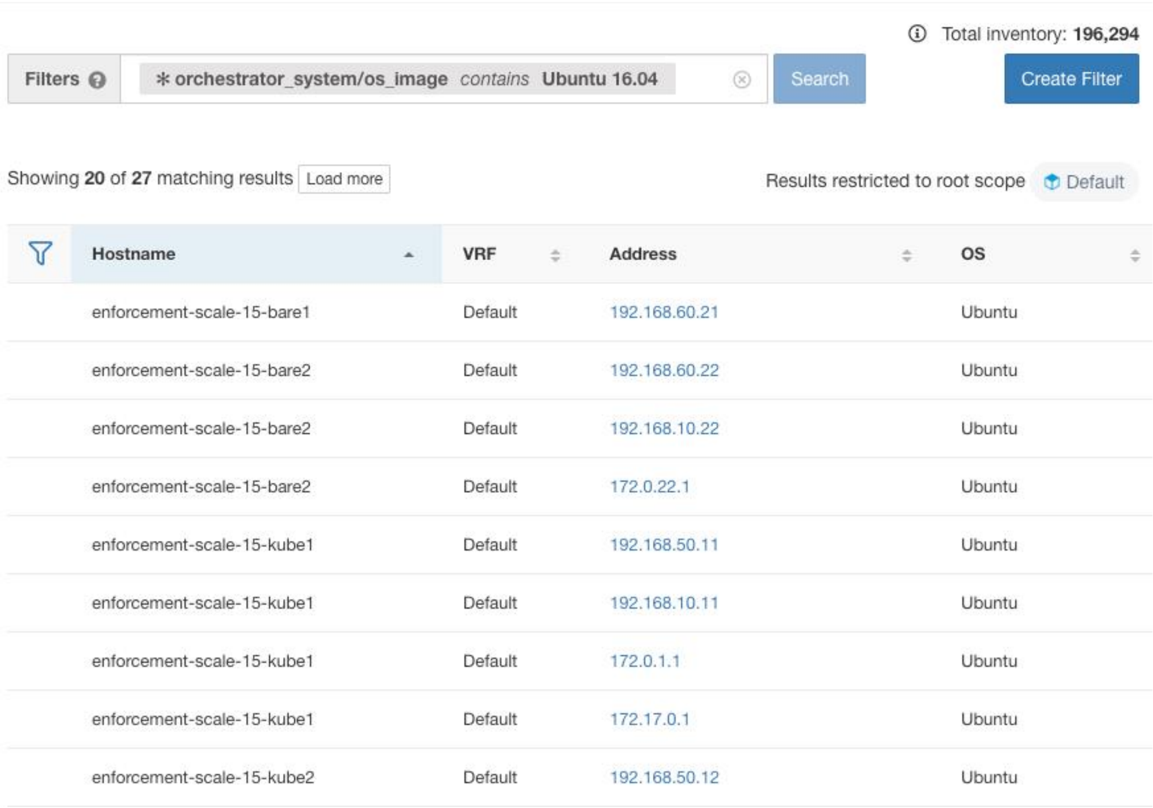
All user labels are prefixed by * in the UI (*user_* in OpenAPI). In addition, labels automatically imported from external orchestrators or from cloud connectors are prefixed with orchestrator_. For labels imported from endpoint connectors, see details in Connectors for Endpoints, but may include labels prefixed with *ldap_*.

For example, a label with a key of *department* imported from user-uploaded CSV files appear in the UI as * *department*, and in OpenAPI as *user_department*. A label with a key of *location* imported from an external orchestrator appear in the UI as * *orchestrator_location*, and in OpenAPI as *user_orchestrator_location*.

The following figure shows an example of inventory search using the orchestrator-generated label using the prefix:

orchestrator_system/os_image:

Figure 164: Example inventory search with orchestrator generated labels



Total inventory: **196,294**

* orchestrator_system/os_image *contains* Ubuntu 16.04

Showing **20** of **27** matching results

Results restricted to root scope Default

Hostname	VRF	Address	OS
enforcement-scale-15-bare1	Default	192.168.60.21	Ubuntu
enforcement-scale-15-bare2	Default	192.168.60.22	Ubuntu
enforcement-scale-15-bare2	Default	192.168.10.22	Ubuntu
enforcement-scale-15-bare2	Default	172.0.22.1	Ubuntu
enforcement-scale-15-kube1	Default	192.168.50.11	Ubuntu
enforcement-scale-15-kube1	Default	192.168.10.11	Ubuntu
enforcement-scale-15-kube1	Default	172.0.1.1	Ubuntu
enforcement-scale-15-kube1	Default	172.17.0.1	Ubuntu
enforcement-scale-15-kube2	Default	192.168.50.12	Ubuntu

Labels Generated by Cloud Connectors

These labels apply to data from AWS and Azure. The source for these labels is workloads and network interfaces of an AWS VPC or Azure VNet. The tags from the source are merged and displayed in Secure Workload. For example, if the workload tag is `env: prod` and the network interface tag is `env: test`, the label value in Secure Workload is `prod,test`, which is displayed under the **orchestrator_env** column on the respective connector page.

For labels specific to AKS, EKS, and GKE, see also Labels Related to Kubernetes Clusters.

Table 18: Labels added to all inventory gathered using a cloud connector

Key	Value
orchestrator_system/orch_type	aws or azure
orchestrator_system/cluster_name	*<Cluster_name is the name given by the user for this connector's configuration>*
orchestrator_system/name	*<Name of connector>*
orchestrator_system/cluster_id	*<Virtual network ID>*

Instance-specific labels

The following labels are specific to each node:

Key	Value
orchestrator_system/workload_type	vm
orchestrator_system/machine_id	*<InstanceID assigned by the platform>*
orchestrator_system/machine_name	<PublicDNS(FQDN) given to this node by AWS> –or– <InstanceName in Azure>
orchestrator_system/segmentation_enabled	*<Flag to determine if segmentation is enabled on the inventory>*
orchestrator_system/virtual_network_id	*<ID of virtual network the inventory belongs to>*
orchestrator_system/virtual_network_name	*<Name of virtual network the inventory belongs to>*
orchestrator_system/interface_id	<Identifier of elastic network interface attached to this inventory>
orchestrator_system/region	<Region the inventory belongs to>
orchestrator_system/resource_group	(This tag applies to Azure inventory only)
orchestrator_'<Tag Key>'	<Tag Value> Key-value pair for any number of custom tags assigned to inventory in the cloud portal.

Labels Related to Kubernetes Clusters

The following information applies to plain-vanilla Kubernetes, OpenShift, and to Kubernetes running on supported cloud platforms (EKS, AKS, and GKE).

For each object type, Secure Workload imports inventory live from a Kubernetes cluster, including labels associated with the object. Label keys and values are imported as-is.

In addition to importing the labels defined for the Kubernetes objects, Secure Workload also generates labels that facilitate the use of these objects in inventory filters. These additional labels are especially useful in defining scopes and policies.

Generated labels for all resources

Secure Workload adds the following labels to all the nodes, pods and services retrieved from the Kubernetes/OpenShift/EKS/AKS/GKE API server.

Key	Value
orchestrator_system/orch_type	kubernetes
orchestrator_system/cluster_id	*<UUID of the cluster's configuration in |product|>*
orchestrator_system/cluster_name	*<Name of kubernetes cluster>*
orchestrator_system/name	*<Name of connector>*

Key	Value
orchestrator_system/namespace	*<The Kubernetes/OpenShift/EKS/AKS/GKE namespace of this item>*

Node-specific labels

The following labels are generated for nodes only.

Key	Value
orchestrator_system/workload_type	machine
orchestrator_system/machine_id	*<UUID assigned by Kubernetes/OpenShift>*
orchestrator_system/machine_name	*<Name given to this node>*
orchestrator_system/kubelet_version	*<Version of the kubelet running on this node>*
orchestrator_system/container_runtime_version	*<The container runtime version running on this node>*

Pod-specific labels

The following labels are generated for pods only.

Key	Value
orchestrator_system/workload_type	pod
orchestrator_system/pod_id	*<UUID assigned by Kubernetes/OpenShift>*
orchestrator_system/pod_name	*<Name given to this pod>*
orchestrator_system/hostnetwork	*<true|false> reflecting whether the pod is running in the host network*
orchestrator_system/machine_name	*<Name of the node the pod is running on>*
orchestrator_system/service_endpoint	*[List of service names this pod is providing]*

Service-specific labels

The following labels are generated for services only.

Key	Value
orchestrator_system/workload_type	service
orchestrator_system/service_name	*<Name given to this service>*

- (For cloud-managed Kubernetes only) Services of ServiceType: LoadBalancer are supported only for gathering metadata, not for collecting flow data or for policy enforcement.

Tip Filtering items using **orchestrator_system/service_name** is not the same as using **orchestrator_system/service_endpoint**.

For example, using the filter **orchestrator_system/service_name = web** selects all *services* with the name **web** while **orchestrator_system/service_endpoint = web** selects all *pods* that provide a service with the name **web**.

Labels Example for Kubernetes Clusters

The following example shows a partial YAML representation of a Kubernetes node and the corresponding labels imported by Secure Workload.

```
- apiVersion: v1
kind: Node
metadata:
  annotations:
    node.alpha.kubernetes.io/ttl: "0"
    volumes.kubernetes.io/controller-managed-attach-detach: "true"
  labels:
    beta.kubernetes.io/arch: amd64
    beta.kubernetes.io/os: linux
    kubernetes.io/hostname: k8s-controller
```

Table 19: Label Keys Imported from Kubernetes

Imported label keys
orchestrator_beta.kubernetes.io/arch
orchestrator_beta.kubernetes.io/os
orchestrator_kubernetes.io/hostname
orchestrator_annotation/node.alpha.kubernetes.io/ttl
orchestrator_annotation/volumes.kubernetes.io/controller-managed-attach-detach
orchestrator_system/orch_type
orchestrator_system/cluster_id
orchestrator_system/cluster_name
orchestrator_system/namespace
orchestrator_system/workload_type
orchestrator_system/machine_id
orchestrator_system/machine_name
orchestrator_system/kubelet_version
orchestrator_system/container_runtime_version

Importing Custom Labels

You can upload or manually assign custom labels to associate user-defined data with specific hosts. This user-defined data is used to annotate associated flows and inventory.

There are limits on the number of IPv4/IPv6 addresses/subnets that can be labeled across all root scopes, regardless of label source (whether manually entered or uploaded, ingested using connectors or external orchestrators, and so on) For details, see Label Limits.

Guidelines for Uploading Label Files

Procedure

Step 1 To view a sample file, in the left pane, select **Organize** > **Label Management** > **User Defined Label Upload**, and then click **Download a Sample**.

Step 2 The CSV files used to upload the user labels must include a label key (IP address).

Step 3 To use non-English characters in labels, the CSV file must be in UTF-8 format.

Step 4 Ensure the CSV files meet the guidelines described in the Label Key Schema section.

Step 5 All uploaded files must follow the same schema.

Label Key Schema

Guidelines governing column names

- There must be one column with a header “IP” in the label key schema. Additionally, there must be at least one other column with attributes for the IP address.
- The column “VRF” has special significance in the label schema. If provided, it should match the root scope to which you upload the labels. It’s mandatory when uploading the CSV file using the Scope-Independent APIs.
- Column names may contain only the following characters: Letters, numbers, space, hyphen, underscore, and slash.
- Column names cannot exceed 200 characters.
- Column names cannot be prefixed with “orchestrator_”, “TA_”, “ISE_”, “SNOW_”, nor “LDAP_” since these can conflict with labels from internal applications.
- The CSV file should not contain duplicate column names.

Guidelines governing column values

- Values are limited to 255 characters. However, they should be as short as possible while still being clear, distinctive, and meaningful to users.
- Keys and values are not case sensitive. However, consistency is recommended.
- Addresses appearing under the “IP” column should conform to the following format:

- IPv4 addresses can be of the format “x.x.x.x” and “x.x.x.x/32”.
- IPv4 subnets should be of the format “x.x.x.x/<netmask>”, where netmask is an integer from 0 to 31.
- IPv6 addresses in the Long format (“x:x:x:x:x:x:x:x” or “x:x:x:x:x:x:x:x/128”) and the Canonical format (“x:x::x” or “x:x::x/128”) are supported.
- IPv6 subnets in the Long format (“x:x:x:x:x:x:x:x/<netmask>”) and the Canonical format (“x:x::x/<netmask>”) are supported. Netmask must be an integer from 0 to 127.

The order of the columns does not matter. The first 32 user-defined columns will automatically be enabled for label. If more than 32 columns are uploaded, up to 32 can be enabled using the checkboxes on the right-side of the page.

Upload Custom Labels

The following steps explain how users with **Site Admin**, **Customer Support** or a root **scope owner** role can upload labels.

Before you begin

To upload the custom labels, create a CSV file according to the ‘Guidelines for Uploading Label Files’ section.

Procedure

Step 1 In the left pane, select **Organize** > **User Defined Label Upload** > **CSV Upload**, and then under **Upload New Labels**, click **Select File**.

Step 2 In the left pane, select **Organize** > **Label Management**, and then under **Upload New Labels**, click **Select File**.

Step 3 Select the operation-Add, Merge, or Delete.

- **Add:** Appends labels to new and existing addresses/subnets. Resolves conflicts by selecting newer labels over existing ones. For example, if labels for an address in the database are *{"foo": "1", "bar": "2"}* and the CSV file contains *{"z": "1", "bar": "3"}*, add` sets labels for this address to *{"foo": "1", "z": "1", "bar": "3"}*.
- **Merge:** Merges labels to existing addresses/subnets. Resolves conflicts by selecting non-empty values over empty values. For example, if labels for an address in the database are *{"foo": "1", "bar": "2", "qux": "", "corge": "4"}* and the CSV file contains *{"z": "1", "bar": "", "qux": "3", "corge": "4-updated"}*, merge` sets labels for this address to *{"foo": "1", "z": "1", "bar": "2", "qux": "3", "corge": "4-updated"}*.

  Note Value of “bar” in not reset to “”(empty), instead existing value of “bar”=”2” is preserved.

- **Delete:** This option removes labels for an address/subnet, which can significantly impact scopes, filters, policies, and enforced behavior. For important details, see *Delete Labels*.

Important: The Delete function, while uploading the custom labels, will remove ALL labels associated with the specified IP addresses/subnets, and is not limited to the columns listed in the CSV file. Therefore, the Delete operation must be used with caution.

Step 4 Click **Upload**.

Search Labels

Users with **Site Admin**, **Customer Support** or a root **scope owner** role can search for, view, and edit labels assigned to an IP address or subnet.

Procedure

Step 1 On the **Label Management** page, click **Search and Assign**.

Step 2 In the **IP or Subnet** field, enter the IP address or subnet and click **Next**.

On the Assign Labels page, the existing labels for the entered IP address or subnet are displayed.

Manually Assign or Edit Custom Labels

Users with **Site Admin**, **Customer Support**, or a root **scope owner** role can manually assign labels to a given IP address or subnet.

Procedure

Step 1 On the **Label Management** page, click **Search and Assign**.

Step 2 In the **IP or Subnet** field, enter the IP address or subnet and click **Next**.

The Assign Labels page is displayed. Note that the existing labels will be displayed and can be edited.

Step 3 To add a new label, in the **Labels for <IP address/subnet>** section, enter the label name and value, and then click **Confirm**. Click **Next**.

Step 4 Review the changes and click **Assign** to commit them.

Download Labels

Users with **Site Admin**, **Customer Support**, or a root **scope owner** role can download previously defined labels belonging to a root scope.

Procedure

Step 1 On the **Label Management** page, click **User Defined Label Upload**.

Step 2 Under the **Download Existing Labels** section, click **Download Labels**.

The labels used by Secure Workload are downloaded as a CSV file.

Change Labels

Warning If you need to change a label, do so cautiously, as doing so changes the membership in and effects of existing queries, filters, scopes, clusters, policies, and enforced behavior that are based on that label.

Procedure

Step 1 On the **Label Management** page, click the **Search and Assign** tab.

Step 2 In the **IP or Subnet** field, enter the IP address or subnet and click **Next**.

The labels used by Secure Workload for the entered IP address/subnet are displayed.

Step 3 Under the **Actions** column, click the **Edit** icon to change the name and value of the required label.

Step 4 Click **Confirm**, and then click **Next**.

Step 5 Review the changes and click **Assign**.

Disable Labels

One way to change the schema is to disable the labels. *Proceed with caution*.

Procedure

Step 1 Navigate to the **Label Management** page.

Step 2 For the required label, under the **Actions** column, select **Disable** and confirm to remove the label from the inventory by clicking **Yes**.

If you decide to enable the label at a later time, click **Enable** to use the label.

Delete Labels

Warning One way to change the schema is to disable the labels and delete them. Proceed with caution. This action deletes the selected label which impacts all dependent **Filters** and **Scopes**. Ensure that these labels are not used. This action cannot be undone.

Procedure

Step 1 Disable the labels. See disable_lables.

Step 2 Click the **TrashCan** icon and confirm by clicking **Yes** to delete the label.

View Labels Usage

The IP addresses/subnet inventory gets updated with the custom labels uploaded using CSV files or manually assigned by users. The labels are then used in defining the scopes and filters, and the application policies are created based on these filters. Therefore, understanding the usage of labels is critical as any modifications to the labels directly impacts the scopes, filters, and policies in Secure Workload.

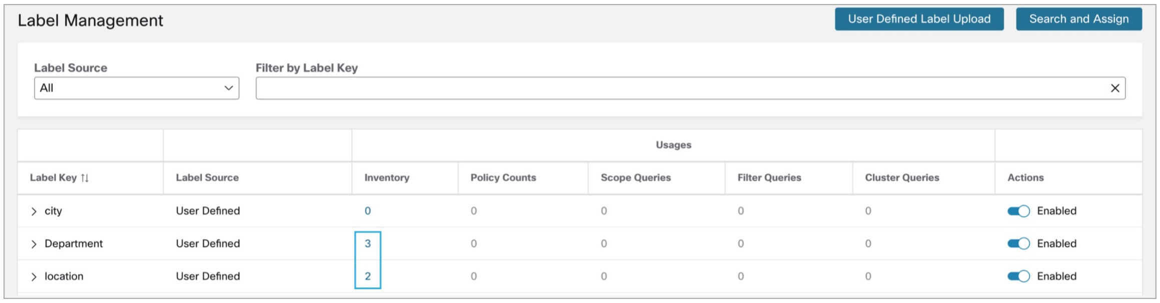
To view the usage of labels:

Procedure

Step 1 On the **Label Management** page, the label keys, top five values of the labels in use, inventory, scopes, filters, and clusters using the custom labels are displayed.

Step 2 Under the Usages column, click the count values against the inventory, scopes, or filters. For example, to view the scopes using the "Location" label, click the scope queries count.

Figure 165: View scopes of selected label



Label Management

Label Source: All

Filter by Label Key:

		Usages					
Label Key ↑↓	Label Source	Inventory	Policy Counts	Scope Queries	Filter Queries	Cluster Queries	Actions
› city	User Defined	0	0	0	0	0	Enabled
› Department	User Defined	3	0	0	0	0	Enabled
› location	User Defined	2	0	0	0	0	Enabled

The Scopes and Inventory page is displayed, and the query automatically filters the scopes with the selected label.

Note You can only view the usage of labels either uploaded using CSV files or those manually assigned to the IP address/subnet.

Create a Process for Maintaining Labels

Your network and inventory will change, and you must plan to update labels to reflect those changes.

For example, if a workload is retired and its IP address is reassigned to a workload with a different purpose, you need to update the labels associated with that workload. This is true for both manually uploaded labels and for labels maintained in and ingested from other systems such as a configuration management database (CMDB.)

Create a process to ensure that your labels are updated on a regular, ongoing basis, and add this process to your network-maintenance routine.

Scopes and Inventory

Scopes and Inventory Overview

This section provides visibility of the scope hierarchy, along with all the inventory it contains. Scopes categorize all of the inventory using a hierarchical structure. See Inventory, on page 339. On the left is the scope directory user interface. Here, you can traverse down your scope hierarchy. Each scope is displayed in a scope card. It displays the name of the scope, the number of children scopes, the inventory count, and uncategorized inventory if applicable. Clicking on a scope card updates the pane to the right to show details about that scope as well as a filterable list of all its inventory.

Scope Design Principles

1. Inventory is matched to scope tree according to dynamic query match.
    - Queries may match against IP/Subnet or Label (preferred)
    - Tree is formed through conjunctive query at each layer.
2. Scope structure may be location specific if appropriate.
    - Combined Cloud vs Data Center and Cloud Specific vs Geographic location
3. Each layer of the scope tree should represent an anchor point for:
    - Policy control
    - Role Based Access Control (RBAC)
4. Every child scope should be a subset of its parent scope.
    - Ensure non-overlapping sibling scopes, see Scope Overlap

Note Every organization is structured differently, and depending on your industry, require different approaches. Choose one focus in designing your scope hierarchy; location, environment, or application.

Note Do not use IP address or subnet to define scopes that involve Kubernetes inventory. You must use labels to define scopes and policy for these workloads. IP address alone is not sufficient to identify pod services; using IP address for scope definition will produce unreliable results.

Key Features

Filtering feature for both scopes and inventory provides you with the ability to quickly traverse down the scope tree or filter the scope hierarchy and filter the inventory items of the selected scope.

Inventory count is displayed in the scopes card, providing a quick view into the number of workloads in the scope.

Scopes

Scopes are a foundational element to configuration and policy in Secure Workload. Scopes are a collection of workloads arranged in a hierarchy. Workloads labelled to serve as attributes that build a model about where it is, its role, and its function in your environment. Scopes provide a structure to support dynamic mechanisms like identification and attributes associated with an IP that may change over time.

Scopes are used to group datacenter applications and, along with Roles, enable fine grained control of their management. For example, Scopes are used throughout the product to define access to Policies, on page 413, Flows and Filters.

Scopes are defined hierarchically as sets of trees with the root corresponding to a **VRF**. As a result, each Scope tree hierarchy represents disjoint data that does not overlap with another Scope tree, see Scope Overlap.

Scope Definition

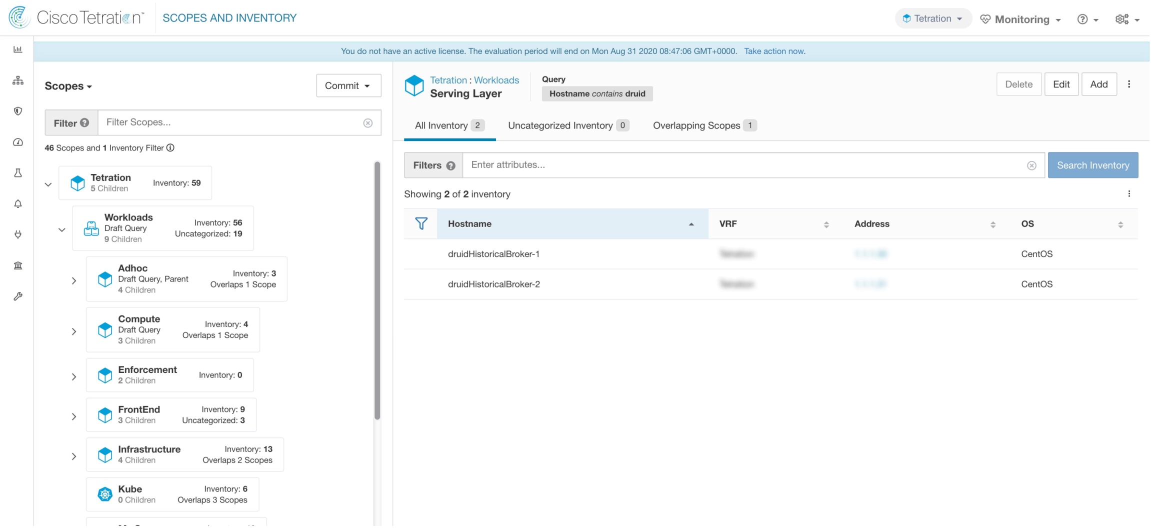
Each individual Scope is defined with the attributes below:

Attribute	Description
Parent Scope	The parent of the new scope defines the tree hierarchy structure.
Name	The name to identify the scope.
Type	This is used to specify different categories of inventory. If none are applicable, or the scope contains a mix, it can be left blank.
Query	The Query defining the individual scope.

Note Scopes should be defined in a hierarchy that mimics the application ownership hierarchy of the organization.

Note Query may match against IP/Subnet or other Inventory attributes.

Figure 166: Example of Traversing through Scope Hierarchy



You do not have an active license. The evaluation period will end on Mon Aug 31 2020 08:47:06 GMT+0000. Take action now.

46 Scopes and 1 Inventory Filter

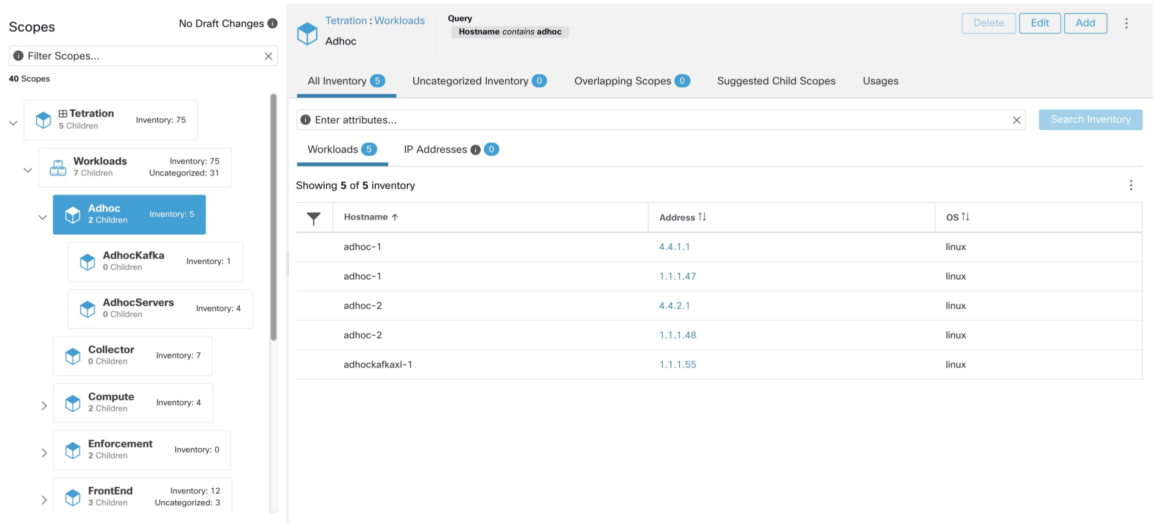
Scope	Details	Counts
Tetration	5 Children	Inventory: 59
Workloads	Draft Query 9 Children	Inventory: 56 Uncategorized: 19
Adhoc	Draft Query, Parent 4 Children	Inventory: 3 Overlaps 1 Scope
Compute	Draft Query 3 Children	Inventory: 4 Overlaps 1 Scope
Enforcement	2 Children	Inventory: 0
FrontEnd	3 Children	Inventory: 9 Uncategorized: 3
Infrastructure	4 Children	Inventory: 13 Overlaps 2 Scopes
Kube	0 Children	Inventory: 6 Overlaps 3 Scopes

Showing 2 of 2 inventory

Hostname	VRF	Address	OS
druidHistoricalBroker-1	[redacted]	[redacted]	CentOS
druidHistoricalBroker-2	[redacted]	[redacted]	CentOS

The scope directory displays the scope hierarchy and some details of each scope (for example, Inventory Count, number of child scopes, Workspaces). Clicking on a scope selects that scope and the details pane to the right updates with more information about that scope and that scope's inventory.

Figure 167: Inventory count



40 Scopes

Scope	Children	Counts
Tetration	5 Children	Inventory: 75
Workloads	7 Children	Inventory: 75 Uncategorized: 31
Adhoc	2 Children	Inventory: 5
AdhocKafka	0 Children	Inventory: 1
AdhocServers	0 Children	Inventory: 4
Collector	0 Children	Inventory: 7
Compute	2 Children	Inventory: 4
Enforcement	2 Children	Inventory: 0
FrontEnd	3 Children	Inventory: 12 Uncategorized: 3

Showing 5 of 5 inventory

Hostname	Address	OS
adhoc-1	4.4.1.1	linux
adhoc-1	1.1.1.47	linux
adhoc-2	4.4.2.1	linux
adhoc-2	1.1.1.48	linux
adhockafkaxl-1	1.1.1.55	linux

Scope Filter

Users can use the Scope filter to quickly identify different scope details such as overlapping scopes and query. The filter feature is also helpful in identifying query changes, parent changes, etc.

Field	Description
Name	Filter by the name of the Scope or Inventory Filter.
Description	Filter by text appearing in the description of a scope.

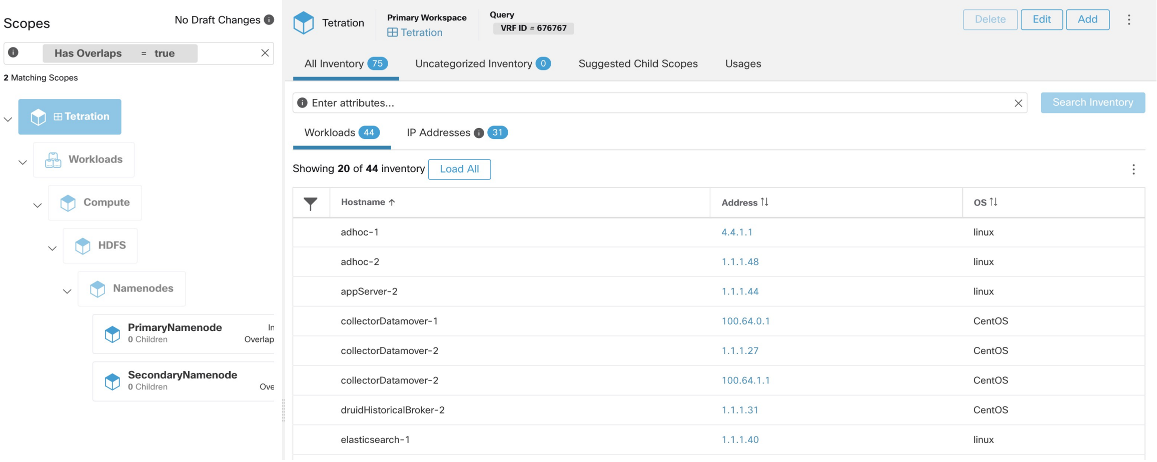
Field	Description
Query	Filter by fields or values used in the query.
Query Change	Filter by scopes that have an uncommitted query.
Parent Change	Filter by scopes that have been moved in the draft but not committed.
Is Inventory Filter	Show Inventory Filters that are restricted to their ownership scope.
Has Workspace	Filter by scopes that have a primary workspace.
Has Enforced Workspace	Filter by scopes that have a primary workspace that is enforced.
Has Overlaps	Filter by scopes that have inventory in common with a sibling scope.
Has Invalid Query	Filter by scopes that have a query that uses invalid or unknown labels.

Examples:

Has Overlaps

Example of Scope Overlap

Figure 168: Has Overlaps



Has Overlaps = true

2 Matching Scopes

Query: VRF ID = 676767

Showing 20 of 44 inventory

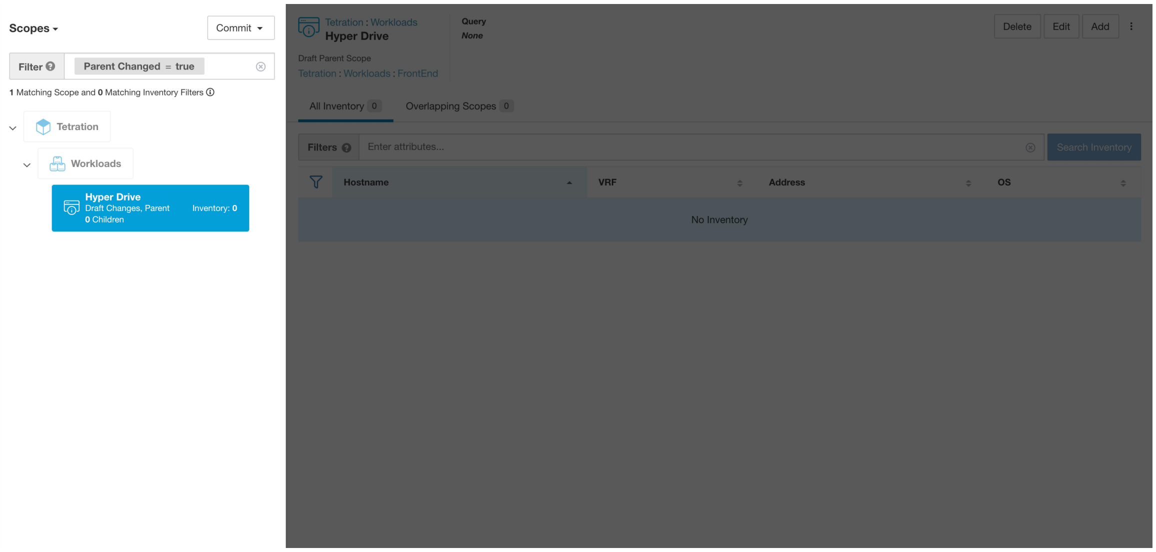
Hostname ↑	Address ⇅	OS ⇅
adhoc-1	4.4.1.1	linux
adhoc-2	1.1.1.48	linux
appServer-2	1.1.1.44	linux
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-2	1.1.1.27	CentOS
collectorDatamover-2	100.64.1.1	CentOS
druidHistoricalBroker-2	1.1.1.31	CentOS
elasticsearch-1	1.1.1.40	linux

For more information see Scope Overlap

Parent Change

Scopes that are moved in the draft but not yet committed.

Figure 169: Parent Change

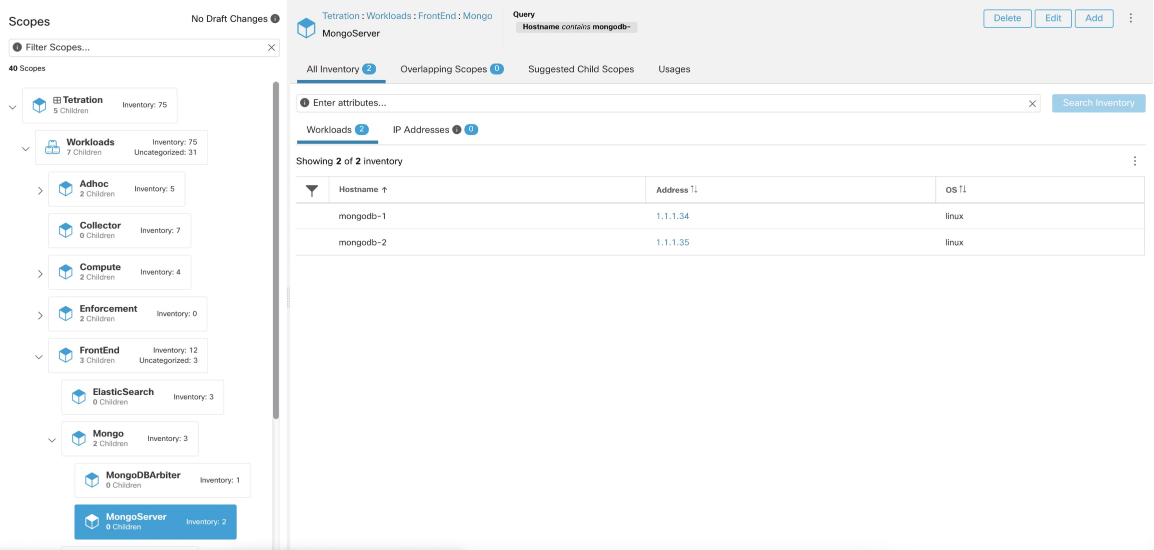


Filter: Parent Changed = true

Query: None

Full Scope Queries

Figure 170: Example of Scope Hierarchy



Query: Hostname *contains* mongodb-

Showing 2 of 2 inventory

Hostname ↑	Address ↑↓	OS ↑↓
mongodb-1	1.1.1.34	linux
mongodb-2	1.1.1.35	linux

Scopes are defined hierarchically, the full query of the scope is defined as the logical ‘and’ of the scope along with all of its parents. Using the example above, assets assigned to the `Workloads:FrontEnd:Mongo`

Scope would match:

```
vrf_id = 676767 and (ip in 1.1.1.0/24) and (Hostname contains mongo).
```

Where vrf_id = 676767 comes from the root scope query and ip in 1.1.1.0/24 comes from the parent scope query.

Note It is a best practice to not have overlapping queries at the same level. This removes the importance of ordering and reduces confusion. See Scope Overlap

Providing Access to Scopes

You can grant Read, Write, Execute, Enforce, and Owner abilities on Scopes. An overview is provided below, for more information see Roles.

A User is given access to a "sub-tree". That is, the given Scope and all its children. Using the preceding example, you have the Read access to the `Workloads:FrontEnd` scope would, by inheritance, have read access to all the scopes under `Workloads:FrontEnd` including:

- `Workloads:FrontEnd:Mongo`
- `Workloads:FrontEnd:ElasticSearch`
- `Workloads:FrontEnd:Redis`
- `etc. . .`

It's possible to define Roles with access to multiple Scopes. For example, an "Mongo Admin" role might have Owner access to the Scopes:

- `Workloads:FrontEnd:Mongo:MongoServer`
- `Workloads:FrontEnd:Mongo:MongoDBArbiter`

Roles and Capabilities allow you to have horizontal access to the Scope hierarchy.

Scope Abilities are also inherited. For example, having the Write ability on a Scope allows one to also Read that information.

Viewing Scope

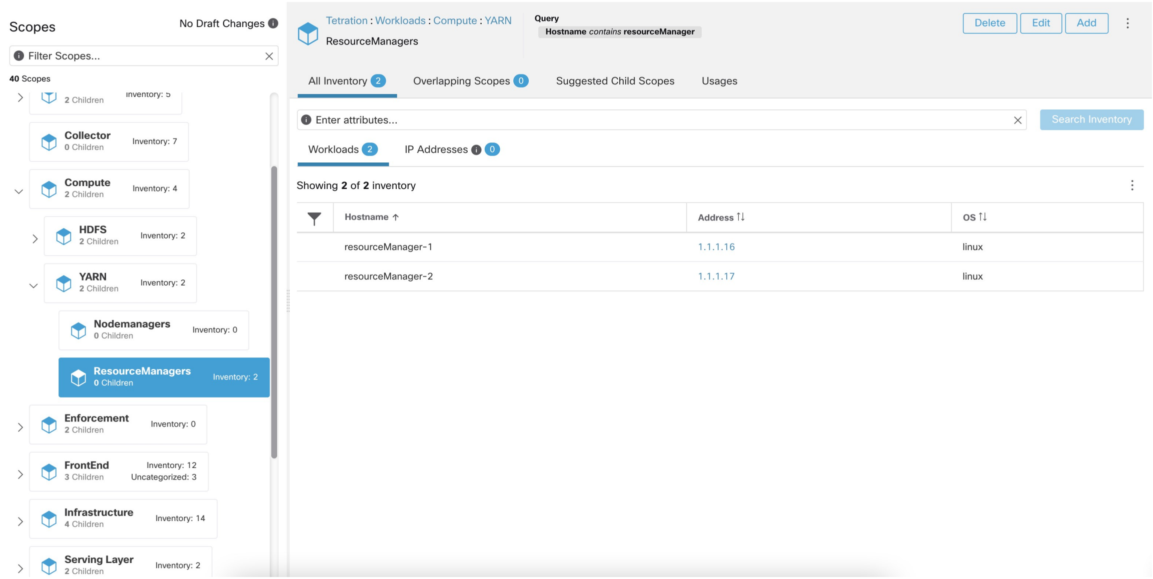
Every user can view the scope tree they have access to. Users who have the Owner ability on the root scope have the ability to create, edit and delete scope in that tree. To access this view:

In the navigation bar on the left, click **Organize** > **Scopes and Inventory**.

You can traverse through the complete scope hierarchy (up to the root) for any Scopes you have access to. This complete traversal provides context as users can create policies to any Scope. Several actions can be performed on this page:

- Click the chevron in the scope hierarchy to show that scope's children.
- Clicking on a scope card will update the pane to the right to show details about that scope as well as a filterable list of all of its inventory.

Figure 171: Example Non-Admin View


Scopes
No Draft Changes
Filter Scopes...
40 Scopes
2 Children Inventory: 5
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
HDFS 2 Children Inventory: 2
YARN 2 Children Inventory: 2
Nodemanagers 0 Children Inventory: 0
ResourceManagers 0 Children Inventory: 2
Enforcement 2 Children Inventory: 0
FrontEnd 3 Children Inventory: 12 Uncategorized: 3
Infrastructure 4 Children Inventory: 14
Serving Layer 2 Children Inventory: 2
Tetration : Workloads : Compute : YARN
ResourceManagers
Query
Hostname contains resourceManager
Delete
Edit
Add
All Inventory 2
Overlapping Scopes 0
Suggested Child Scopes
Usages
Enter attributes...
Search Inventory
Workloads 2
IP Addresses 0

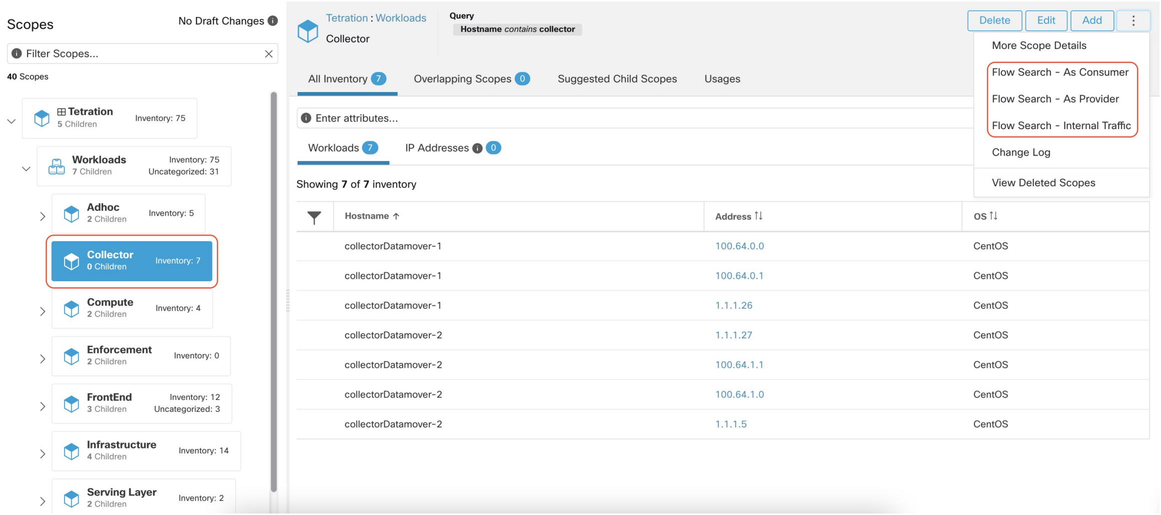
Showing 2 of 2 inventory

Hostname ↑	Address ⇅	OS ⇅
resourceManager-1	1.1.1.16	linux
resourceManager-2	1.1.1.17	linux

Searching for flows referencing a scope

There are some shortcuts provided on the scopes page to help the user in scenarios they need to search for flows where one or both endpoints of the flow fall within a provided scope.

Figure 172: Searching for flows for a scope


Scopes
No Draft Changes
Filter Scopes...
40 Scopes
Tetration 5 Children Inventory: 75
Workloads 7 Children Inventory: 75 Uncategorized: 31
Adhoc 2 Children Inventory: 5
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
Enforcement 2 Children Inventory: 0
FrontEnd 3 Children Inventory: 12 Uncategorized: 3
Infrastructure 4 Children Inventory: 14
Serving Layer 2 Children Inventory: 2
Tetration : Workloads
Collector
Query
Hostname contains collector
Delete
Edit
Add
More Scope Details
Flow Search - As Consumer
Flow Search - As Provider
Flow Search - Internal Traffic
Change Log
View Deleted Scopes
All Inventory 7
Overlapping Scopes 0
Suggested Child Scopes
Usages
Enter attributes...
Workloads 7
IP Addresses 0

Showing 7 of 7 inventory

Hostname ↑	Address ⇅	OS ⇅
collectorDatamover-1	100.64.0.0	CentOS
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-1	1.1.1.26	CentOS
collectorDatamover-2	1.1.1.27	CentOS
collectorDatamover-2	100.64.1.1	CentOS
collectorDatamover-2	100.64.1.0	CentOS
collectorDatamover-2	1.1.1.5	CentOS

After selecting desired scope in the scope tree (left side panel), as shown in the figure above, user can choose between the following three options:

1. *Flow Search - As Consumer* provides shortcut to the flow search page to help search for flows with selected scope as *Consumer Scope* for the flows. In other words, consumer or source endpoint in the flows belongs to the selected scope.

2. *Flow Search - As Provider* provides shortcut to the flow search page to help search for flows with selected scope as *Provider Scope* for the flows. In other words, provider or destination endpoint in the flows belongs to the selected scope.
3. *Flow Search - Internal Traffic* provides shortcut to the flow search page to help search for flows that are completely restricted to the selected scope. In other words, both endpoints of the flows (consumer and provider) belong to the selected scope.

Creating a New Scope

Child scopes are created on the **Scopes** admin page. This action requires the `SCOPE_OWNER` ability on the root scope. **Site Admins** are owners of all scopes.

Creating a child scope will impact the application inventory membership (member workloads) of the parent scope. As a result, the parent scope will be marked as having “draft changes”. The changes will need to be committed and dependent structures will need to be updated. See Commit Changes.

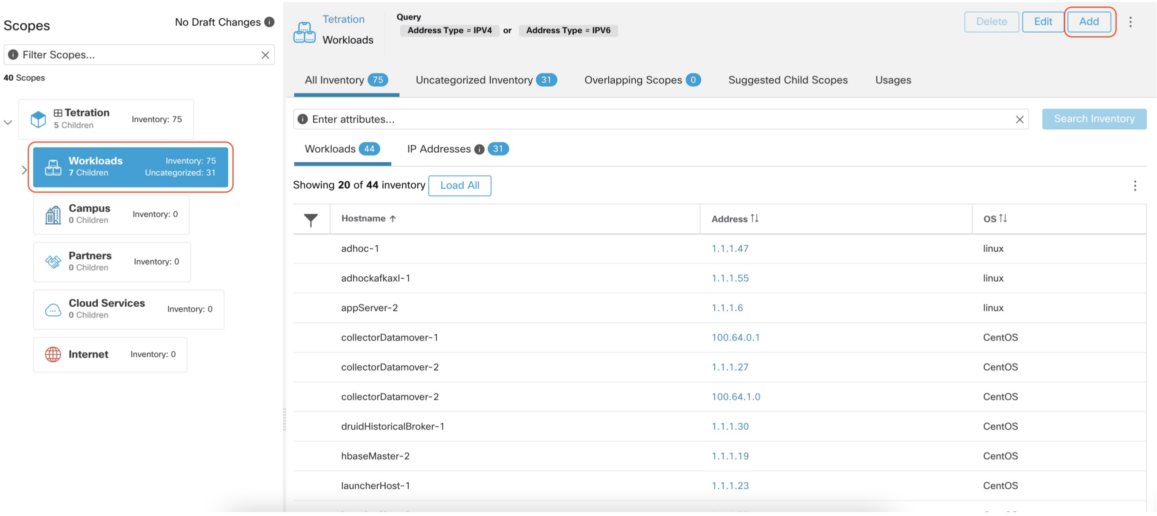
Procedure

Step 1 In the navigation bar on the left, click **Organize** > **Scopes and Inventory**. The page displays the root Scopes corresponding to Tenants+VRFs already created on the system.

Step 2 Select a child scope in the scope directory. You can filter the scopes first if necessary.

Step 3 Click the **Add** button.

Figure 173: Scope Add Button



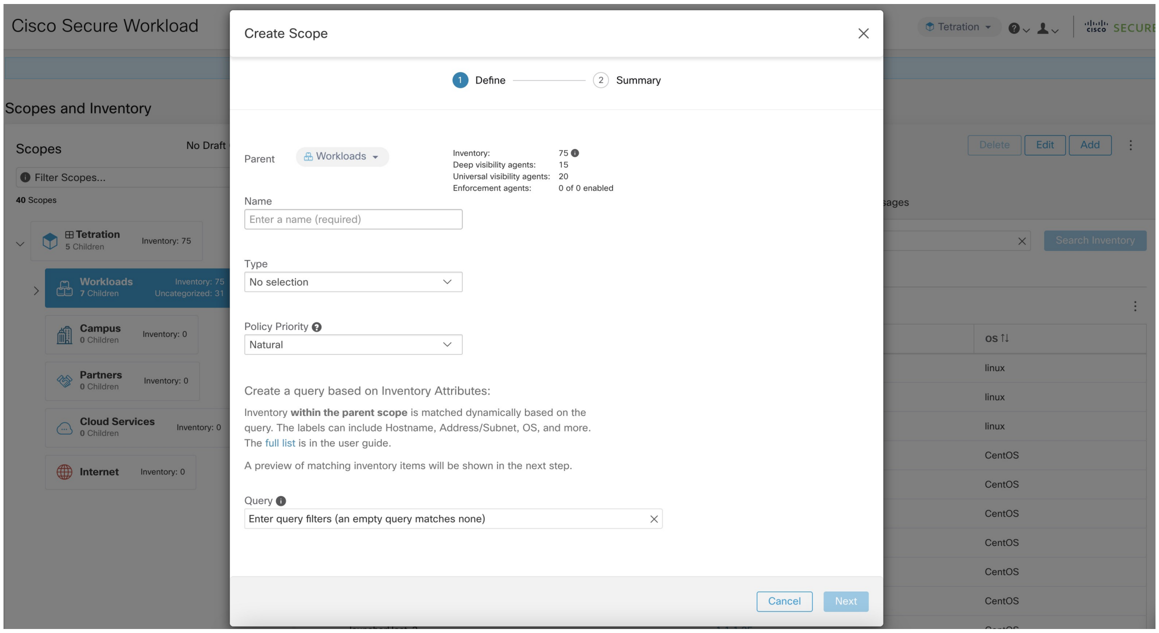
Hostname ↑	Address ⇅	OS ⇅
adhoc-1	1.1.1.47	linux
adhockafkaxl-1	1.1.1.55	linux
appServer-2	1.1.1.6	linux
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-2	1.1.1.27	CentOS
collectorDatamover-2	100.64.1.0	CentOS
druidHistoricalBroker-1	1.1.1.30	CentOS
hbaseMaster-2	1.1.1.19	CentOS
launcherHost-1	1.1.1.23	CentOS

Step 4 Enter the appropriate values in the following fields:

Field	Description
Parent	The parent of the new Scope.
Name	The name to identify the Scope. Must be unique under the parent scope

Field	Description
Type	Select a category for the new Scope.
Query	The Query/Filter to match the assets.

Figure 174: Scope Create Modal



Parent: Workloads

Inventory: 75
Deep visibility agents: 15
Universal visibility agents: 20
Enforcement agents: 0 of 0 enabled

Name: Enter a name (required)

Type: No selection

Policy Priority: Natural

Create a query based on Inventory Attributes:

Inventory **within the parent scope** is matched dynamically based on the query. The labels can include Hostname, Address/Subnet, OS, and more. The full list is in the user guide.

A preview of matching inventory items will be shown in the next step.

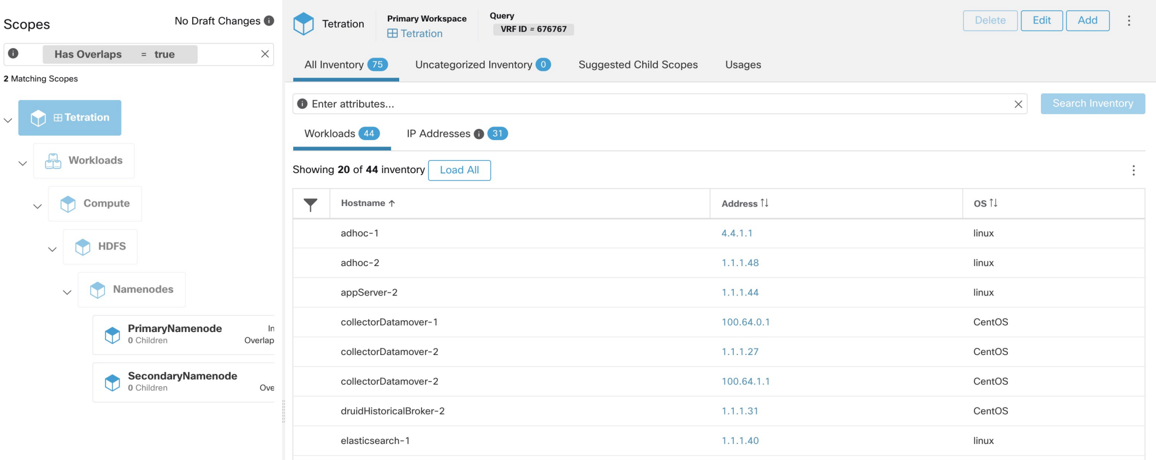
Query: Enter query filters (an empty query matches none)

Scope Overlap

While adding scopes, it is recommended to avoid overlapping scopes. When scopes overlap, policies generated for overlapping scopes can potentially end up confusing end users. This feature proactively notifies the user if there are any overlapping scope membership, that is, the same inventory belongs to more than one scope at the same depth in scope tree (sibling scopes). The goal is to avoid having the same workload exist in different parts of the scope tree.

To view which inventory items belong to multiple scopes, use the scope filter and enter the **Has Overlaps = true** facet.

Figure 175: Overlap facet in Scope filter



Has Overlaps = true

Tetration — Primary Workspace: Tetration — Query: VRF ID = 676767

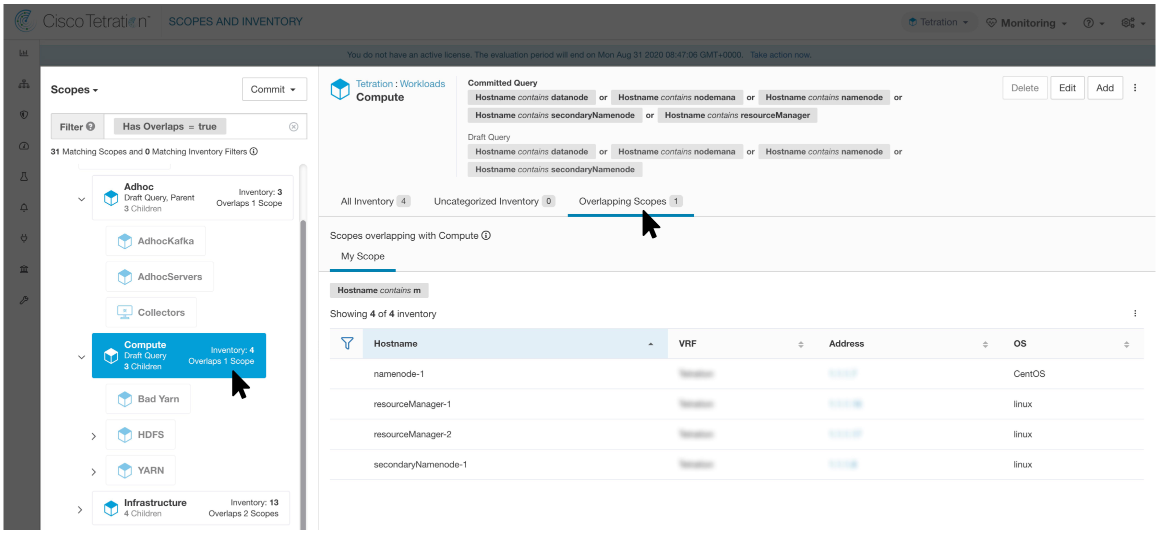
Enter attributes...

Showing **20** of **44** inventory

Hostname	Address	OS
adhoc-1	4.4.1.1	linux
adhoc-2	1.1.1.48	linux
appServer-2	1.1.1.44	linux
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-2	1.1.1.27	CentOS
collectorDatamover-2	100.64.1.1	CentOS
druidHistoricalBroker-2	1.1.1.31	CentOS
elasticsearch-1	1.1.1.40	linux

The list of overlapping scopes and the corresponding overlapping IP addresses can be viewed by traversing down the scope tree and selecting the **Overlapping Scopes** tab.

Figure 176: Overlapping Scopes and IPs



You do not have an active license. The evaluation period will end on Mon Aug 31 2020 08:47:06 GMT+0000. Take action now.

Has Overlaps = true

31 Matching Scopes and **0** Matching Inventory Filters

Tetration : Workloads
Compute

Committed Query
Hostname *contains* datanode or Hostname *contains* nodemana or Hostname *contains* namenode or Hostname *contains* secondaryNamenode or Hostname *contains* resourceManager

Draft Query
Hostname *contains* datanode or Hostname *contains* nodemana or Hostname *contains* namenode or Hostname *contains* secondaryNamenode

Scopes overlapping with Compute

Hostname *contains* m

Showing **4** of **4** inventory

Hostname	VRF	Address	OS
namenode-1	[redacted]	[redacted]	CentOS
resourceManager-1	[redacted]	[redacted]	linux
resourceManager-2	[redacted]	[redacted]	linux
secondaryNamenode-1	[redacted]	[redacted]	linux

Editing Scopes

Scopes can only be edited by users with the `SCOPE_OWNER` ability on the root scope. Site admins are owners of all scopes.

Editing a scope name

Editing a scope name happens immediately and can take several minutes depending on the number of child scopes that need to be updated.

Note Flow searches by scope name will be impacted when changing the scope name.

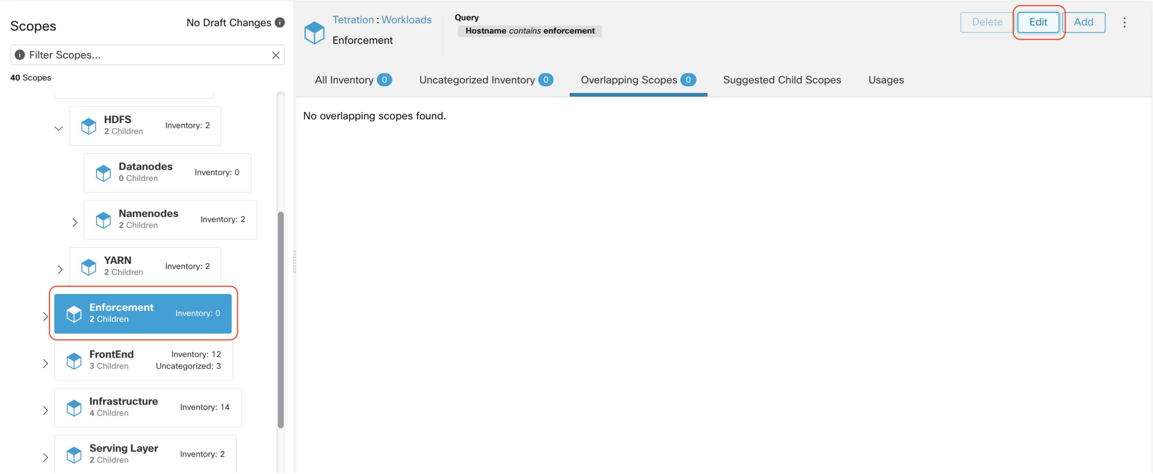
Editing a scope query

When a scope's query is changed the direct parent and child scopes are impacted. Those scopes are marked as having 'draft changes' indicating changes have been made to the tree that have not been committed. Once all query updates have been completed, the user must click the **Commit Changes** button above the Scope Directory to make the change permanent. This will trigger a background task to update all of the scope queries and 'dynamic cluster queries' in the workspace.

Warning Updating a scope query can impact the scopes inventory membership (the workloads that are members of the scope). Changes will take effect during the **Commit Changes** process. To mitigate risks, you can compare membership changes for further impact analysis from the Review Scope/Filter Change Impact window.

New host firewall rules will be inserted and any existing rules will be deleted on the relevant hosts.

Figure 177: Edit a Scope



No overlapping scopes found.

To edit a scope:

Procedure

Step 1 Click on the **edit button** on the respective scope to be edited.

Step 2 Edit the Name or Query for the selected scope.

Step 3 Compare changes between the old and new Draft Query by following the **Review query change impact** link.

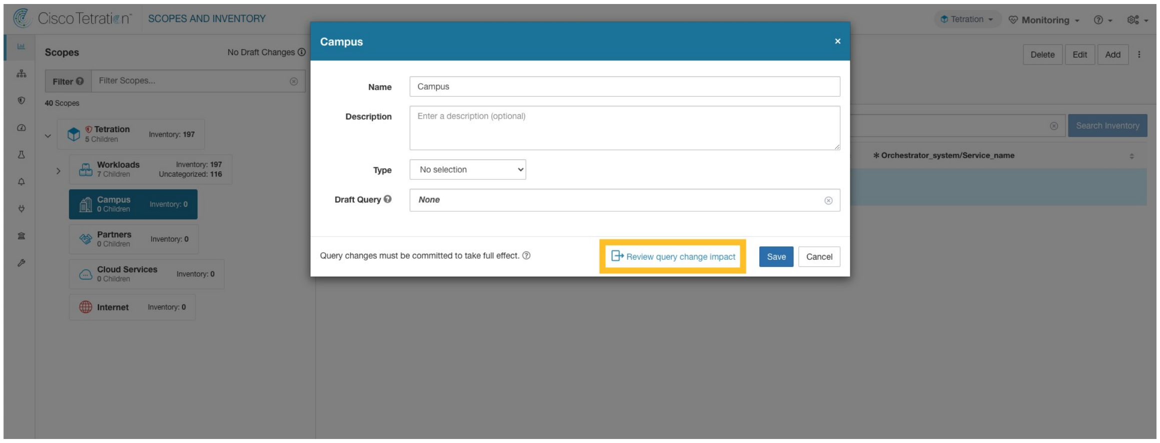
Step 4 Click on **Save**. Name gets updated right away.

Step 5 To update the Query of all scopes, Click the **Commit Changes** button.

Step 6 You will get a popup confirmation which states the consequences of performing scope changes. The update is processed asynchronously in a background task.

Step 7 Click on **Save**. Depending on the number of changes this can a minute or more.

Figure 178: Review query change impact



Campus

Name: Campus

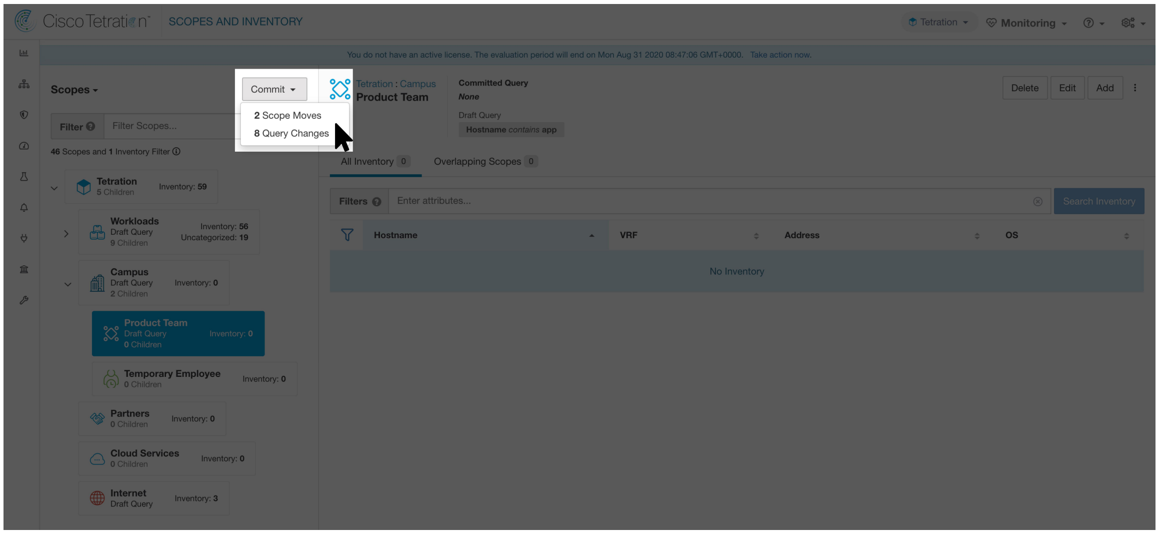
Description: Enter a description (optional)

Type: No selection

Draft Query: None

Query changes must be committed to take full effect.

Figure 179: Commit Changes



You do not have an active license. The evaluation period will end on Mon Aug 31 2020 08:47:06 GMT+0000. Take action now.

Committed Query: None

Draft Query: Hostname contains app

Editing the parent of a scope

When the parent of a scope is updated, the scope query changes. This change effects the membership of both the parent and child scopes. Similar to editing the scope query, these changes are initially saved as ‘draft changes’ and will not go into effect unless they are committed. The user can validate the impact of this change before committing by clicking on “Review query change impact” on the Edit Scope modal. Once validated, the changes can be committed by clicking “Commit” and accepting the “scope moves” and “query changes”.

To edit the parent of a scope:

Procedure

Step 1 Click on the **edit button** on the respective scope to be edited.

Step 2 Edit the parent for the selected scope.

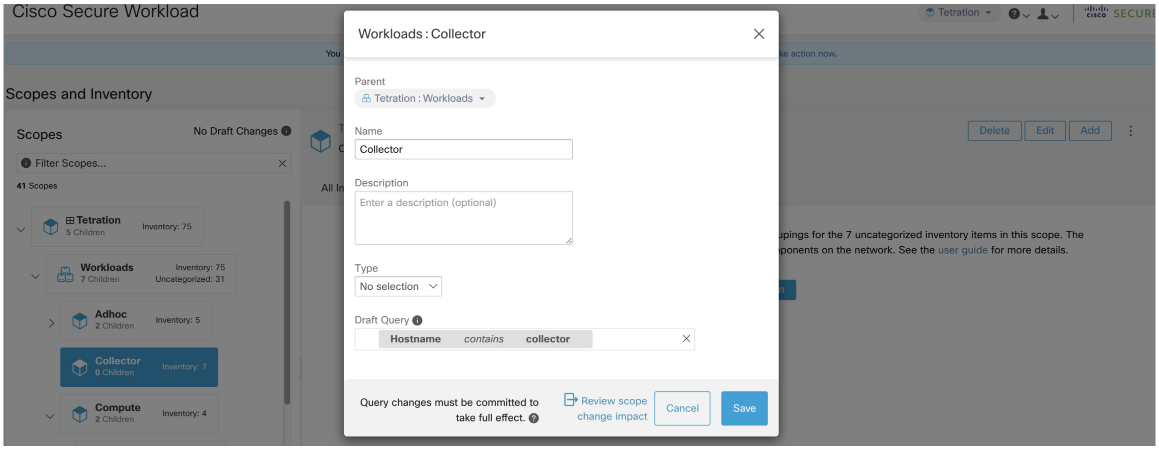
Step 3 Compare changes between the old and new Draft Query by clicking the **Review query change impact** link.

Step 4 Click on **Save**.

Step 5 Click on “Commit” and accept the ‘scope moves’ and ‘query changes’. The update is processed asynchronously in a background task.

Step 6 Depending on the number of workloads this change impacts, this can take a minute or more.

Figure 180: Changing the parent scope from Default scope to Default:ProdHosts



Workloads : Collector

Parent: Tetration : Workloads

Name: Collector

Description: Enter a description (optional)

Type: No selection

Draft Query: Hostname *contains* collector

Query changes must be committed to take full effect.

Review scope change impact

Deleting Scopes

Scopes can only be deleted by users with the `SCOPE_OWNER` ability on the root scope. Site admins are owners of all scopes.

Deleting a scope will impact the application inventory membership of the parent scope (the workloads that are members of the parent scope). . As a result, the parent scope will be marked as having ‘draft changes’. The changes will need to be committed and dependent structures will need to be updated. See Commit Changes.

Scopes with dependent objects can not be deleted. An error will be returned if:

- A workspace is defined for the Scope.
- There is an Inventory Filter assigned to the Scope.
- A policy exists that uses the Scope to define its consumers or providers.
- An Agent Config Intent is defined on the Scope
- An Interface Config Intent is defined on the Scope.
- A Forensics Config Intent is defined on the Scope.

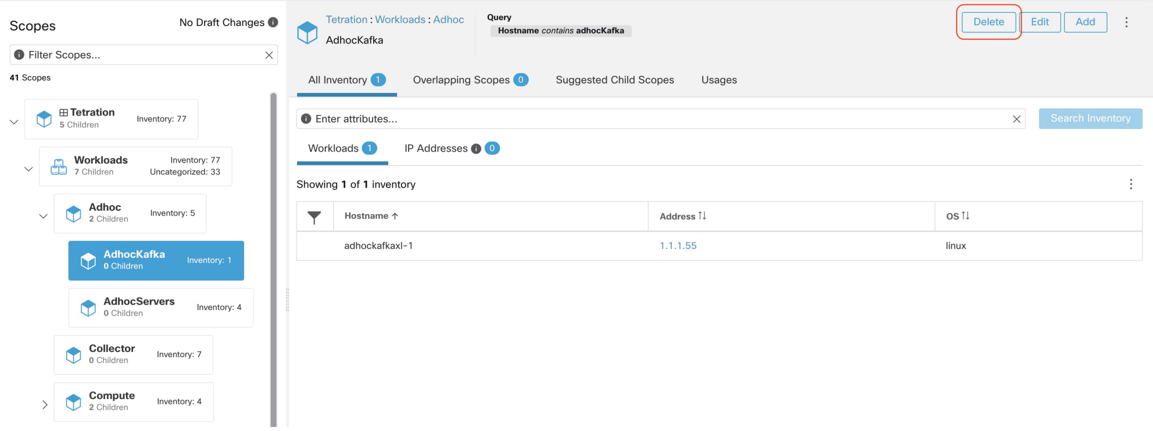
  To further drill down on scope dependencies, you can visit the **Dependencies** tab from the Review Scope/Filter Change Impact window.

  These objects need to be removed before the Scope can be deleted.

1. In the navigation bar on the left, click **Organize** > **Scopes and Inventory**.

2. Select a “scope” then click again to display child Scopes. Select the child scope you wish to delete.
3. Click the **Delete** button next to the edit and add buttons.

Figure 181: Delete Scope


Scopes
No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
Tetration : Workloads : Adhoc
AdhocKafka
Query
Hostname contains adhocKafka
Delete
Edit
Add
All Inventory 1
Overlapping Scopes 0
Suggested Child Scopes
Usages
Enter attributes...
Search Inventory
Workloads 1
IP Addresses 0

Showing 1 of 1 inventory

Hostname ↑	Address ↑↓	OS ↑↓
adhockafkaxl-1	1.1.1.55	linux

> **Note** Only Scopes without children can be deleted

> **Note** Root scopes must be deleted by removing the VRF from the Tenants page.

Reset the Scope Tree

If any of the above configurations exist, you must delete them before you can reset the scope tree. The Reset button is not available until you do so.

To reset the scope tree:

Before you begin

You can delete the entire scope tree and start over.

Resetting the scope tree deletes all scopes, labels, workspaces, and collection rules. It does not delete any ingested data.

Only a user with the `SCOPE_OWNER` ability on the root scope can reset the scope tree.

However, you cannot reset the scope tree if any of the following are defined for any scope in the tree:

- Workspaces (except the single workspace created if you created the scope tree using the wizard)
- Inventory filters
- Policies
- Agent Config Intents

- Interface Config Intents
- Forensics Config Intents

Procedure

Step 1 From the navigation menu on the left, choose **Organize** > **Scopes and Inventory**.

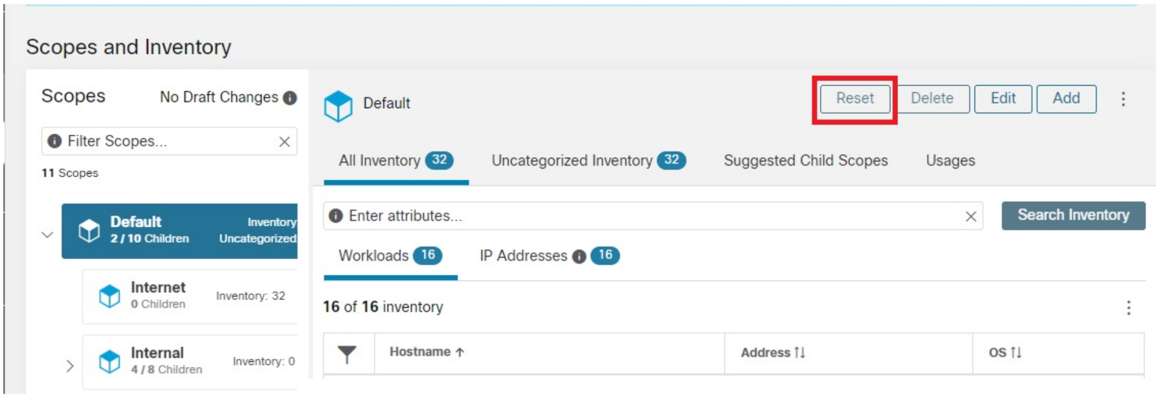
Step 2 Click the scope at the top of the tree.

Step 3 Click **Reset**.

Step 4 Confirm your choice.

Step 5 If necessary, refresh the browser page to continue.

Figure 182: Reset Scope Tree



Commit Changes

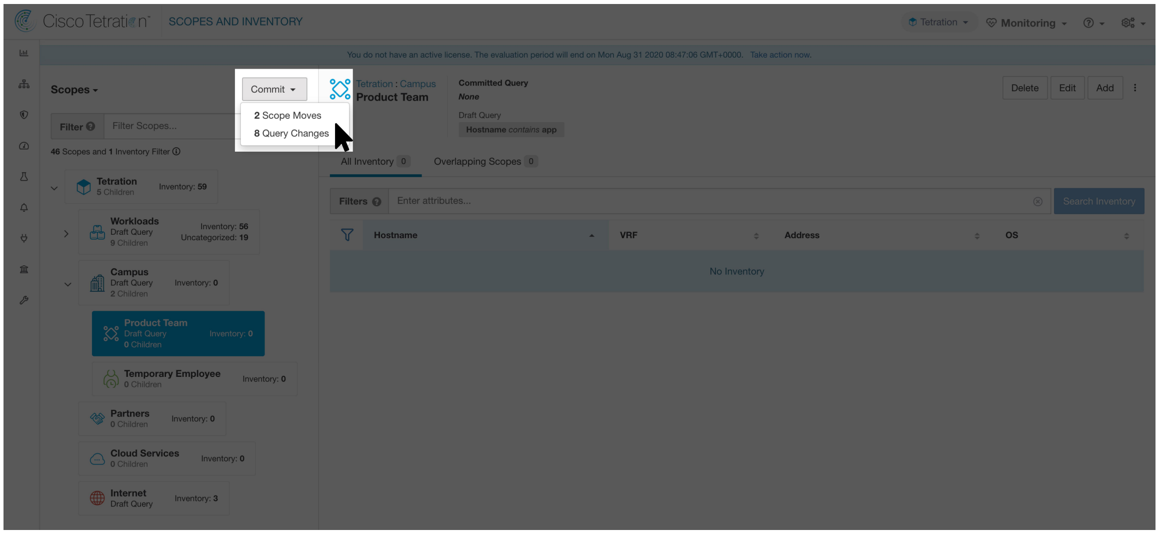
A scope's application inventory query definition is defined by its query and those of its direct children. When this happens the scope is marked as having 'draft changes' and the scope's query, workspaces, and clusters will not be changed until the **Commit Changes** background task is run. When a scope is in draft, the caution triangle is shown by the affected scopes icons, and the 'Commit Changes' button is shown on the Scopes page (top right) and should be clicked to run the **Commit Changes** background task.

Events that can mark a scope as in draft:

- Query update
- The query of any parent is updated.
- Direct child is added.
- Direct child is deleted.
- Direct child's query is updated.

Changing the name of a scope does not change the draft state of the scope.

Figure 183: Commit Changes


Cisco Tetration
SCOPES AND INVENTORY
Tetration
Monitoring
You do not have an active license. The evaluation period will end on Mon Aug 31 2020 08:47:06 GMT+0000. Take action now.
Scopes
Commit
2 Scope Moves
8 Query Changes
Filter
Filter Scopes...
46 Scopes and 1 Inventory Filter
Tetration : Campus
Product Team
Committed Query
None
Draft Query
Hostname contains app
Delete
Edit
Add
All Inventory 0
Overlapping Scopes 0
Filters
Enter attributes...
Search Inventory
Hostname
VRF
Address
OS
No Inventory
Tetration 5 Children Inventory: 59
Workloads Draft Query 9 Children Inventory: 56 Uncategorized: 19
Campus Draft Query 2 Children Inventory: 0
Product Team Draft Query 0 Children Inventory: 0
Temporary Employee 0 Children Inventory: 0
Partners 0 Children Inventory: 0
Cloud Services 0 Children Inventory: 0
Internet Draft Query Inventory: 3

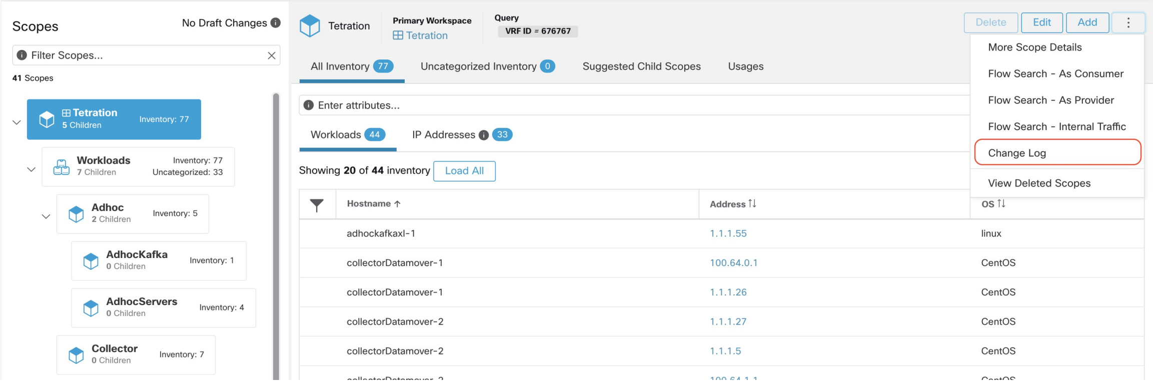
Note The **Commit Changes** task is asynchronous. It usually takes several seconds but large scope trees can take several minutes.

Note The scope update task will be completed when the root scope is no longer in draft. Refresh the page to get the latest state.

Change Log

Site Admins and users with the `SCOPE_OWNER` ability on the root scope can view the change logs for each scope by clicking change log in the overflow menu in the upper right.

Figure 184: Change Log

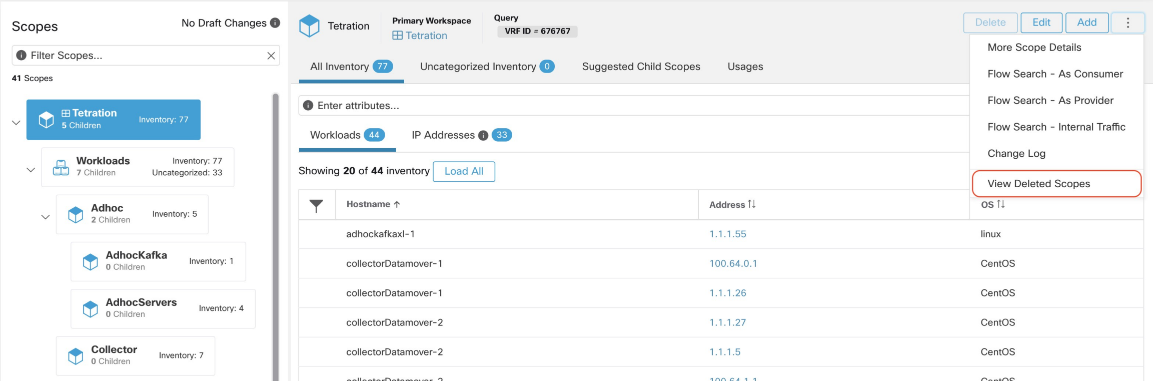

Scopes
No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Tetration
Primary Workspace
Tetration
Query
VRF ID = 676767
Delete
Edit
Add
More Scope Details
Flow Search - As Consumer
Flow Search - As Provider
Flow Search - Internal Traffic
Change Log
View Deleted Scopes
All Inventory 77
Uncategorized Inventory 0
Suggested Child Scopes
Usages
Enter attributes...
Workloads 44
IP Addresses 33
Load All

Showing 20 of 44 inventory

Hostname ↑	Address	OS
adhockafkaxl-1	1.1.1.55	linux
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-1	1.1.1.26	CentOS
collectorDatamover-2	1.1.1.27	CentOS
collectorDatamover-2	1.1.1.5	CentOS

These users can also view a list of deleted scopes by clicking on the **View Deleted Scopes** link is in the overflow menu in the upper right corner.

Figure 185: View Deleted Scopes



Hostname	Address	OS
adhockafkaxl-1	1.1.1.55	linux
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-1	1.1.1.26	CentOS
collectorDatamover-2	1.1.1.27	CentOS
collectorDatamover-2	1.1.1.5	CentOS

Creating a New Tenant

Root level scopes map to VRFs that are created under Tenants or through the **Scopes** admin page. This action is only available to **Site Admins** and **Customer Support users**.

Procedure

Step 1 In the navigation bar on the left, click **Platform** > **Tenants**.

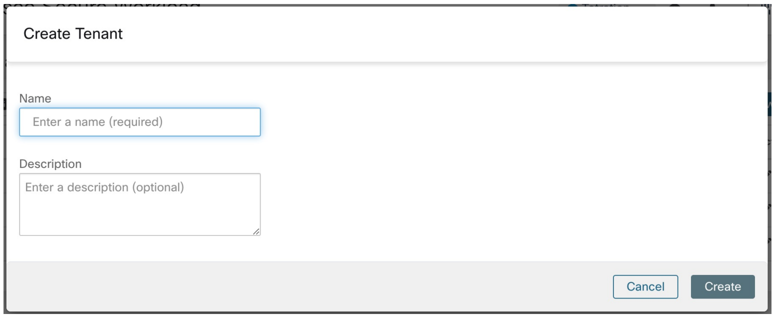
Step 2 Click the **Create New Tenant** button.

Step 3 Enter the appropriate values in the following fields:

Field	Description
Name	The name to identify the Scope. Must be unique under the parent Scope.
Description	An optional description.

Step 4 Click the **Create** button.

Figure 186: Create Tenant



Inventory

To work with inventory, click **Organize** > **Scopes and Inventory** in the left navigation bar.

Inventory Search

All inventory detected on the network is searchable. To search inventory, use the **Search Inventory** button. Each inventory item is uniquely identifiable by IP and VRF and can be used for performing a search. A service inventory item is not searchable using its IP Address. Use any of the User Labels associated to the service such as user_orchestrator_system/service_name for searching a service inventory. After a host has been found, you can view detailed information about the host on the host profile page.

Inventory Building Blocks

1. Root Scope
    - Root of the scope hierarchy under a given tenant
    - Provides a logical separation for L3 address domains
2. Scope
    - Inventory container defined by dynamic query
    - Foundation for hierarchical policy model
    - Anchor point for policy, RBAC, and filter configuration
3. Filter
    - Flexible construct based on dynamic inventory query
    - Anchor point for intent definition, provided services, and policy definition

Note Includes all IP addresses from partners and anything that is communicating in your environment. Whether they have an agent on them or not, you should define what they are through label.

Label Planning Considerations

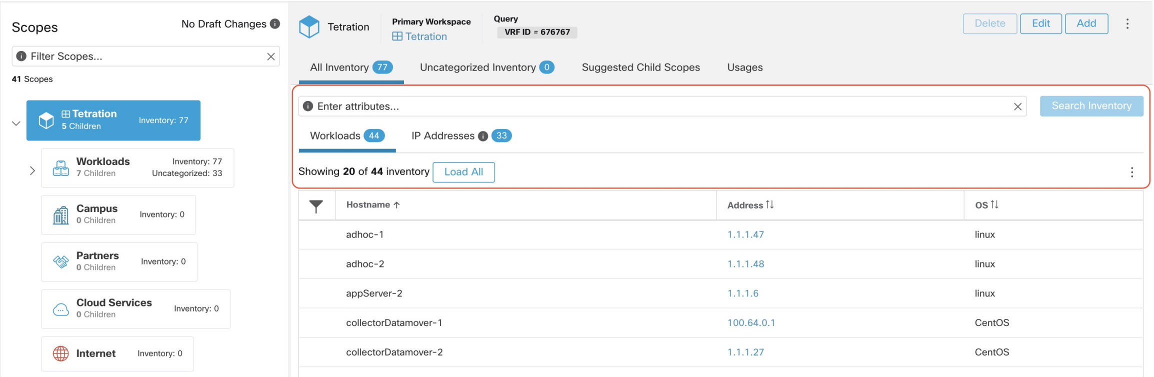
1. Source of data
    - Networks - IPAM? Routing tables? Spreadsheet?
    - Hosts - CMDB, Hypervisor, Cloud, App Owners?
2. Accuracy of data
3. How dynamic the data is and how it will be updated.
    - Manual Upload?
    - API Integration?

4. Start with the basics and grow.
    - Use network labels to build high-level scope structure.
    - Use host labels to build more detailed scope structure at app level.

Searching Inventory

Searching inventory enables you to view information about specific inventory items.

Figure 187: Inventory Search



Hostname ↑	Address ⇅	OS ⇅
adhoc-1	1.1.1.47	linux
adhoc-2	1.1.1.48	linux
appServer-2	1.1.1.6	linux
collectorDatamover-1	100.64.0.1	CentOS
collectorDatamover-2	1.1.1.27	CentOS

Procedure

Step 1 From the top-level menu, select **Organize** > **Scopes and Inventory**.

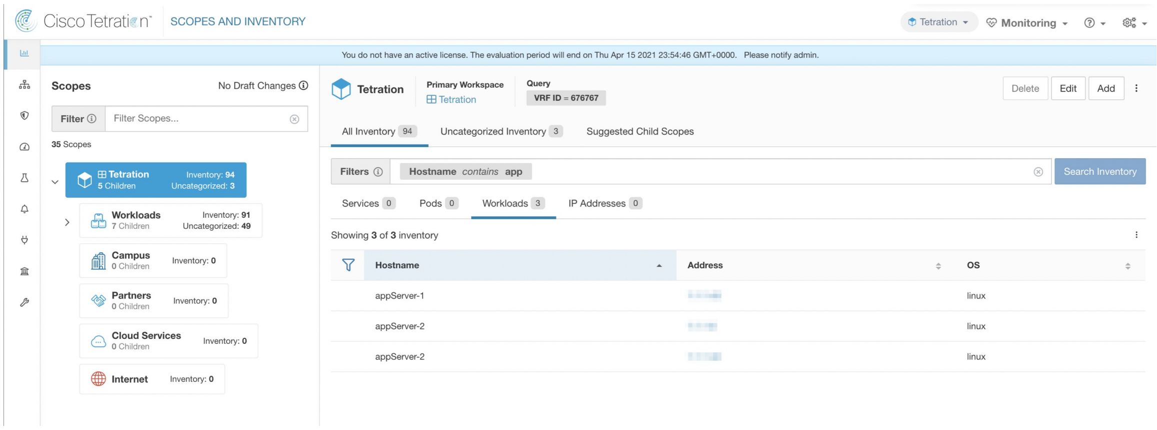
Step 2 Enter the attributes in the **Filters** field for the inventory item you are looking for. The attributes include the following:

Attributes	Description
Hostname	Enter a full or partial hostname.
VRF Name	Enter a VRF name.
VRF ID	Enter a VRF ID (numeric).
Address	Enter a valid IP address or subnet (IPv4 or IPv6).
Address Type	Enter either IPv4 or IPv6.
OS	Enter an OS name (e.g. CentOS).
OS Version	Enter an OS version (e.g. 6.5).
Interface Name	Enter an interface name (e.g. eth0).
MAC	Enter a MAC address.
In Collection Rules?	Enter true or false.

Attributes	Description
Process Command Line	Enter the sub-string of a command that is running on host (Note: this facet cannot be saved as part of inventory filter).
Process Binary Hash	Enter the process hash of a command that is running on host (Note: this facet cannot be saved as part of inventory filter).
Package Info	Enter the package name optionally followed by a package version (prefixed by #).
Package CVE	Enter part of or a complete CVE ID.
CVE Score v2	Enter a CVSSv2 (Common Vulnerability Scoring System) score (numeric).
CVE Score v3	Enter a CVSSv3 (Common Vulnerability Scoring System) score (numeric).
User Labels	Attributes prefixed with come from user labels.

Step 3 Click **Search Inventory**. The results are displayed below the **Filters** field grouped into four tabs. Each tab displays a table with the relevant columns. Additional columns can be displayed by clicking on the funnel icon in the table header. If any user labels are available, they will be prefixed with and can be toggled here.

Figure 188: Inventory Search Results



You do not have an active license. The evaluation period will end on Thu Apr 15 2021 23:54:46 GMT+0000. Please notify admin.

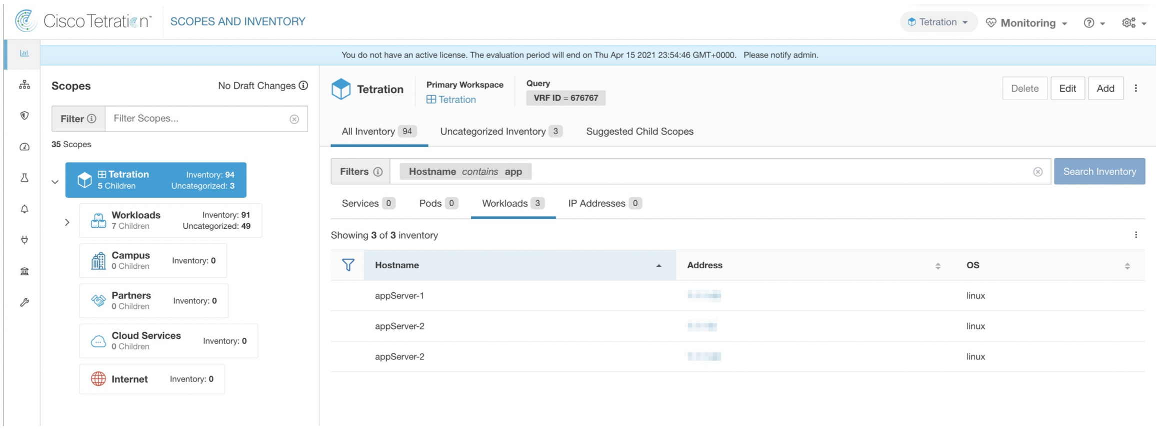
Query: VRF ID = 676767

Filters: Hostname *contains* app

Showing 3 of 3 inventory

Hostname	Address	OS
appServer-1	[redacted]	linux
appServer-2	[redacted]	linux
appServer-2	[redacted]	linux

Figure 189: Inventory Search Results



You do not have an active license. The evaluation period will end on Thu Apr 15 2021 23:54:46 GMT+0000. Please notify admin.

Hostname contains app

Showing 3 of 3 inventory

Hostname	Address	OS
appServer-1	[redacted]	linux
appServer-2	[redacted]	linux
appServer-2	[redacted]	linux

The search results are grouped into four tabs:

Tab	Description
Services	Lists the Kubernetes services and load balancers discovered through External Orchestrators. This tab is hidden unless a related external orchestrator is configured.
Pods	Lists the Kubernetes pods. This tab is hidden unless a related external orchestrator is configured.
Workloads	Lists the inventory items reported by Secure Workload agents.

Note By default, the catch all subnets for IPv4 and IPv6 addresses display in each tenant.

There is also a mention of the inventory count next to each tab. The immediately available information in a search includes hostname, IP Addresses with subnets, OS, OS Version, Service Name and Pod Name. The list of displayed columns can be toggled by clicking the funnel icon in the table header. Search results are restricted to the currently selected scope shown in the scope directory. More information can be seen on the respective profile page by clicking on an item in the search results.

More details about each host is displayed on the **Workload Profile**, which is accessible by clicking on the IP address field of a search result row. See the Workload Profile for more information.

To create Inventory Filters via the sidebar: Choose **Organize** > **Inventory Filters** from the top-level menu. Click on the **Create Filter** button. A modal dialog appears where you can name your saved filter.

Suggest Child Scopes

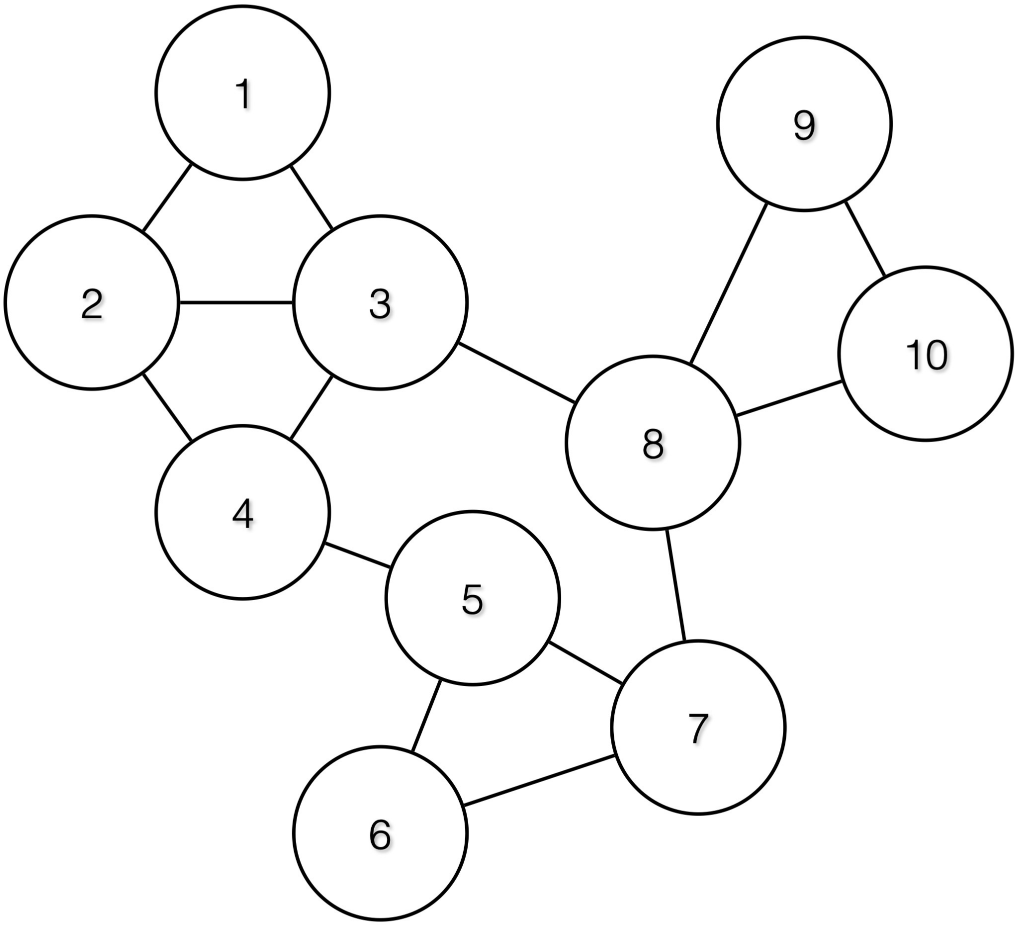
Suggest Child Scopes is a tool that uses machine learning algorithms (such as community detection in networks) to discover groupings that could serve as scopes. This tool is helpful when building a scope hierarchy, and facilitates the process of defining more granular child scopes for a given scope. Candidate child scopes are shown as suggestions that can then be selected and added.

A description of the algorithms at a conceptual level: A graph based on the communications among the unclaimed members of the parent scope is first created (note: unclaimed members are those that do not belong to any child scope of the parent), and the graph is preprocessed, for example the algorithms attempt to identify endpoints that communicate with sufficiently high proportion of other endpoints in the graph. Such a group of endpoints, if found, is displayed to the user as a candidate **common services** grouping. The rest of the graph is processed to detect groups that behave as **communities**, meaning roughly that the endpoints disproportionately communicate with one another more often (or on more provider ports) than to endpoints outside the group. Each such grouping may correspond to an application or a department within the organization. Such a partitioning can also lead to sparser policies among scopes.

Example:

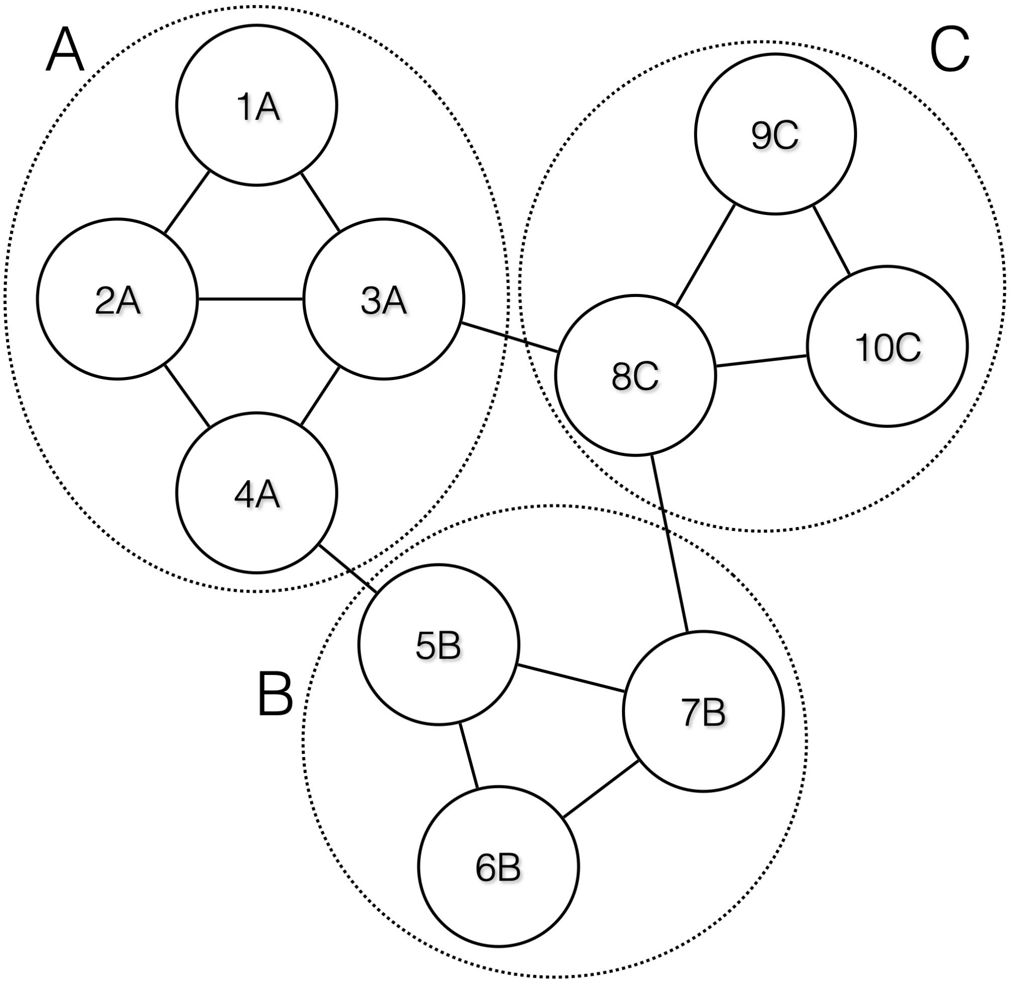
Let 1 through 10 be individual endpoint IPs. Assume the input (communications) graph is as follows:

Figure 190: Input graph



Then the endpoints 1 - 4, 5 - 7 and 8 - 10 will be grouped together because they have relatively high degree of communication (number of edges) among one another, and relatively low communications to other endpoints.

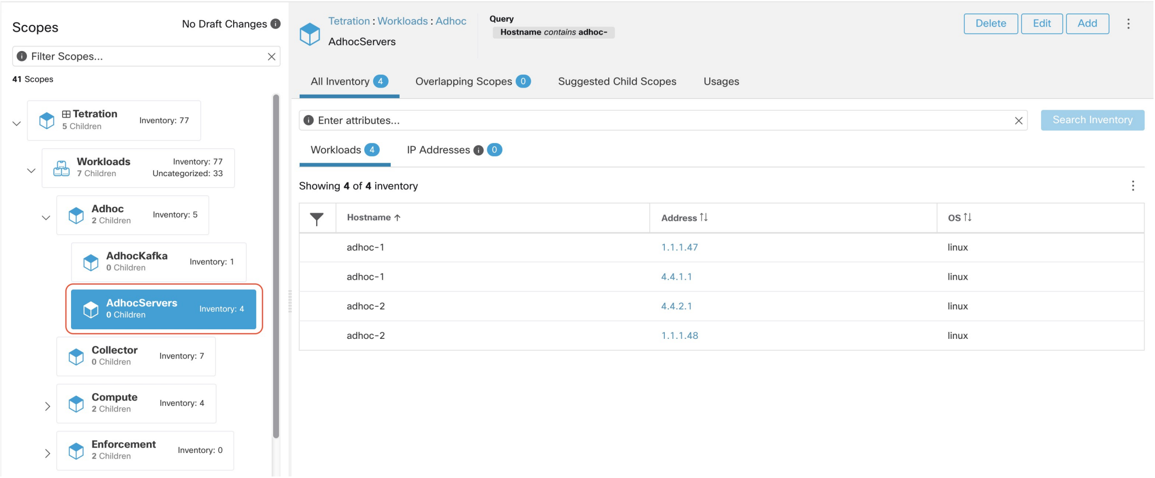
Figure 191: Output groups



Steps to perform scope suggestion

To invoke scope suggestion for a desired scope user should locate on the scopes page and select it.

Figure 192: Example of selecting a scope

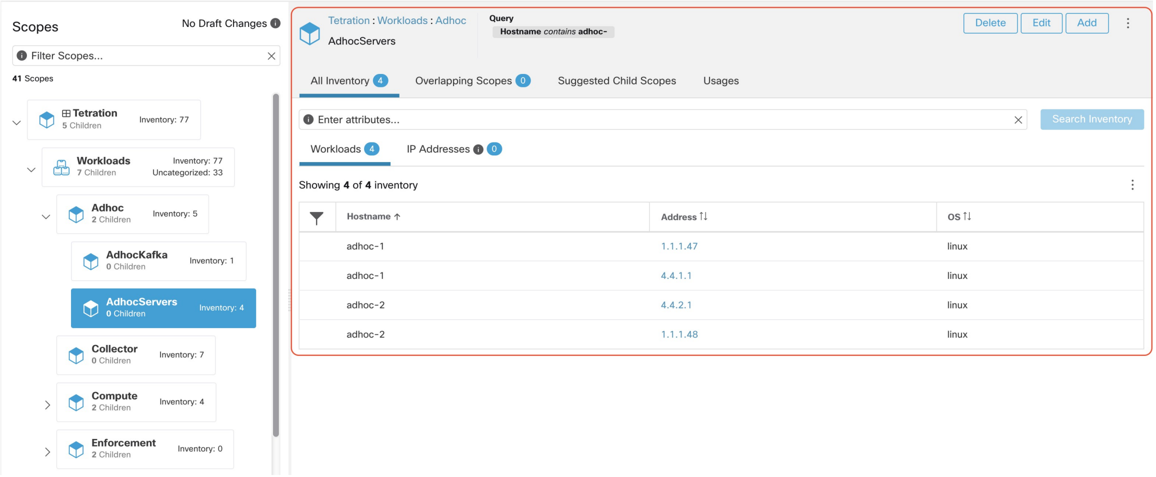

Scopes
No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
Enforcement 2 Children Inventory: 0
Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname contains adhoc-
Delete
Edit
Add
All Inventory 4
Overlapping Scopes 0
Suggested Child Scopes
Usages
Enter attributes...
Search Inventory
Workloads 4
IP Addresses 0

Showing **4** of **4** inventory

Hostname ↑	Address ↑↓	OS ↑↓
adhoc-1	1.1.1.47	linux
adhoc-1	4.4.1.1	linux
adhoc-2	4.4.2.1	linux
adhoc-2	1.1.1.48	linux

In the window, user can browse the inventory, *uncategorized inventory items*, i.e. those items that belong to the current selected scope and that do not belong to any of the current selected scope’s child scopes. Clicking on the **uncategorized inventory items** allows one to view this list.

Figure 193: Example of scope window

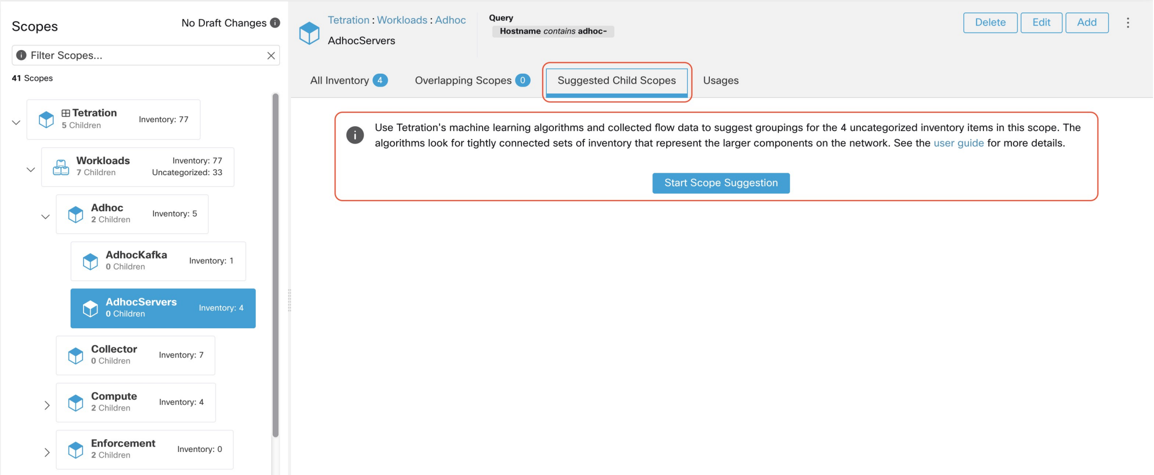

Scopes
No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
Enforcement 2 Children Inventory: 0
Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname contains adhoc-
Delete
Edit
Add
All Inventory 4
Overlapping Scopes 0
Suggested Child Scopes
Usages
Enter attributes...
Search Inventory
Workloads 4
IP Addresses 0

Showing **4** of **4** inventory

Hostname ↑	Address ↑↓	OS ↑↓
adhoc-1	1.1.1.47	linux
adhoc-1	4.4.1.1	linux
adhoc-2	4.4.2.1	linux
adhoc-2	1.1.1.48	linux

After selecting the scope user can click on **Suggest Child Scopes**, and click on **Start Scope Suggestion** (or click on Rerun, in case this is not the first time). Note that the input for a scope suggestion run will be the uncategorized inventory items.

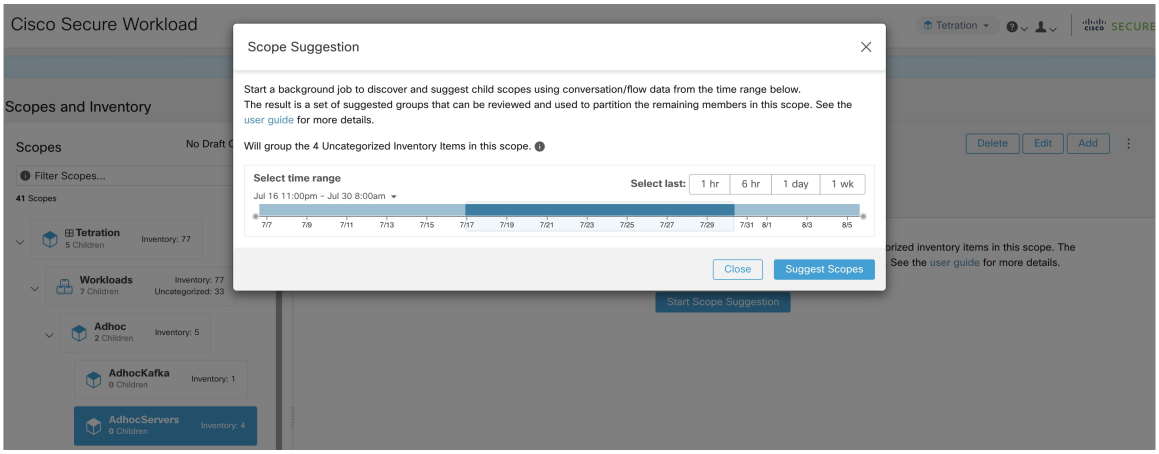
Figure 194: Suggest Child Scopes tab


Scopes
No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
Enforcement 2 Children Inventory: 0
Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname contains adhoc-
Delete
Edit
Add
All Inventory 4
Overlapping Scopes 0
Suggested Child Scopes
Usages
Start Scope Suggestion

Use Tetration's machine learning algorithms and collected flow data to suggest groupings for the 4 uncategorized inventory items in this scope. The algorithms look for tightly connected sets of inventory that represent the larger components on the network. See the user guide for more details.

User can set the date range as input for scope suggestion and click on **Suggest Scopes**. A scope suggestion run is often fast under medium overall load, and takes only a few minutes for processing ten to thousands of endpoints, with tens of thousands of conversations.

Figure 195: Example of scope suggestion data range selector



Start a background job to discover and suggest child scopes using conversation/flow data from the time range below. The result is a set of suggested groups that can be reviewed and used to partition the remaining members in this scope. See the user guide for more details.

Will group the 4 Uncategorized Inventory Items in this scope.

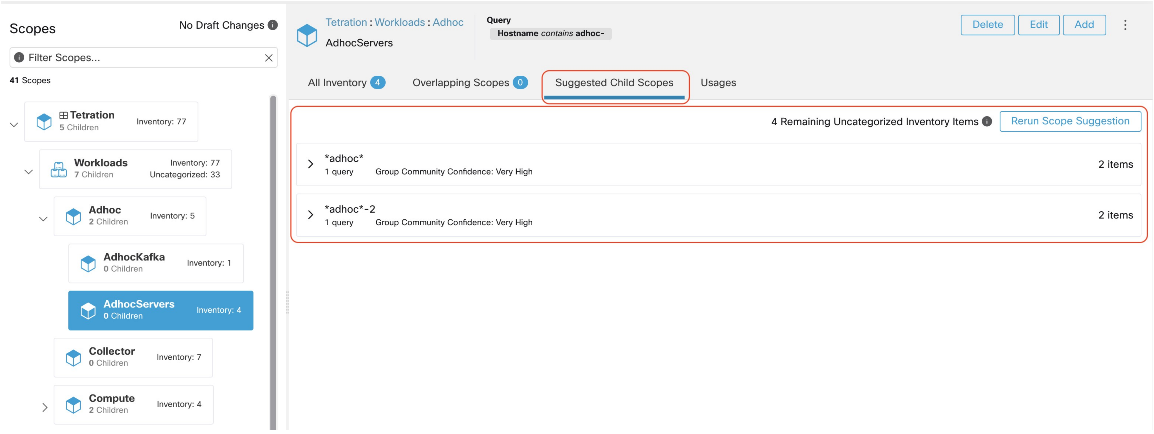
The output is shown to the user as a list of candidates, currently up to 20 groups (shown), each accompanied with information such as group confidence (quality), a candidate scope name, and queries. Each discovered group has an associated **Group Community Confidence**, the possible values being: **Very High**, **High**, **Medium** and **Low**. This is a measure of the **Community** property of the group: the higher the confidence, the higher the community property of the given group of endpoints (many edges inside the group, relatively few edges to outside). Currently, the subset of groups picked to be shown are selected based on the Group Community Confidence. The groups discovered can currently fall under one of these four group types:

- **Generic Group**: Any group discovered via machine learning based on the community property. Note that any group that is not explicitly designated with the special types below is a generic group.

- **Common Service**: This group consists of endpoints that communicate with much of the input inventory. These endpoints could be running some kind of shared service(s).

- **Common Service Clients**: This group consists of endpoints that only communicate with the **Common Service** group.
- **Ungrouped**: This group consists of endpoints that cannot be grouped since they don't have sufficient commu- nications.

Figure 196: Example of scope suggestion output

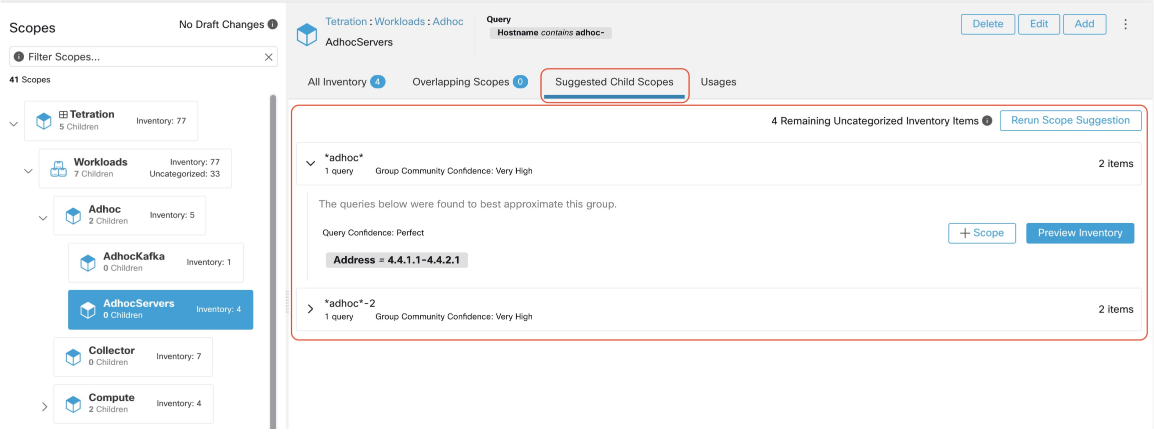


Scopes No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4

Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname *contains* adhoc-
Delete Edit Add
All Inventory 4 | Overlapping Scopes 0 | Suggested Child Scopes | Usages
4 Remaining Uncategorized Inventory Items Rerun Scope Suggestion
adhoc 1 query Group Community Confidence: Very High 2 items
adhoc-2 1 query Group Community Confidence: Very High 2 items

The user can click on a discovered group to view the list of queries generated for the selected group. The user can preview the inventory covered by the query which will closely define the discovered group. The queries consist of IP-ranges, subnets, host names and user uploaded labels. There is a confidence measure associated with each group called **Query confidence** which can have one of the following range of values **Perfect**, **Very High**, **High**, **Medium** and **Low**. For query generation, first the groups are discovered via graph processing and machine learning, then the queries are generated for each group. **Query Confidence** is a measure of how well the query can cover the endpoints. A query confidence of **Perfect** indicates that the query exactly covers the suggested (discovered) group. On the other end of the spectrum, a **Low** query confidence indicates that the query significantly misses out on exactly capturing the suggested group, which means that the query covers many **Extra IPs** (not part of the discovered group) and/or has many **Missing IPs** (not covered by the query).

Figure 197: Example of scope suggestion output queries



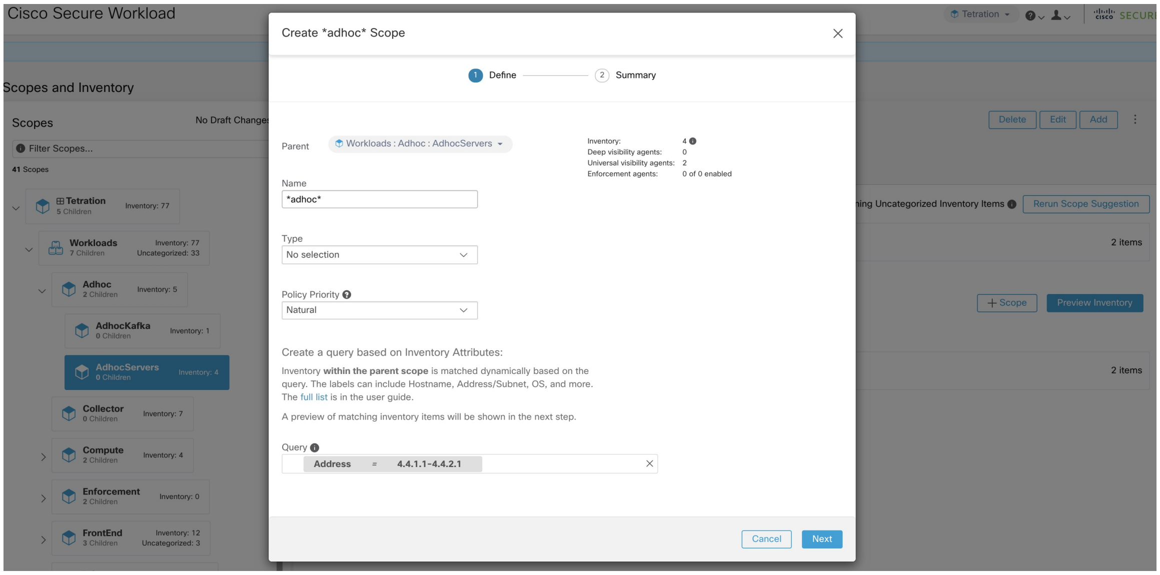
Scopes No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4

Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname *contains* adhoc-
Delete Edit Add
All Inventory 4 | Overlapping Scopes 0 | Suggested Child Scopes | Usages
4 Remaining Uncategorized Inventory Items Rerun Scope Suggestion
adhoc 1 query Group Community Confidence: Very High 2 items
The queries below were found to best approximate this group.
Query Confidence: Perfect
+ Scope Preview Inventory
Address = 4.4.1.1-4.4.2.1
adhoc-2 1 query Group Community Confidence: Very High 2 items

The user can click on **+ Scope** button which will take the user to an edit window where the user can edit the group name and group query. The user can examine a query, the IPs that it matches, and decide whether some

IPs need to be added or removed by adjusting the query. Once satisfied, the user can then click on **Next**, to review and convert the group to a scope on the draft view canvas.

Figure 198: Example of scope suggestion edit window


Cisco Secure Workload
Tetration
SECURE
Scopes and Inventory
Scopes
No Draft Changes
Filter Scopes...
41 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 0 Children Inventory: 4
Collector 0 Children Inventory: 7
Compute 2 Children Inventory: 4
Enforcement 2 Children Inventory: 0
FrontEnd 3 Children Inventory: 12 Uncategorized: 3
Delete
Edit
Add
Rerun Scope Suggestion
2 items
+ Scope
Preview Inventory
2 items
1 Define
2 Summary
Cancel
Next

Create *adhoc* Scope

Parent: Workloads : Adhoc : AdhocServers

Inventory: 4
Deep visibility agents: 0
Universal visibility agents: 2
Enforcement agents: 0 of 0 enabled

Name: *adhoc*

Type: No selection

Policy Priority: Natural

Create a query based on Inventory Attributes:

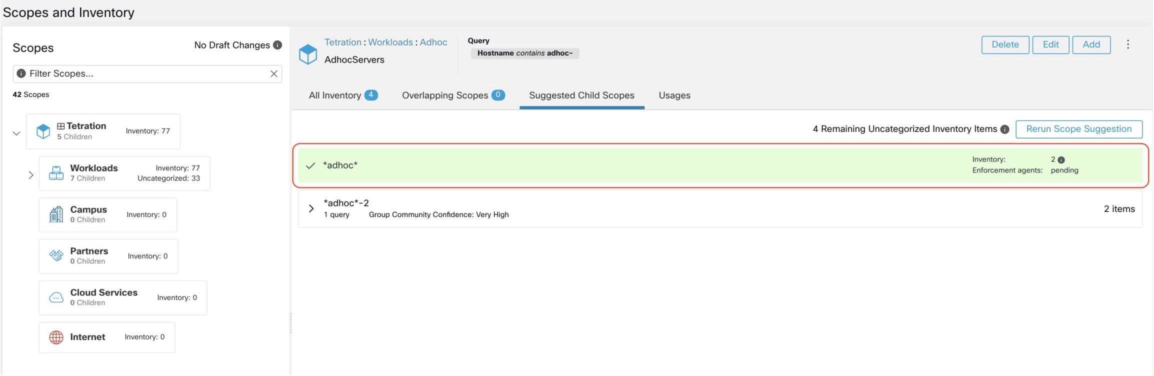
Inventory **within the parent scope** is matched dynamically based on the query. The labels can include Hostname, Address/Subnet, OS, and more. The full list is in the user guide.

A preview of matching inventory items will be shown in the next step.

Query: Address = 4.4.1.1-4.4.2.1

After the user has converted a suggested group to a scope, the group slot turns green and the **Uncategorized Inventory Items** count decreases.

Figure 199: Example of scope suggestion output after converting one suggested group to a scope


Scopes and Inventory
Scopes
No Draft Changes
Filter Scopes...
42 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Campus 0 Children Inventory: 0
Partners 0 Children Inventory: 0
Cloud Services 0 Children Inventory: 0
Internet Inventory: 0
Tetration : Workloads : Adhoc
AdhocServers
Delete
Edit
Add
All Inventory 4
Overlapping Scopes 0
Suggested Child Scopes
Usages
Rerun Scope Suggestion

Query: Hostname *contains* adhoc-

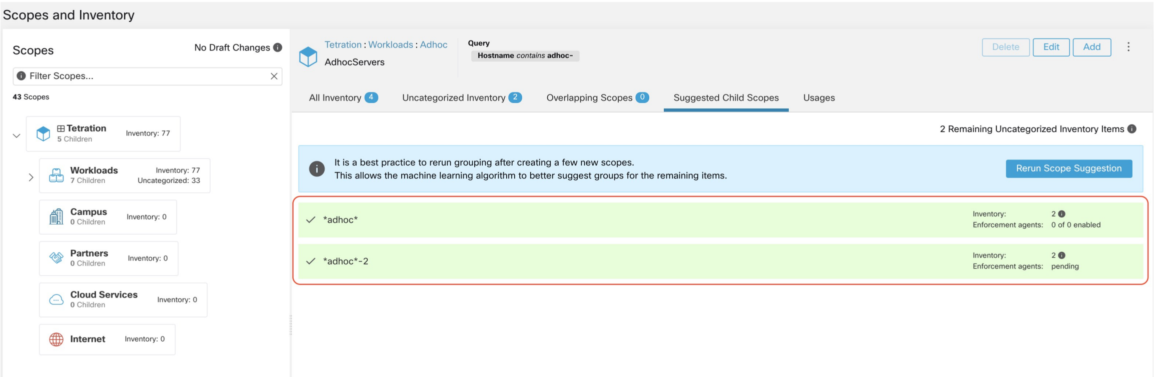
4 Remaining Uncategorized Inventory Items

✓ *adhoc* — Inventory: 2; Enforcement agents: pending

adhoc-2 — 1 query — Group Community Confidence: Very High — 2 items

The user can repeat the process of scope creation from the remaining list of groups. The recommended workflow is to create one or more scopes and then re-run **scope suggestion**. A zero count for **Uncategorized Inventory Items** indicates that there is no inventory left to be further scoped (for the currently selected parent scope).

Figure 200: Example of scope suggestion output after multiple scope creations

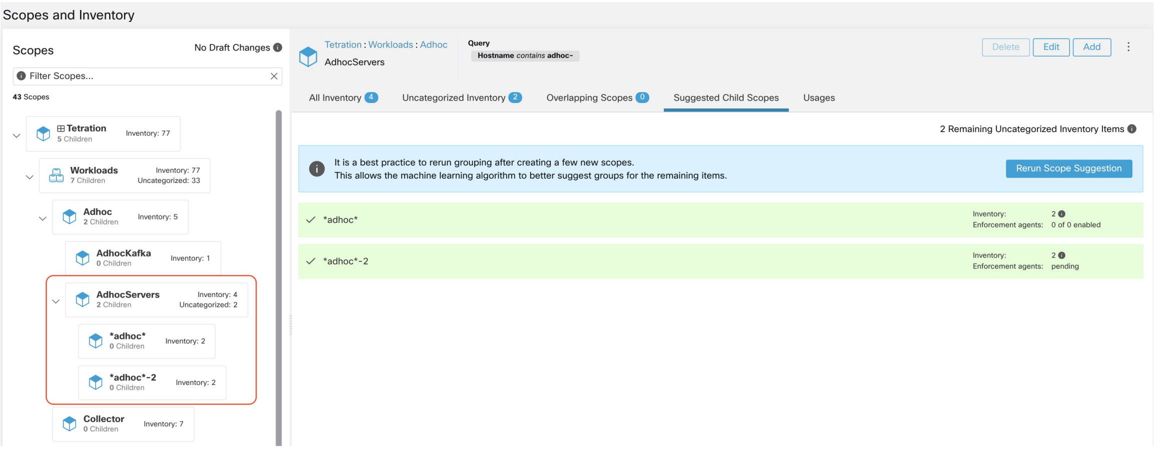


It is a best practice to rerun grouping after creating a few new scopes.
This allows the machine learning algorithm to better suggest groups for the remaining items.

Scopes and Inventory
Scopes
No Draft Changes
Filter Scopes...
43 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Campus 0 Children Inventory: 0
Partners 0 Children Inventory: 0
Cloud Services 0 Children Inventory: 0
Internet Inventory: 0
Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname contains adhoc-
Delete
Edit
Add
All Inventory 4
Uncategorized Inventory 2
Overlapping Scopes 0
Suggested Child Scopes
Usages
2 Remaining Uncategorized Inventory Items
Rerun Scope Suggestion
adhoc Inventory: 2 Enforcement agents: 0 of 0 enabled
adhoc-2 Inventory: 2 Enforcement agents: pending

After the scope creation process is done (the uncategorized count is 0), user can repeat this process on the newly created child scopes in order to generate a deeper scope tree as desired.

Figure 201: Example of the scopes list after the initial scope suggestion and creation



It is a best practice to rerun grouping after creating a few new scopes.
This allows the machine learning algorithm to better suggest groups for the remaining items.

Scopes and Inventory
Scopes
No Draft Changes
Filter Scopes...
43 Scopes
Tetration 5 Children Inventory: 77
Workloads 7 Children Inventory: 77 Uncategorized: 33
Adhoc 2 Children Inventory: 5
AdhocKafka 0 Children Inventory: 1
AdhocServers 2 Children Inventory: 4 Uncategorized: 2
adhoc 0 Children Inventory: 2
adhoc-2 0 Children Inventory: 2
Collector 0 Children Inventory: 7
Tetration : Workloads : Adhoc
AdhocServers
Query
Hostname contains adhoc-
Delete
Edit
Add
All Inventory 4
Uncategorized Inventory 2
Overlapping Scopes 0
Suggested Child Scopes
Usages
2 Remaining Uncategorized Inventory Items
Rerun Scope Suggestion
adhoc Inventory: 2 Enforcement agents: 0 of 0 enabled
adhoc-2 Inventory: 2 Enforcement agents: pending

Note There is also a possibility that the uncategorized items in a scope do not partition well (e.g., do not form communities). In that case, the algorithm may return no groupings (an empty result).

Filters

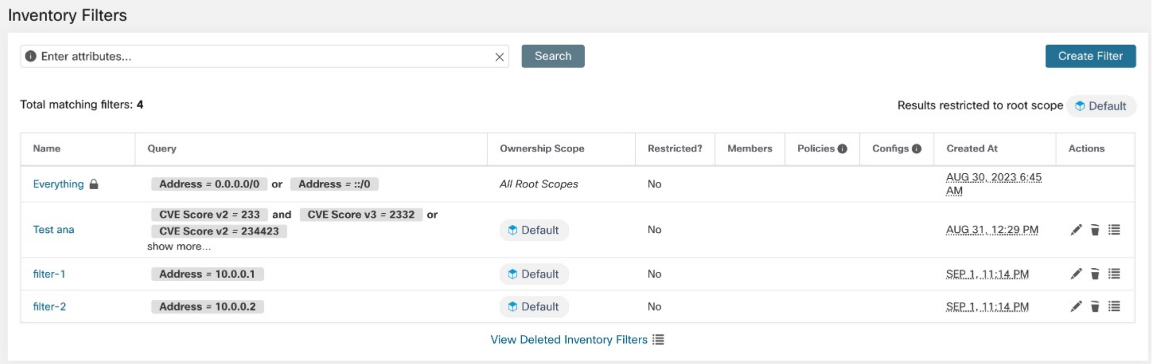
Filters are saved inventory searches that can be used when defining policies, config intents, and so on. Each filter must be associated with a scope, which is defined as the filter's ownership scope.

To view existing filters, select **Organize** > **Inventory Filters** from the left navigation menu. You can also view inventory filters specific to any scope in any workspace for that scope.

The list of filters are restricted based on the root of the currently selected scope.

The filters also display he number of members, number of policies it is involved in, the sum of draft analysed and enforced policies.

Figure 202: Inventory filters



Inventory Filters

Total matching filters: **4**

Results restricted to root scope Default

Name	Query	Ownership Scope	Restricted?	Members	Policies	Configs	Created At	Actions
Everything	Address = 0.0.0.0/0 or Address = ::/0	*All Root Scopes*	No				AUG 30, 2023 6:45 AM	
Test ana	CVE Score v2 = 233 and CVE Score v3 = 2332 or CVE Score v2 = 234423 show more...	Default	No				AUG 31, 12:29 PM	
filter-1	Address = 10.0.0.1	Default	No				SEP 1, 11:14 PM	
filter-2	Address = 10.0.0.2	Default	No				SEP 1, 11:14 PM	

You can review inventory membership changes with respect to the selected parent scope by visiting the Review Scope/Filter Change Impact window.

Create an Inventory Filter

You can create inventory filters for many purposes. For example, you can use inventory filters to :

- Create or discover policies specific to subsets of workloads within a scope.

  For example, if you have an application that is accessed only via API interface, you might want to create a group of API servers within the scope so you can create policies that allow that traffic but block access to all other workloads for that application.

- Create policies for workloads that might exist across many scopes.

  For example, if you need to create a policy that applies to all workloads on your network that are running a particular operating system, you could create an inventory filter that spans multiple (or all) scopes.

Tip To convert an existing cluster to an inventory filter, see Convert a Cluster to an Inventory Filter, on page 489.

Procedure

Step 1 Navigate to one of the following locations:

- Choose **Organize** > **Inventory Filters**.
- Navigate to any workspace in a scope for which you want to create an inventory filter, then click **Manage Policies**, then click **Filters**, then click **Inventory Filters**.

Step 2 Click **Create Filter** or **Add Inventory Filter**.

Step 3 Add a name, description, and query that includes all of, and only, the workloads that you want to include in the filter.

Step 4 If you see **Show advanced options**, click this link.

Step 5 Specify the scope for this filter.

The selected scope determines:

- Who can modify this filter:

  To modify this filter, an administrator must have write access to the specified scope or any of its ancestors.

- (Depending on other settings in this procedure) The workloads included in the filter.

Step 6 Configure options:

To	Do This
Include workloads that meet the filter query criteria, whether or not they are members of the scope specified in this filter.	Deselect **Restrict query to ownership scope**
Include only workloads that are members of the scope specified in this filter.	Select **Restrict query to ownership scope**.
Allow automatic policy discovery to suggest policies specific to the set of workloads defined by this filter. These workloads must be a subset of the scope specified in the filter.	Select both **Restrict query to ownership scope** AND **Provides a service external of its scope**. You must select the former in order to select the latter. In order to use this filter, you must configure external dependencies. See Fine-Tune External Dependencies for a Workspace, on page 445.

Step 7 Click **Next**.

Step 8 Review the details and click **Create**.

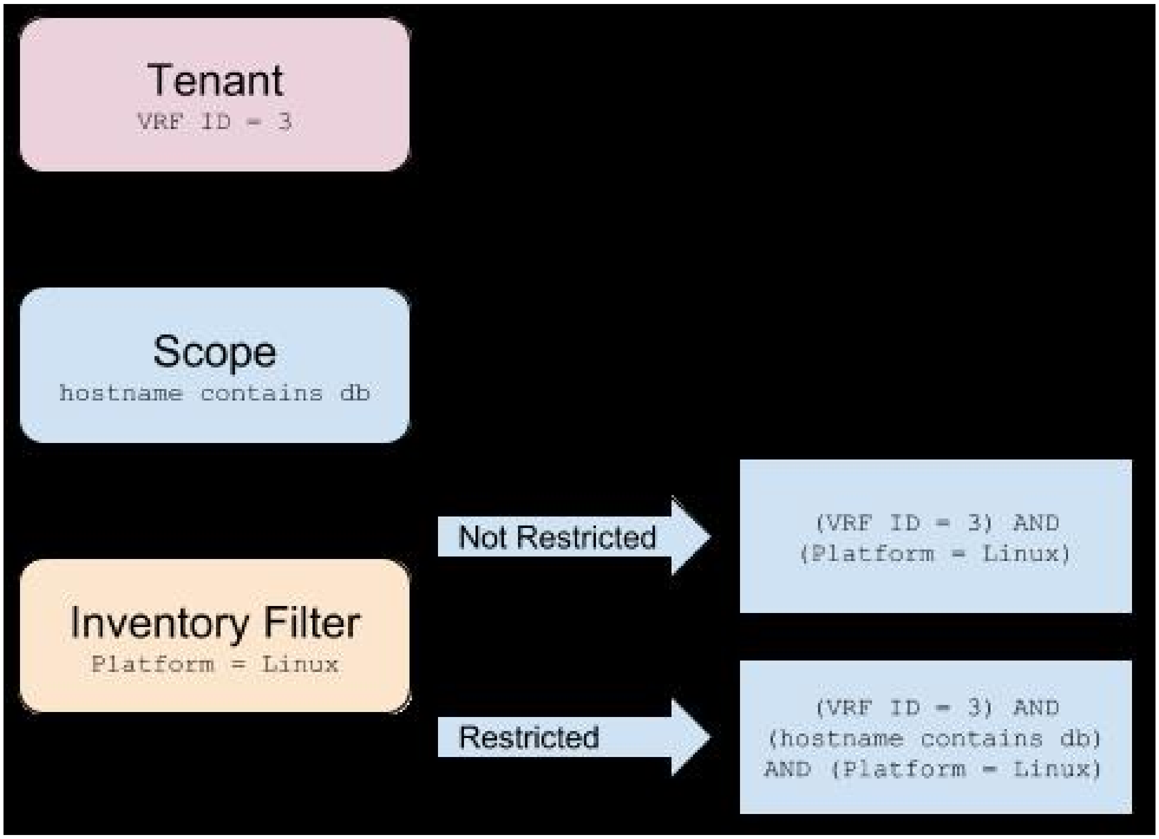
Restrict to Ownership Scope

Whether or not the scope impacts the inventory matched by a filter is determined by the **Restrict to Ownership Scope?** checkbox.

For example, given the following structure:

1. Tenant with query `VRF ID = 3`
2. Scope within this tenant with query `hostname contains db`
3. Inventory filter with query `Platform = Linux` attached to this scope.

Figure 203: Tenant, Scope and Inventory Filter Structure

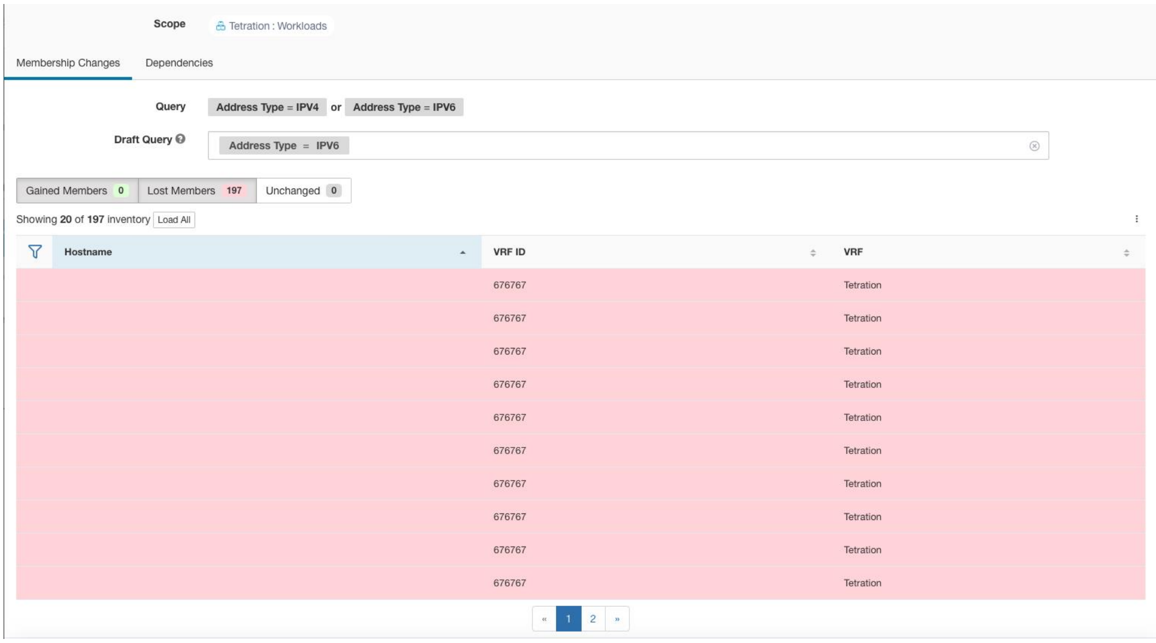


- When **Restrict to Ownership Scope** is not checked: The filter matches all hosts within the tenant that also match the filter. The effective query would be: `(VRF ID = 3) AND (Platform = Linux)`.
- When **Restrict to Ownership Scope** is checked: The filter only matches hosts within the tenant and the scope that also match the filter. The effective query would be: `(VRF ID = 3) AND (hostname contains db) AND (Platform = Linux)`.

Review Scope/Filter Change Impact

Updating a scope query can impact the scope's inventory membership after it gets committed. Likewise filter query change, which gets saved directly, can also impact the scope inventory memberships. You can identify membership changes between the new and old queries by following the **Review query change impact** link on either Scope or Filter Edit modals. In addition, knowing the scope or filter dependencies can be helpful for impact analysis and removing all necessary objects preventing Scope deletion. Visit the **Dependencies** tab as well, to traverse the Scope Dependencies tree for further information.

Figure 204: Download Membership Table



Scope: Tetration : Workloads

Query: Address Type = IPV4 or Address Type = IPV6

Draft Query: Address Type = IPV6

Showing 20 of 197 inventory Load All

Hostname	VRF ID	VRF
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration
	676767	Tetration

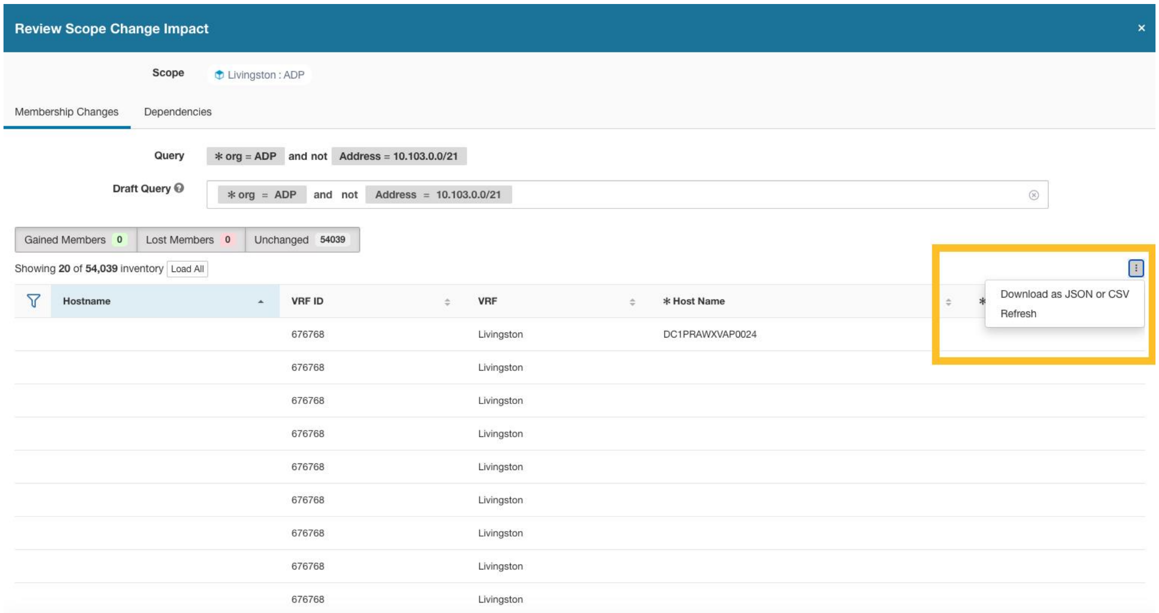
Scope Query Change Impact Modal

Both **Membership Changes** and **Dependencies** tab can be accessed by following the link to **Review query change impact** on Scope Edit window.

Membership Changes

The inventory table under Membership view displays all columns by default. You can choose the columns to display. Furthermore, you can download the csv or json of chosen Membership columns and rows with an additional Diff column identifying whether the inventory is **Gained**, **Lost** or **Unchanged**. Be sure that all table selection desired for download is visible to the table view.

Figure 205: Scope Membership Changes



Review Scope Change Impact ×

Scope Livingston : ADP

Membership Changes Dependencies

Query ∗ org = ADP and not Address = 10.103.0.0/21

Draft Query ∗ org = ADP and not Address = 10.103.0.0/21

Gained Members 0 | Lost Members 0 | Unchanged 54039

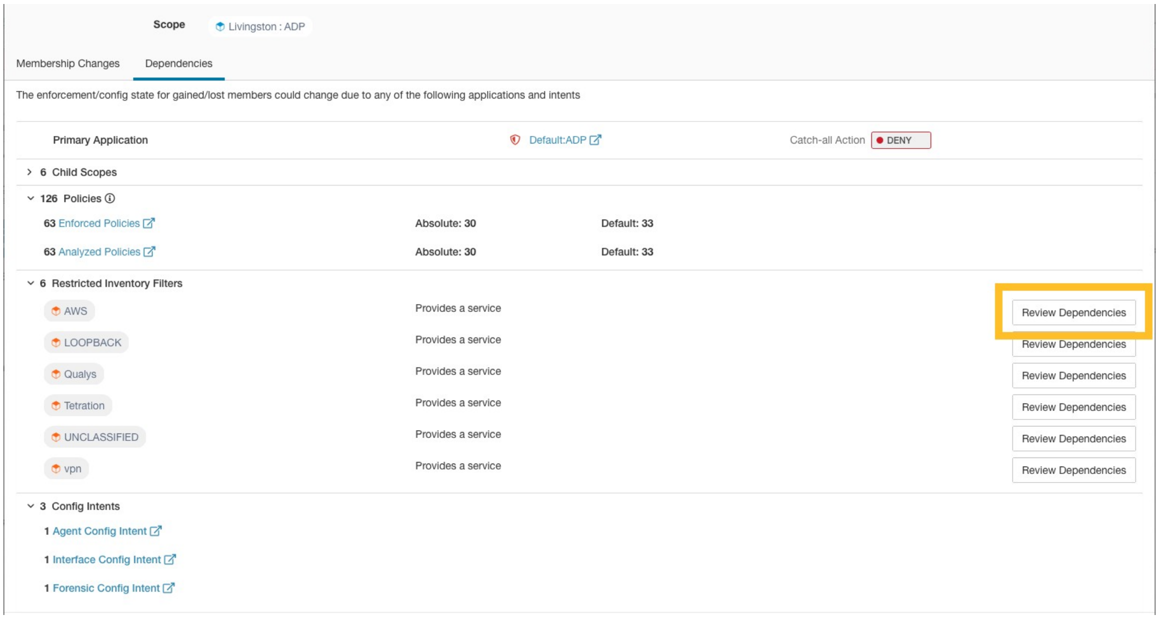
Showing 20 of 54,039 inventory Load All

Hostname	VRF ID	VRF	∗ Host Name
	676768	Livingston	DC1PRAWXVAP0024
	676768	Livingston	
	676768	Livingston	
	676768	Livingston	
	676768	Livingston	
	676768	Livingston	
	676768	Livingston	
	676768	Livingston	
	676768	Livingston	

Dependencies

You can traverse down to nested dependencies by further selecting **Review Dependencies**

Figure 206: Review Dependencies



Scope Livingston : ADP

Membership Changes Dependencies

The enforcement/config state for gained/lost members could change due to any of the following applications and intents

Primary Application Default:ADP Catch-all Action ● DENY

6 Child Scopes

126 Policies

63 Enforced Policies	Absolute: 30	Default: 33
63 Analyzed Policies	Absolute: 30	Default: 33

6 Restricted Inventory Filters

AWS	Provides a service	Review Dependencies
LOOPBACK	Provides a service	Review Dependencies
Qualys	Provides a service	Review Dependencies
Tetration	Provides a service	Review Dependencies
UNCLASSIFIED	Provides a service	Review Dependencies
vpn	Provides a service	Review Dependencies

3 Config Intents

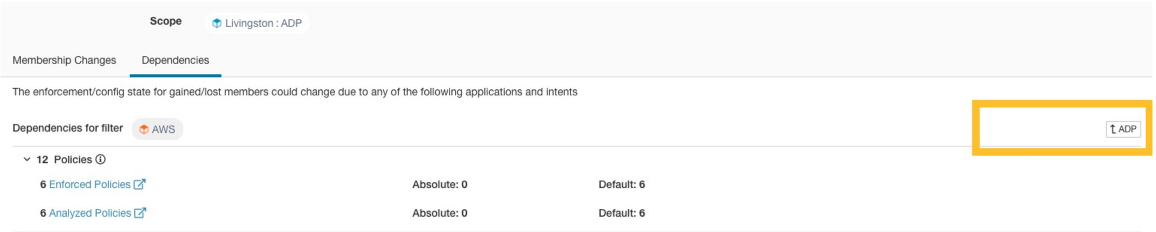
1 Agent Config Intent

1 Interface Config Intent

1 Forensic Config Intent

You can traverse back up the dependencies tree by selecting the selected Parent link:

Figure 207: Parent Link



Scope Livingston : ADP

The enforcement/config state for gained/lost members could change due to any of the following applications and intents

Dependencies for filter AWS

12 Policies ⓘ

6 Enforced Policies	Absolute: 0	Default: 6
6 Analyzed Policies	Absolute: 0	Default: 6

The following are Scope Dependencies which may exist:

Table 20: The following are Scope Dependencies which may exist

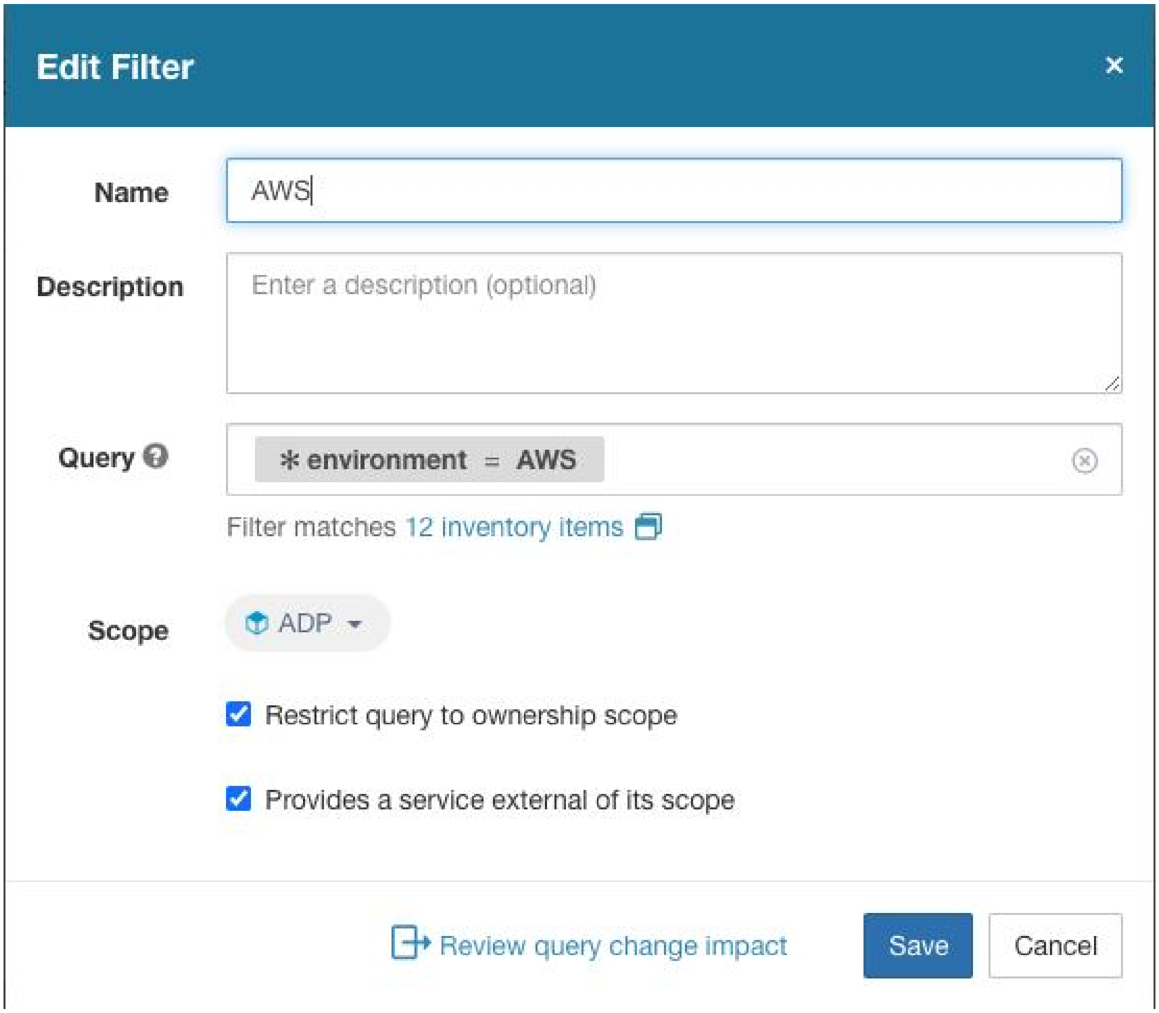
Type	Description
Application	Has primary and secondary application names and links to the specific workspaces under Segmentation.
Child Scopes	Has names and links to child Scope Detail views. Allows drill down to lower level Dependencies.
Policies	Has analyzed and enforced policies counts and links to respective Global Policy Views filtered by selected scope.
Restricted Inventory Filters	Has names and links to child Filter Detail views. Allows drill down to lower level Dependencies.
Config Intents	Has names and links to Agent, Interface and Forensics Config Intents views.

Filter Query Change Impact Modal

Both **Membership Changes** and **Dependencies** tab can be accessed by following the link to **Review query change impact** on Inventory Filter Edit window.

Membership Changes

Figure 208: Inventory Filter Membership Changes



Edit Filter

Name: AWS

Description: Enter a description (optional)

Query: ✻ environment = AWS

Filter matches 12 inventory items

Scope: ADP

☑ Restrict query to ownership scope

☑ Provides a service external of its scope

Dependencies

The following are Filter Dependencies which may exist:

Type	Description
Policies	Has analyzed and enforced policies counts and links to respective Global Policy Views filtered by selected scope
Config Intents	Has names and links to Agent, Interface and Forensics Config Intents views

Inventory Profile

Note An inventory profile page is linked from various places. One of the ways to see an inventory profile is to perform a search for inventory, then click an IP address to go to its profile. If you are working in the Scopes and Inventory page, click an IP address in the IP addresses tab, not an IP address in the Workloads tab. (Clicking an IP address in the Workloads tab displays the Workload Profile, not the Inventory Profile.)

The following information is available for the inventory:

Field	Description
Scopes	List of scopes that the inventory belongs to.
Inventory Type	• **Flow Learnt** inventory was registered based on the observed flows. • **Labeled** inventory was manually uploaded using the inventory upload utility. • **Agent** inventory was reported by the software agent installed on a host. • **Tagged** inventory was either reported by connectors or external orchestrators.
User Labels	The list of user uploaded attributes for this inventory. See Workload Labels for more details.

Additional information is available only if both of the following are true:

1. Inventory has been ingested through a cloud connector.
2. Segmentation is enabled for the virtual network in which the inventory resides.

Field	Description
Enforcement Health	The status information of the host software agent. See Agent Health Tab for more details.
Concrete Policies	This tab shows Secure Workload concrete enforcement policies applied on the host. See Concrete Policies Tab for more details.
Security Groups	The list of security groups and their policies applied to this inventory.

Inventory Profile Information

Field	Description
Experimental Groups	A list of cluster or user-defined inventory filters that are used for policy live analysis.
Enforcement Groups	A list of cluster or user-defined inventory filters that are used for policy enforcement. They can be different from experimental groups depending on the versions of policies being analyzed and/or enforced in the system.

Note The inventory profile details may not be available for an IP address when:

- The inventory is excluded from collection rules.
- In a unidirectional flow, the inventory is available only for two minutes, and then it is removed.
- In a bidirectional flow, the inventory is available for 30 days. If no more flows are observed during these 30 days then the inventory details are removed.

Workload Profile

Workload profile displays detailed information about a host where Secure Workload software agent is installed. This section explains how to view a workload profile and the information it contains.

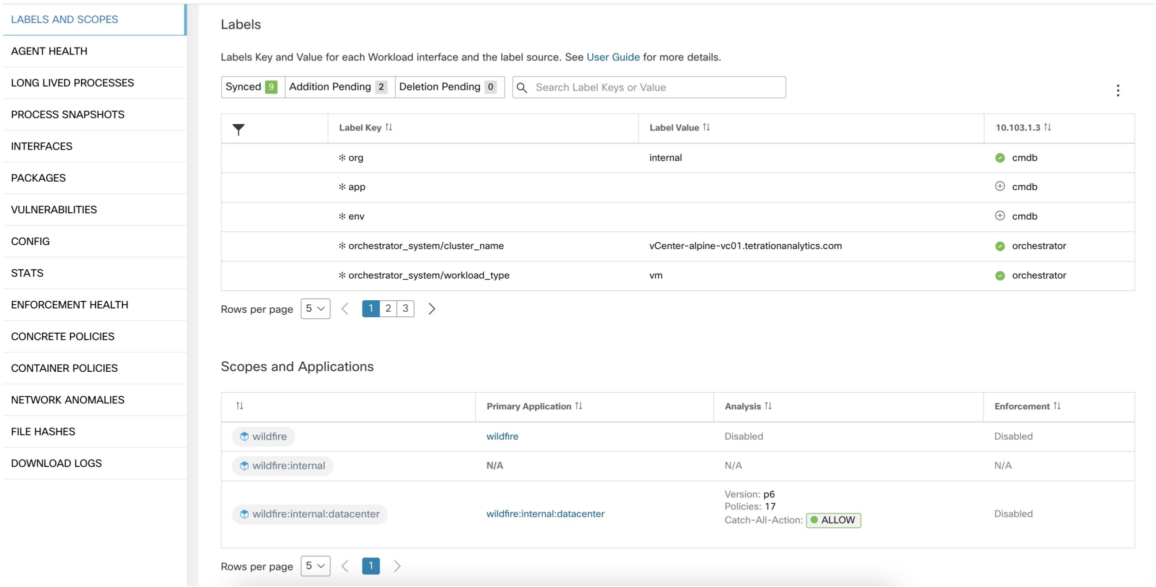
Note A workload profile page is linked from various places. One of the ways to see a workload profile is to perform a search for host as described in search

From the results of inventory search, click on IP address of the host to go to it’s profile. Based on the type of agent installed on the host, the following tabs are available on the page. Note that you may end up on inventory profile page if Secure Workload software agent is not installed on the host that this inventory belongs to.

Labels and Scopes Tab

This tab includes the enforcement and experimental groups, scopes that the host belongs to. The experimental groups are inventory filters that are used for policy live analysis, while the enforcement groups are the filters that are used for policy enforcement. They can be different depending on the versions of policies being analyzed and/or enforced in the system.

Figure 209: Workload Labels and Scopes



Labels

Labels Key and Value for each Workload interface and the label source. See User Guide for more details.

	Label Key	Label Value	10.103.1.3
	✻ org	internal	✓ cmdb
	✻ app		⊕ cmdb
	✻ env		⊕ cmdb
	✻ orchestrator_system/cluster_name	vCenter-alpine-vc01.tetrationanalytics.com	✓ orchestrator
	✻ orchestrator_system/workload_type	vm	✓ orchestrator

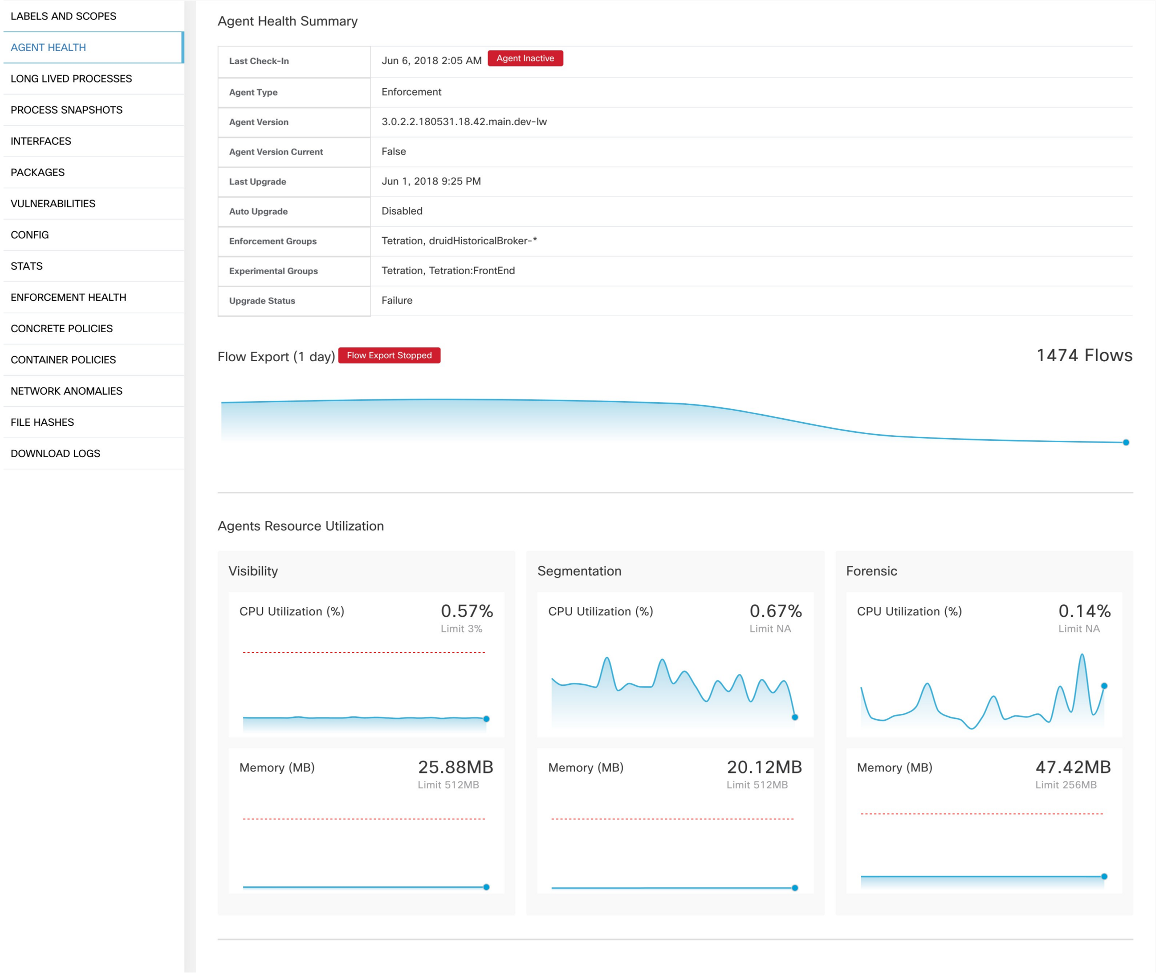
Scopes and Applications

	Primary Application	Analysis	Enforcement
wildfire	wildfire	Disabled	Disabled
wildfire:internal	N/A	N/A	N/A
wildfire:internal:datacenter	wildfire:internal:datacenter	Version: p6 Policies: 17 Catch-All-Action: ● ALLOW	Disabled

Agent Health Tab

The status information of the host software agent such as it’s type, OS platform, agent version and last check-in time are also shown in the **Agent Health** tab. See Software Agent Config for more details. This tab also shows detailed time series data for traffic bytes and packets occurred per one day.

Figure 210: Workload Agent Health Details



Agent Health Summary

Last Check-In	Jun 6, 2018 2:05 AM Agent Inactive
Agent Type	Enforcement
Agent Version	3.0.2.2.180531.18.42.main.dev-lw
Agent Version Current	False
Last Upgrade	Jun 1, 2018 9:25 PM
Auto Upgrade	Disabled
Enforcement Groups	Tetration, druidHistoricalBroker-*
Experimental Groups	Tetration, Tetration:FrontEnd
Upgrade Status	Failure

Flow Export (1 day) Flow Export Stopped

1474 Flows

Agents Resource Utilization

Visibility

CPU Utilization (%) 0.57% Limit 3%

Memory (MB) 25.88MB Limit 512MB

Segmentation

CPU Utilization (%) 0.67% Limit NA

Memory (MB) 20.12MB Limit 512MB

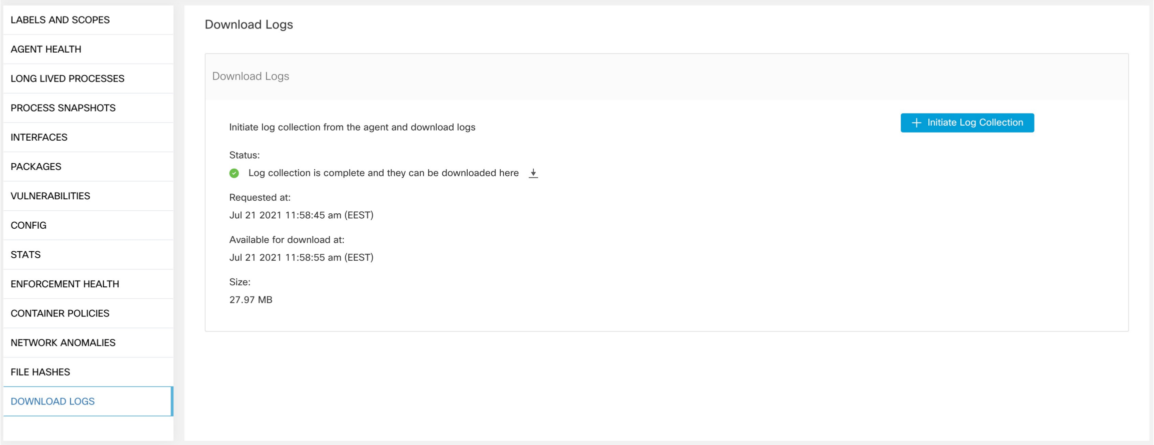
Forensic

CPU Utilization (%) 0.14% Limit NA

Memory (MB) 47.42MB Limit 256MB

For users with root scope owner privileges, summary page also includes a section to collect and download agent logs for deep visibility and enforcement agents (versions 3.3 or later) within that root scope. Also note that this feature is not available for agents running on platforms AIX and SUSE Linux Enterprise Server (s390x-Linux on IBM Z architectures). Use "Initiate Log Collection" button to collect logs from the agent and then logs are available for download in a few minutes. If the download fails, retry collection of logs, and then attempt download again.

Figure 211: Agent Logs



Download Logs

Download Logs

Initiate log collection from the agent and download logs

Status:
Log collection is complete and they can be downloaded here

Requested at:
Jul 21 2021 11:58:45 am (EEST)

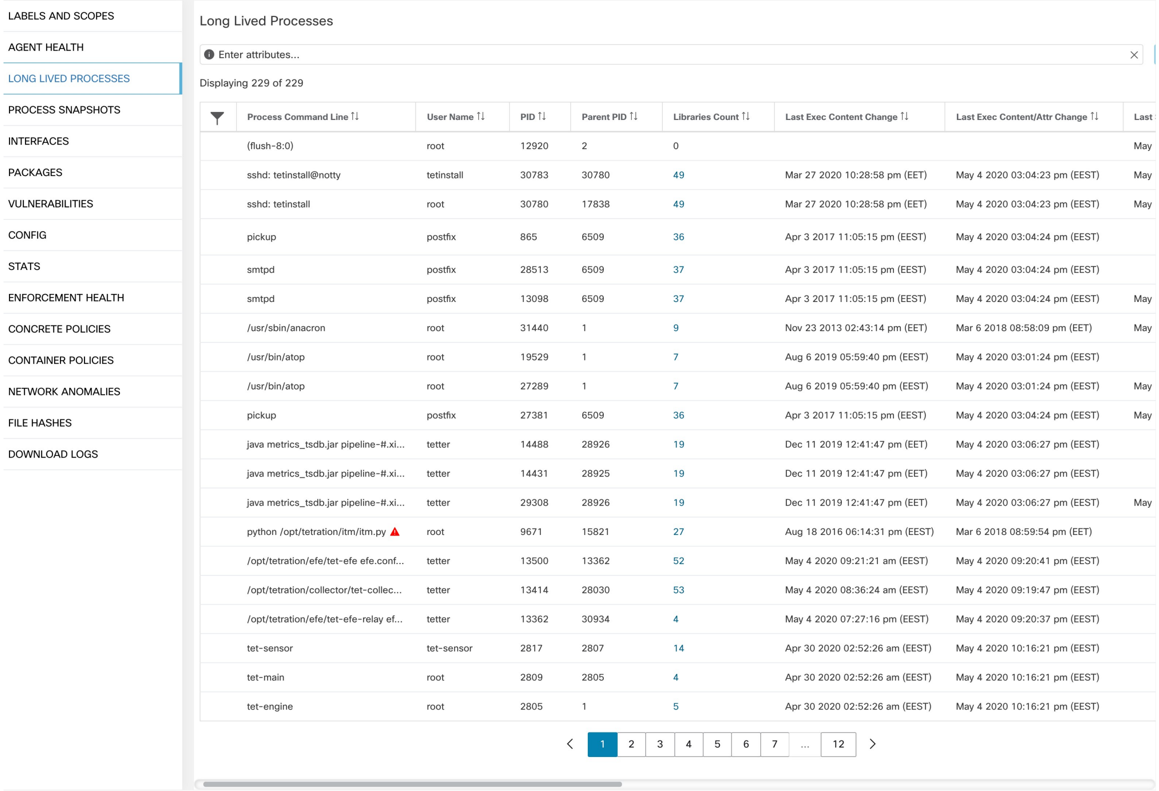
Available for download at:
Jul 21 2021 11:58:55 am (EEST)

Size:
27.97 MB

Process List Tab

This tab shows list of processes running on the host. A filter is also available to narrow down the list of processes based on the attributes of a process shown in table header below.

Figure 212: Workload Process List



Long Lived Processes

Displaying 229 of 229

	Process Command Line ↑↓	User Name ↑↓	PID ↑↓	Parent PID ↑↓	Libraries Count ↑↓	Last Exec Content Change ↑↓	Last Exec Content/Attr Change ↑↓	Last
	(flush-8:0)	root	12920	2	0			May
	sshd: tetinstall@notty	tetinstall	30783	30780	49	Mar 27 2020 10:28:58 pm (EET)	May 4 2020 03:04:23 pm (EEST)	May
	sshd: tetinstall	root	30780	17838	49	Mar 27 2020 10:28:58 pm (EET)	May 4 2020 03:04:23 pm (EEST)	May
	pickup	postfix	865	6509	36	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	
	smtpd	postfix	28513	6509	37	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	
	smtpd	postfix	13098	6509	37	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	May
	/usr/sbin/anacron	root	31440	1	9	Nov 23 2013 02:43:14 pm (EET)	Mar 6 2018 08:58:09 pm (EET)	May
	/usr/bin/atop	root	19529	1	7	Aug 6 2019 05:59:40 pm (EEST)	May 4 2020 03:01:24 pm (EEST)	
	/usr/bin/atop	root	27289	1	7	Aug 6 2019 05:59:40 pm (EEST)	May 4 2020 03:01:24 pm (EEST)	May
	pickup	postfix	27381	6509	36	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	May
	java metrics_tsdb.jar pipeline-#.xi...	tetter	14488	28926	19	Dec 11 2019 12:41:47 pm (EET)	May 4 2020 03:06:27 pm (EEST)	
	java metrics_tsdb.jar pipeline-#.xi...	tetter	14431	28925	19	Dec 11 2019 12:41:47 pm (EET)	May 4 2020 03:06:27 pm (EEST)	
	java metrics_tsdb.jar pipeline-#.xi...	tetter	29308	28926	19	Dec 11 2019 12:41:47 pm (EET)	May 4 2020 03:06:27 pm (EEST)	May
	python /opt/tetration/itm/itm.py ⚠	root	9671	15821	27	Aug 18 2016 06:14:31 pm (EEST)	Mar 6 2018 08:59:54 pm (EET)	
	/opt/tetration/efe/tet-efe efe.conf...	tetter	13500	13362	52	May 4 2020 09:21:21 am (EEST)	May 4 2020 09:20:41 pm (EEST)	
	/opt/tetration/collector/tet-collec...	tetter	13414	28030	53	May 4 2020 08:36:24 am (EEST)	May 4 2020 09:19:47 pm (EEST)	
	/opt/tetration/efe/tet-efe-relay ef...	tetter	13362	30934	4	May 4 2020 07:27:16 pm (EEST)	May 4 2020 09:20:37 pm (EEST)	
	tet-sensor	tet-sensor	2817	2807	14	Apr 30 2020 02:52:26 am (EEST)	May 4 2020 10:16:21 pm (EEST)	
	tet-main	root	2809	2805	4	Apr 30 2020 02:52:26 am (EEST)	May 4 2020 10:16:21 pm (EEST)	
	tet-engine	root	2805	1	5	Apr 30 2020 02:52:26 am (EEST)	May 4 2020 10:16:21 pm (EEST)	

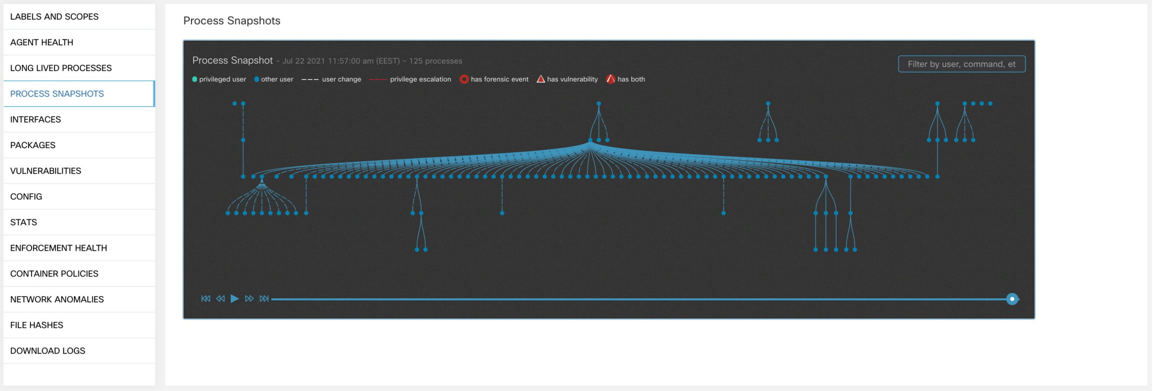
Attribute Descriptions:

Attribute	Description
Last Exec Content Change	Similar to mtime in linux. It is the timestamp when only the file content changes.
Last Exec Content Change	Similar to ctime in linux. It is the timestamp when either the file content or attribute changes.
Last Seen	Last time when the process is observed. Available when the process is dead.
CPU Usage	CPU usage trend by the process in the past hour.
Memory Usage	Memory usage trend by the process in the past hour.
Process Binary Hash	SHA256 hash of the process binary in hex string, also known as process hash for short. Not available for kernel processes.
Anomaly Score	Process hash (anomaly) score. See Process Hash Anomaly Detection for more information.
Verdict	Verdict of the process hash (either Malicious or Benign). The verdict is determined based on whether the process hash belongs to any user-defined hash list or known threat-intelligence hash database. See Process Hash Anomaly Detection for more information.
Verdict Source	Source of the verdict. The verdict source can be either User Defined, or Secure Workload Cloud, or NIST. This attribute is known as Hash DB Source in previous releases. See Process Hash Anomaly Detection for more information.

Process Snapshot Tab

This tab shows searchable process tree observed on the workload.

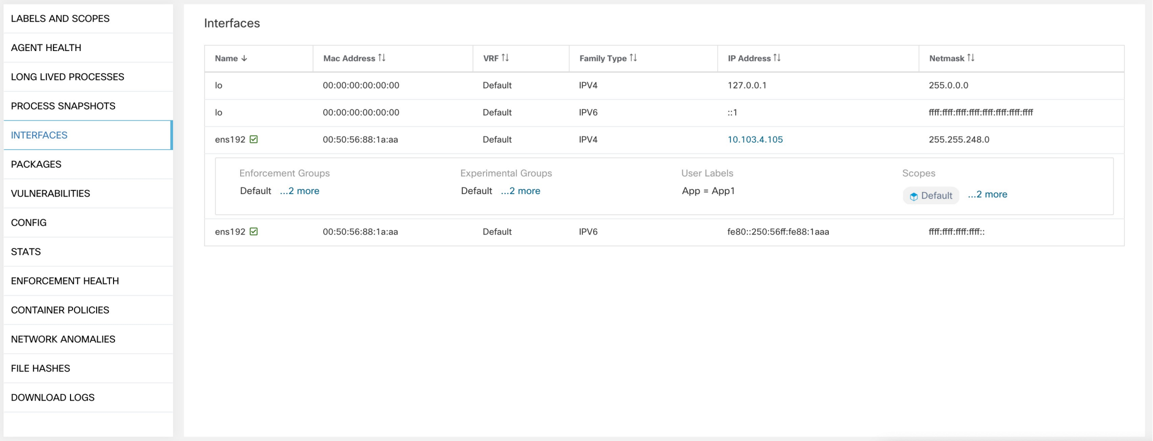
Figure 213: Workload Process Snapshot



Interfaces Tab

This tab shows details about the network interfaces installed on the host. It's available for all types of software agents.

Figure 214: Workload Interface List



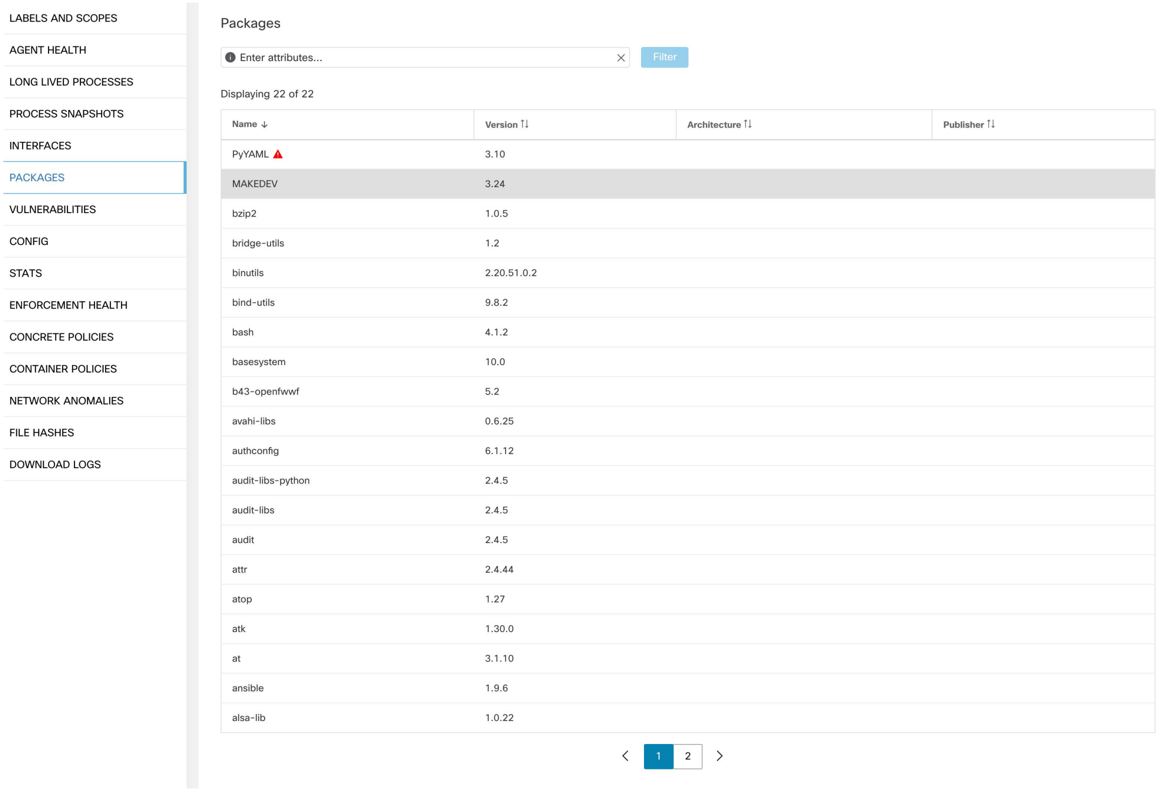
Interfaces

Name ↓	Mac Address ⇅	VRF ⇅	Family Type ⇅	IP Address ⇅	Netmask ⇅
lo	00:00:00:00:00:00	Default	IPV4	127.0.0.1	255.0.0.0
lo	00:00:00:00:00:00	Default	IPV6	::1	ffff:ffff:ffff:ffff:ffff:ffff:ffff:ffff
ens192 ☑	00:50:56:88:1a:aa	Default	IPV4	10.103.4.105	255.255.248.0
Enforcement Groups Default ...2 more	Experimental Groups Default ...2 more		User Labels App = App1	Scopes Default ...2 more	
ens192 ☑	00:50:56:88:1a:aa	Default	IPV6	fe80::250:56ff:fe88:1aaa	ffff:ffff:ffff:ffff::

Software Packages Tab

This tab shows the list of packages installed on the host. You can selectively view software packages based on package attributes in the table header.

Figure 215: Software Packages List



Packages

Enter attributes...

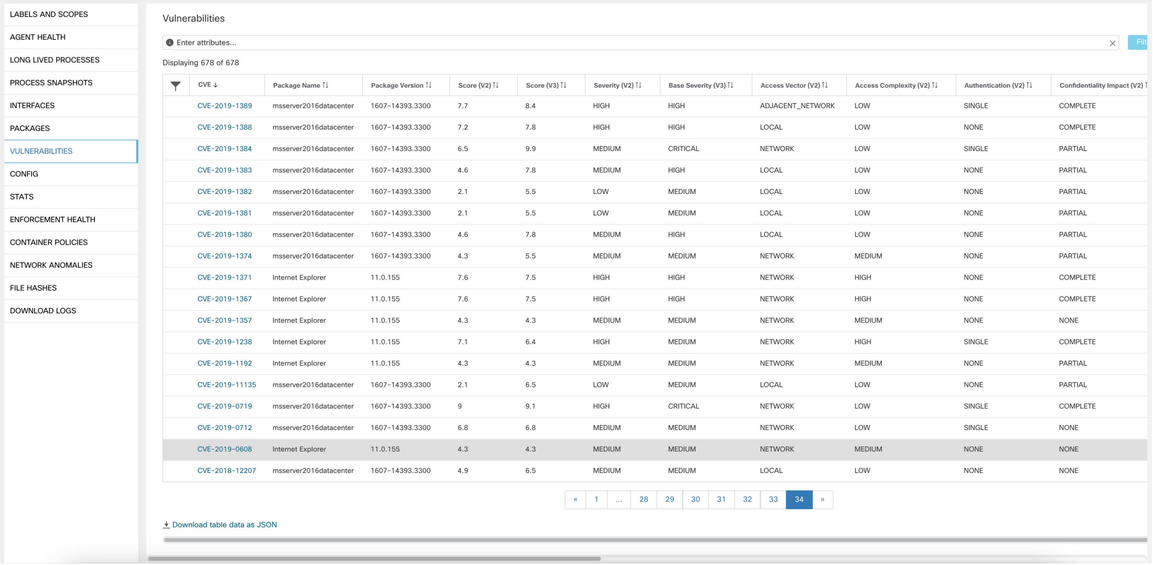
Displaying 22 of 22

Name ↓	Version ⇅	Architecture ⇅	Publisher ⇅
PyYAML ⚠	3.10		
MAKEDEV	3.24		
bzip2	1.0.5		
bridge-utils	1.2		
binutils	2.20.51.0.2		
bind-utils	9.8.2		
bash	4.1.2		
basesystem	10.0		
b43-openfwwf	5.2		
avahi-libs	0.6.25		
authconfig	6.1.12		
audit-libs-python	2.4.5		
audit-libs	2.4.5		
audit	2.4.5		
attr	2.4.44		
atop	1.27		
atk	1.30.0		
at	3.1.10		
ansible	1.9.6		
alsa-lib	1.0.22		

Vulnerabilities Tab

This tab shows searchable vulnerabilities observed on the workload based on the Common Vulnerabilities and Exposures (CVE) system. See Vulnerability data visibility

Figure 216: Vulnerabilities Tab



Vulnerabilities

Enter attributes...

Displaying 678 of 678

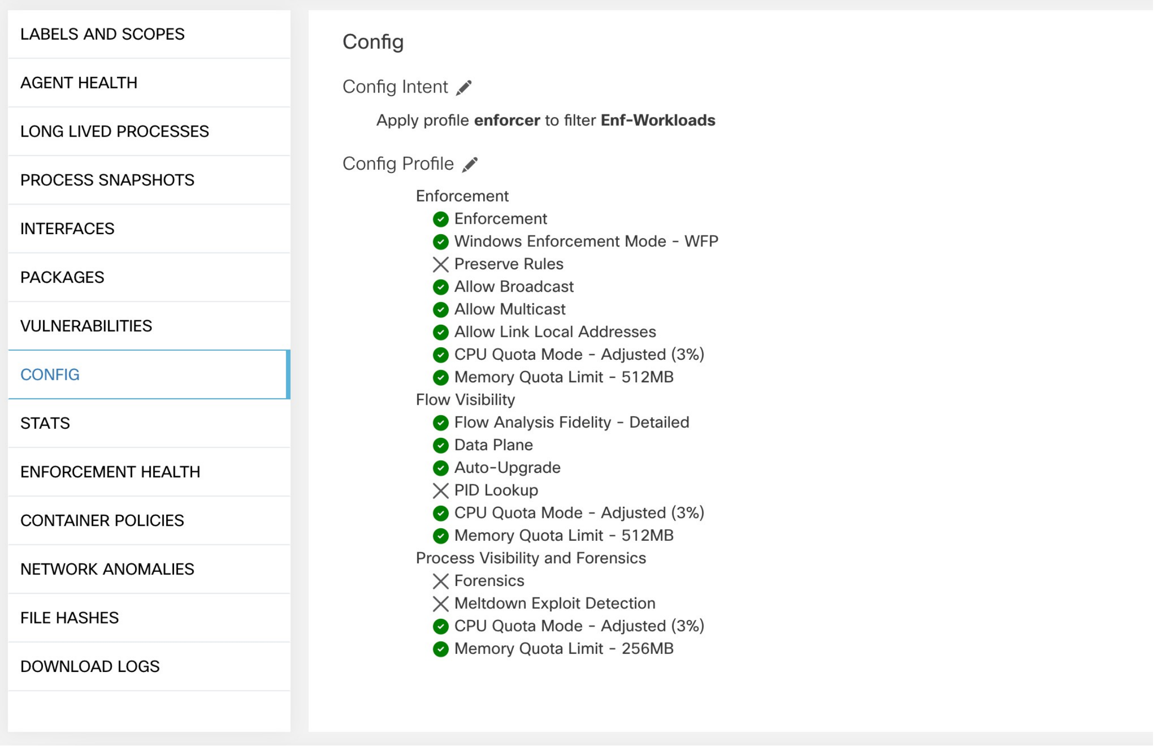
CVE ↓	Package Name ↑↓	Package Version ↑↓	Score (V2) ↑↓	Score (V3) ↑↓	Severity (V2) ↑↓	Base Severity (V3) ↑↓	Access Vector (V2) ↑↓	Access Complexity (V2) ↑↓	Authentication (V2) ↑↓	Confidentiality Impact (V2) ↑
CVE-2019-1389	msserver2016datacenter	1607-14393.3300	7.7	8.4	HIGH	HIGH	ADJACENT_NETWORK	LOW	SINGLE	COMPLETE
CVE-2019-1388	msserver2016datacenter	1607-14393.3300	7.2	7.8	HIGH	HIGH	LOCAL	LOW	NONE	COMPLETE
CVE-2019-1384	msserver2016datacenter	1607-14393.3300	6.5	9.9	MEDIUM	CRITICAL	NETWORK	LOW	SINGLE	PARTIAL
CVE-2019-1383	msserver2016datacenter	1607-14393.3300	4.6	7.8	MEDIUM	HIGH	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1382	msserver2016datacenter	1607-14393.3300	2.1	5.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1381	msserver2016datacenter	1607-14393.3300	2.1	5.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1380	msserver2016datacenter	1607-14393.3300	4.6	7.8	MEDIUM	HIGH	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1374	msserver2016datacenter	1607-14393.3300	4.3	5.5	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	PARTIAL
CVE-2019-1371	Internet Explorer	11.0.155	7.6	7.5	HIGH	HIGH	NETWORK	HIGH	NONE	COMPLETE
CVE-2019-1367	Internet Explorer	11.0.155	7.6	7.5	HIGH	HIGH	NETWORK	HIGH	NONE	COMPLETE
CVE-2019-1357	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	NONE
CVE-2019-1238	Internet Explorer	11.0.155	7.1	6.4	HIGH	MEDIUM	NETWORK	HIGH	SINGLE	COMPLETE
CVE-2019-1192	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	PARTIAL
CVE-2019-11135	msserver2016datacenter	1607-14393.3300	2.1	6.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-0719	msserver2016datacenter	1607-14393.3300	9	9.1	HIGH	CRITICAL	NETWORK	LOW	SINGLE	COMPLETE
CVE-2019-0712	msserver2016datacenter	1607-14393.3300	6.8	6.8	MEDIUM	MEDIUM	NETWORK	LOW	SINGLE	NONE
CVE-2019-0608	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	NONE
CVE-2018-12207	msserver2016datacenter	1607-14393.3300	4.9	6.5	MEDIUM	MEDIUM	LOCAL	LOW	NONE	NONE

Download table data as JSON

Agent Configuration Tab

This tab shows software agent settings. It is only available for Deep Visibility and Enforcement Agents. These settings can be modified using Agent Configuration Intents via the agent config page. See Software Agent Config

Figure 217: Applied Workload Configuration



Config

Config Intent

Apply profile **enforcer** to filter **Enf-Workloads**

Config Profile

Enforcement
- ✓ Enforcement
- ✓ Windows Enforcement Mode - WFP
- ✗ Preserve Rules
- ✓ Allow Broadcast
- ✓ Allow Multicast
- ✓ Allow Link Local Addresses
- ✓ CPU Quota Mode - Adjusted (3%)
- ✓ Memory Quota Limit - 512MB

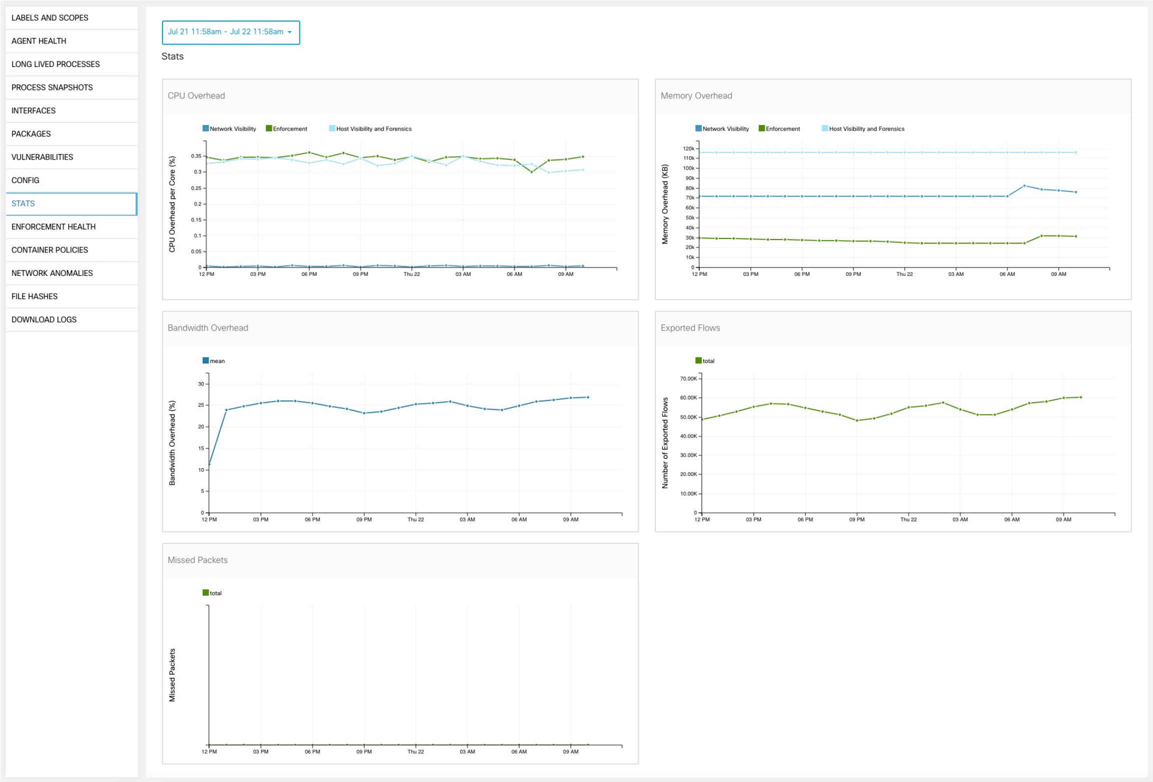
Flow Visibility
- ✓ Flow Analysis Fidelity - Detailed
- ✓ Data Plane
- ✓ Auto-Upgrade
- ✗ PID Lookup
- ✓ CPU Quota Mode - Adjusted (3%)
- ✓ Memory Quota Limit - 512MB

Process Visibility and Forensics
- ✗ Forensics
- ✗ Meltdown Exploit Detection
- ✓ CPU Quota Mode - Adjusted (3%)
- ✓ Memory Quota Limit - 256MB

Agent Statistics Tab

This tab shows statistics about the Secure Workload agent installed on the host. It's only available for Deep Visibility and Enforcement Agents.

Figure 218: Agent Statistics



Concrete Policies Tab

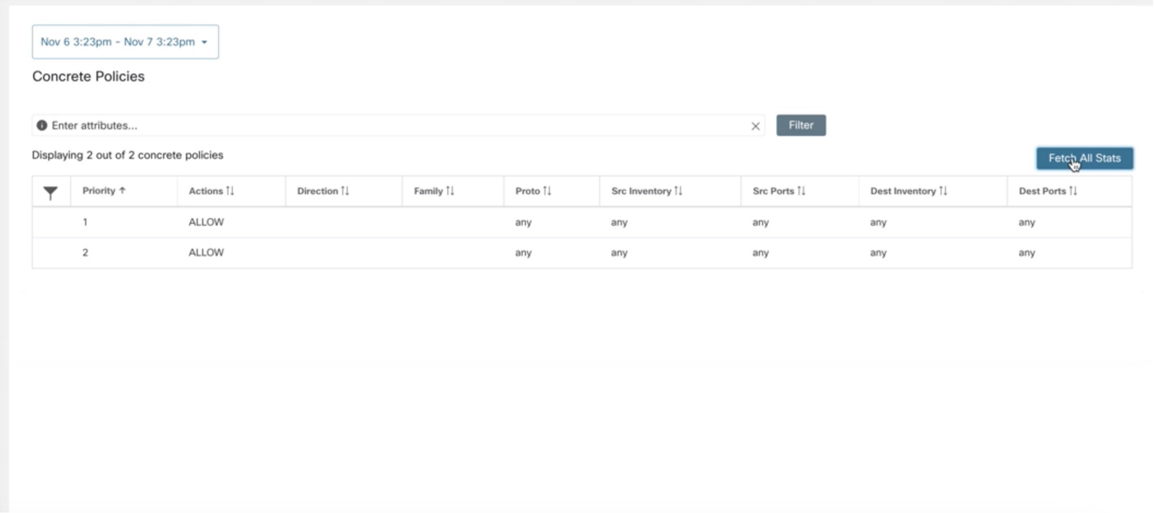
When a workspace is enforced, each workload receives only the policies in that workspace that are specific to that workload. These policies that are actually programmed on each workload are called *concrete policies*.

For example, suppose the provider specified in a policy with action ALLOW includes all inventory in the subnet 1.1.1.0/24. When this policy is installed on a workload with a Secure Workload agent and having IP address 1.1.1.2, the firewall rules look like this:

1. For incoming traffic firewall rules allow traffic destined to 1.1.1.2 specifically, not to the whole subnet 1.1.1.0/24.
2. For outgoing traffic firewall rules allow traffic sourced from 1.1.1.2 specifically, not from the whole subnet 1.1.1.0/24.

The CONCRETE POLICIES tab in the Workload Profile shows Secure Workload concrete enforcement policies applied on the host. Each row in this table corresponds to a firewall rule implemented on the host. Each policy row can be further expanded to display the logical intent from which this concrete policy derived. Packet and byte count time series view is also available for each rule. Click the **Fetch All Stats** button to view packets and bytes count for each rule. A filter is also available in this tab to narrow the list of enforced policies based on attributes of a policy shown in table header below. This tab is only available when the installed agent is enabled for enforccement.

Figure 219: Concrete Policy List



Nov 6 3:23pm - Nov 7 3:23pm

Concrete Policies

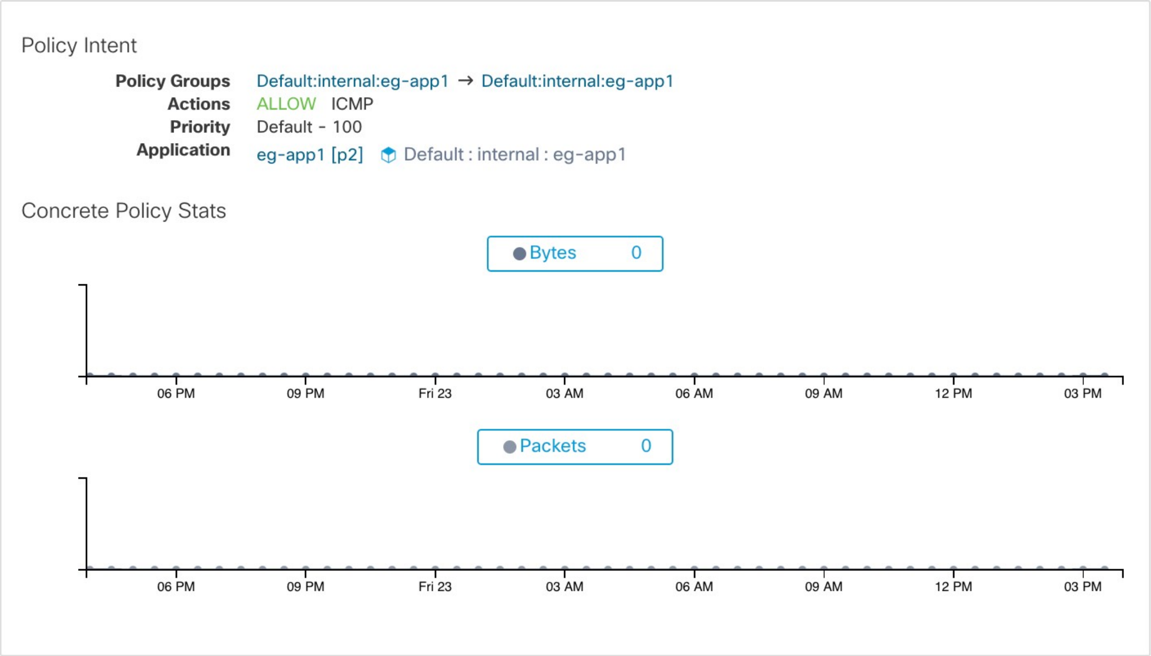
Enter attributes...

Displaying 2 out of 2 concrete policies

Priority ↑	Actions ↑↓	Direction ↑↓	Family ↑↓	Proto ↑↓	Src Inventory ↑↓	Src Ports ↑↓	Dest Inventory ↑↓	Dest Ports ↑↓
1	ALLOW			any	any	any	any	any
2	ALLOW			any	any	any	any	any

In the image below, **Policy Groups** shows the consumer and provider:

Figure 220: Concrete Policy Row



Policy Intent

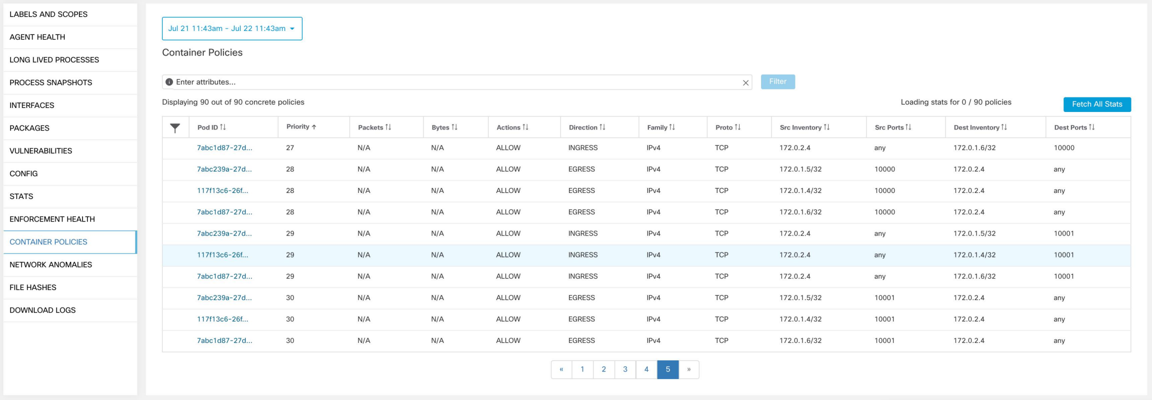
Policy Groups Default:internal:eg-app1 → Default:internal:eg-app1
Actions ALLOW ICMP
Priority Default - 100
Application eg-app1 [p2] Default : internal : eg-app1

Concrete Policy Stats

Container Policies Tab

This tab shows Secure Workload concrete enforcement policies applied on the containers. Each row in this table corresponds to a firewall rule implemented on the container pod.

Figure 221: Container Concrete Policy List



Jul 21 11:43am - Jul 22 11:43am

Container Policies

Enter attributes...

Displaying 90 out of 90 concrete policies

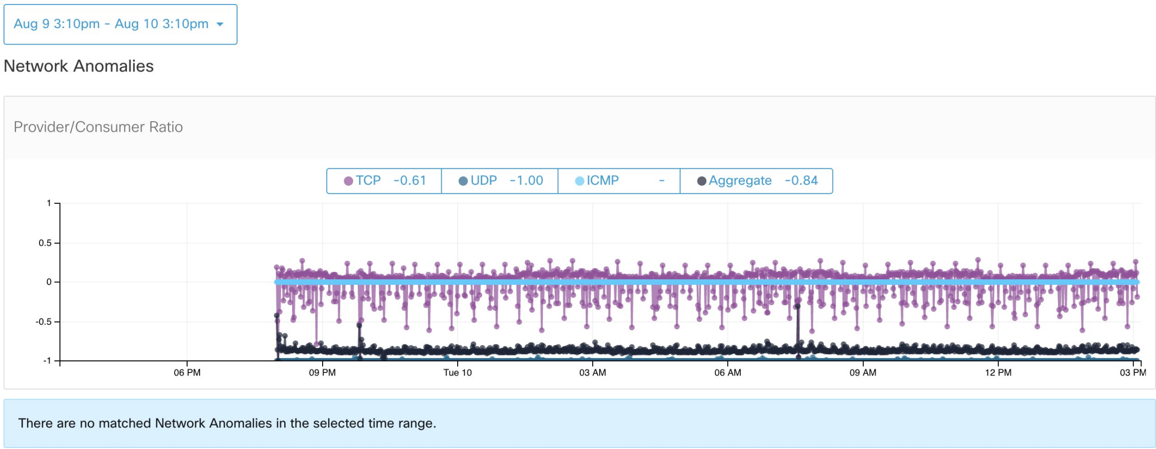
Loading stats for 0 / 90 policies

Pod ID ⇅	Priority ↑	Packets ⇅	Bytes ⇅	Actions ⇅	Direction ⇅	Family ⇅	Proto ⇅	Src Inventory ⇅	Src Ports ⇅	Dest Inventory ⇅	Dest Ports ⇅
7abc1d87-27d...	27	N/A	N/A	ALLOW	INGRESS	IPv4	TCP	172.0.2.4	any	172.0.1.6/32	10000
7abc239a-27d...	28	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.0.1.5/32	10000	172.0.2.4	any
117f13c6-26f...	28	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.0.1.4/32	10000	172.0.2.4	any
7abc1d87-27d...	28	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.0.1.6/32	10000	172.0.2.4	any
7abc239a-27d...	29	N/A	N/A	ALLOW	INGRESS	IPv4	TCP	172.0.2.4	any	172.0.1.5/32	10001
117f13c6-26f...	29	N/A	N/A	ALLOW	INGRESS	IPv4	TCP	172.0.2.4	any	172.0.1.4/32	10001
7abc1d87-27d...	29	N/A	N/A	ALLOW	INGRESS	IPv4	TCP	172.0.2.4	any	172.0.1.6/32	10001
7abc239a-27d...	30	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.0.1.5/32	10001	172.0.2.4	any
117f13c6-26f...	30	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.0.1.4/32	10001	172.0.2.4	any
7abc1d87-27d...	30	N/A	N/A	ALLOW	EGRESS	IPv4	TCP	172.0.1.6/32	10001	172.0.2.4	any

Network Anomalies Tab

This tab helps to identify the events with large data movements in or out of this workload. See PCR-Based Network Anomaly Detection for more information.

Figure 222: Workload Network Anomalies



Aug 9 3:10pm - Aug 10 3:10pm

Network Anomalies

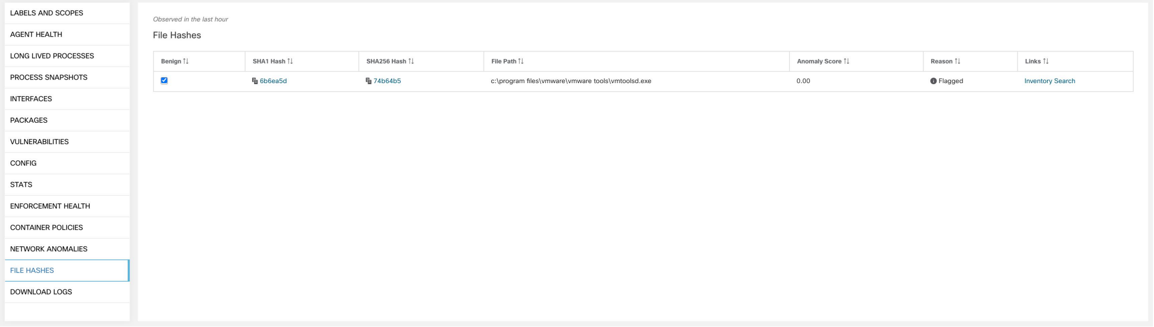
Provider/Consumer Ratio

There are no matched Network Anomalies in the selected time range.

File Hashes Tab

This tab detects process hash anomalies by assessing the consistency of process binary hashes across the system. See Process Hash Anomaly Detection for more info.

Figure 223: Workload File Hashes



Observed in the last hour

File Hashes

Benign ↑↓	SHA1 Hash ↑↓	SHA256 Hash ↑↓	File Path ↑↓	Anomaly Score ↑↓	Reason ↑↓	Links ↑↓
☑	6b6ea5d	74b64b5	c:\program files\vmware\vmware tools\vmtoolsd.exe	0.00	Flagged	Inventory Search

Software Packages

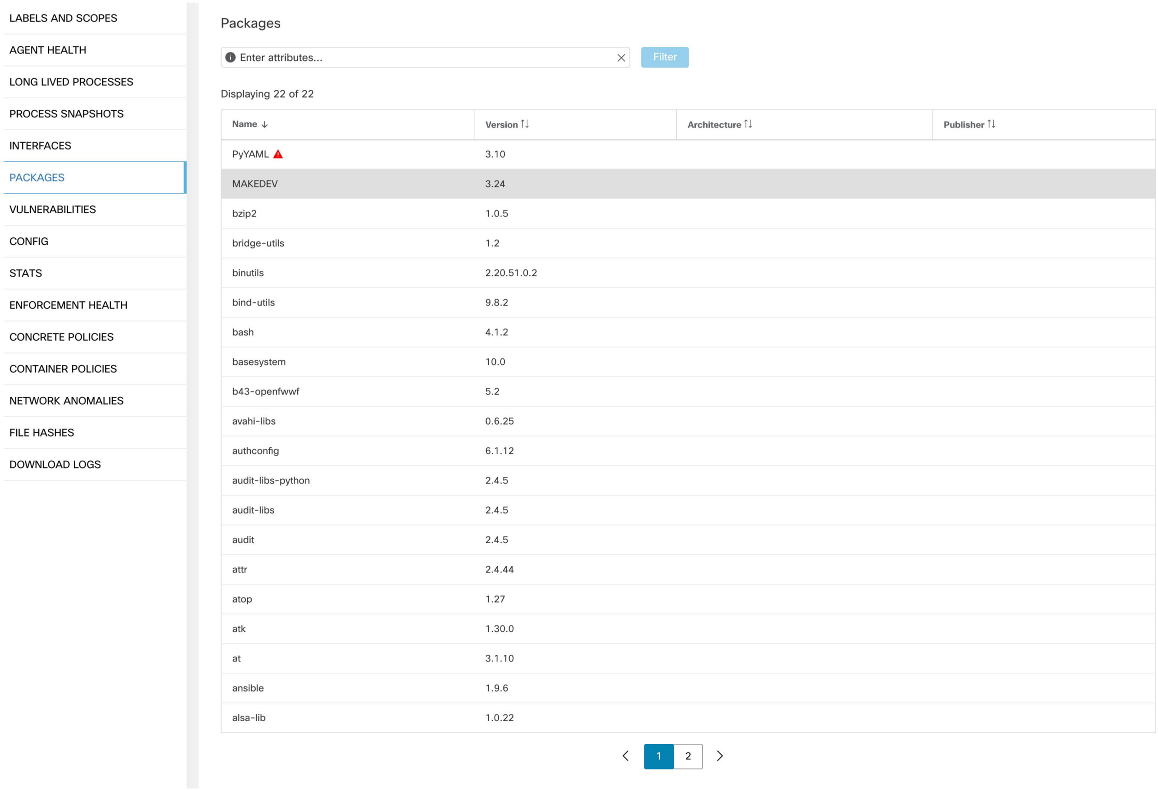
The **Software Packages** feature set allows viewing packages installed on hosts and the vulnerabilities affecting them. Specifically, it allows to:

- View packages registered with the following package managers:
  - Linux: Redhat Package Manager (RPM) and Debian Package Manager (dpkg)
  - Windows: Windows Registry Service
- View Common Vulnerabilities and Exposures (CVEs) affecting packages installed on a host.
- Define inventory filters using the package name and version.

Packages Tab

To view packages installed on a host, navigate to the packages tab on the workload profile Workload Profile page.

Figure 224: Workload profile packages



- LABELS AND SCOPES
- AGENT HEALTH
- LONG LIVED PROCESSES
- PROCESS SNAPSHOTS
- INTERFACES
- PACKAGES
- VULNERABILITIES
- CONFIG
- STATS
- ENFORCEMENT HEALTH
- CONCRETE POLICIES
- CONTAINER POLICIES
- NETWORK ANOMALIES
- FILE HASHES
- DOWNLOAD LOGS

Packages

Enter attributes... Filter

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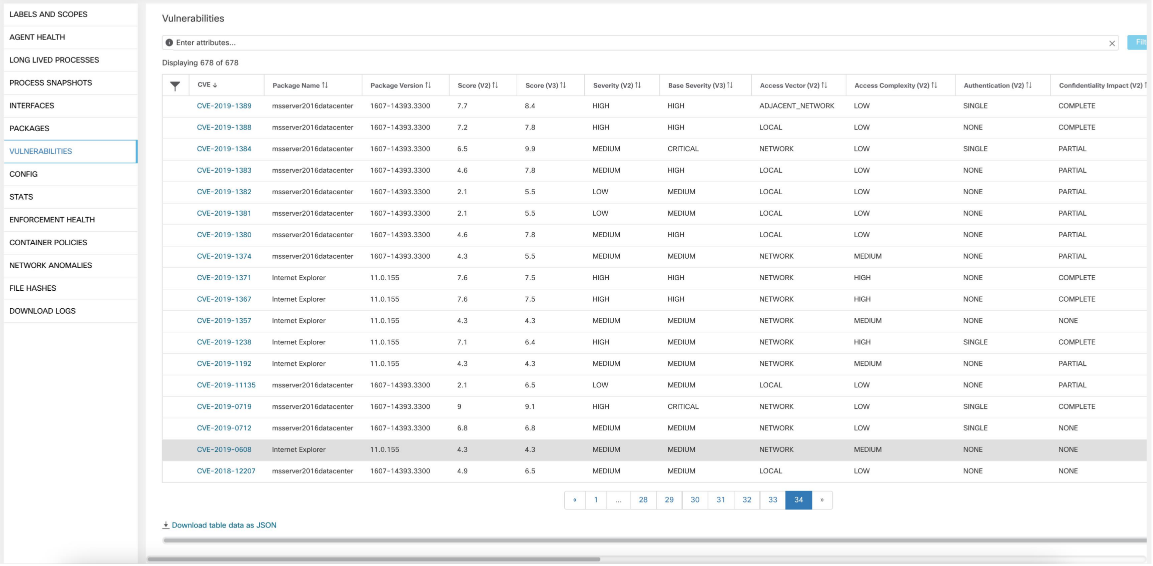
Name ↓	Version ↑↓	Architecture ↑↓	Publisher ↑↓
PyYAML ⚠	3.10		
MAKEDEV	3.24		
bzip2	1.0.5		
bridge-utils	1.2		
binutils	2.20.51.0.2		
bind-utils	9.8.2		
bash	4.1.2		
basesystem	10.0		
b43-openfwwf	5.2		
avahi-libs	0.6.25		
authconfig	6.1.12		
audit-libs-python	2.4.5		
audit-libs	2.4.5		
audit	2.4.5		
attr	2.4.44		
atop	1.27		
atk	1.30.0		
at	3.1.10		
ansible	1.9.6		
alsa-lib	1.0.22		

< 1 2 >

Common Vulnerabilities and Exposures (CVEs)

In addition to displaying packages under the packages tab, we display common vulnerabilities affecting them along with their severity. Each vulnerability contains a link to the Nation Vulnerability Database (NVD) which provides more information on the specific vulnerability. In addition to displaying the CVE ID, we also display the impact score (on a scale of 10), indicative of the severity of the vulnerability.

Figure 225: Workload profile packages CVE



Vulnerabilities

Enter attributes...

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CVE ↓	Package Name ⇅	Package Version ⇅	Score (V2) ⇅	Score (V3) ⇅	Severity (V2) ⇅	Base Severity (V3) ⇅	Access Vector (V2) ⇅	Access Complexity (V2) ⇅	Authentication (V2) ⇅	Confidentiality Impact (V2)
CVE-2019-1389	msserver2016datacenter	1607-14393.3300	7.7	8.4	HIGH	HIGH	ADJACENT_NETWORK	LOW	SINGLE	COMPLETE
CVE-2019-1388	msserver2016datacenter	1607-14393.3300	7.2	7.8	HIGH	HIGH	LOCAL	LOW	NONE	COMPLETE
CVE-2019-1384	msserver2016datacenter	1607-14393.3300	6.5	9.9	MEDIUM	CRITICAL	NETWORK	LOW	SINGLE	PARTIAL
CVE-2019-1383	msserver2016datacenter	1607-14393.3300	4.6	7.8	MEDIUM	HIGH	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1382	msserver2016datacenter	1607-14393.3300	2.1	5.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1381	msserver2016datacenter	1607-14393.3300	2.1	5.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1380	msserver2016datacenter	1607-14393.3300	4.6	7.8	MEDIUM	HIGH	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1374	msserver2016datacenter	1607-14393.3300	4.3	5.5	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	PARTIAL
CVE-2019-1371	Internet Explorer	11.0.155	7.6	7.5	HIGH	HIGH	NETWORK	HIGH	NONE	COMPLETE
CVE-2019-1367	Internet Explorer	11.0.155	7.6	7.5	HIGH	HIGH	NETWORK	HIGH	NONE	COMPLETE
CVE-2019-1357	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	NONE
CVE-2019-1238	Internet Explorer	11.0.155	7.1	6.4	HIGH	MEDIUM	NETWORK	HIGH	SINGLE	COMPLETE
CVE-2019-1192	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	PARTIAL
CVE-2019-11135	msserver2016datacenter	1607-14393.3300	2.1	6.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-0719	msserver2016datacenter	1607-14393.3300	9	9.1	HIGH	CRITICAL	NETWORK	LOW	SINGLE	COMPLETE
CVE-2019-0712	msserver2016datacenter	1607-14393.3300	6.8	6.8	MEDIUM	MEDIUM	NETWORK	LOW	SINGLE	NONE
CVE-2019-0608	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	NONE
CVE-2018-12207	msserver2016datacenter	1607-14393.3300	4.9	6.5	MEDIUM	MEDIUM	LOCAL	LOW	NONE	NONE

Windows Packages and CVEs

Following section lists the behavior of Windows agent with regard to reporting package information to Secure Workload.

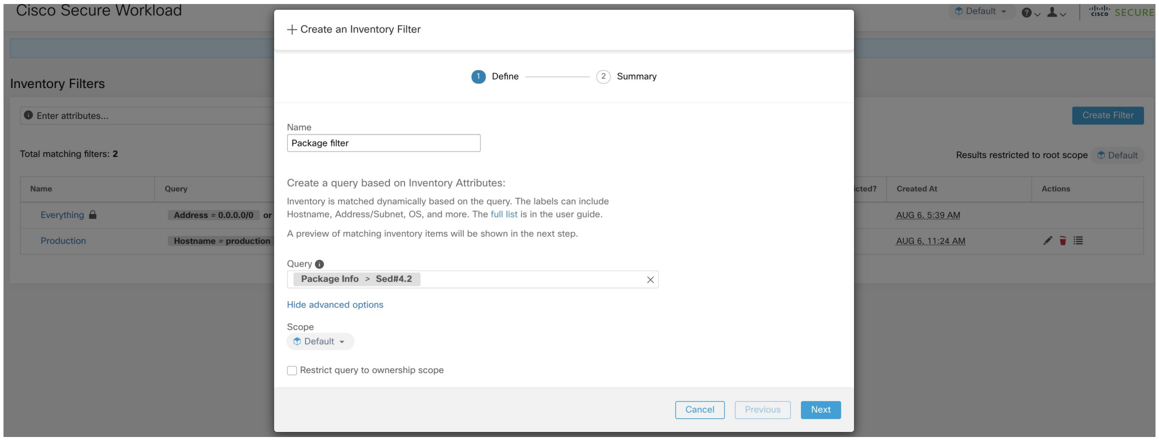
- Windows applications, PowerShell, IE are reported as packages. .net framework is also reported as a package.
- Other Windows applications like notepad.exe, cmd.exe, mstsc.exe, and so on are not reported.
- Windows server configured roles and features are reported as packages but the version may be incorrect. For example: If the DNS server is configured, reported version will either 0 or 8.
- Windows agent reports 3rd party products installed using MSI installer or exe installer:
  - For MSI installers, MSI APIs are used to retrieve package information. For example, version, publisher, package name.
  - If the exe installer is used to install the package, package information is retrieved from the registry.
  - Package installer fields like version, publisher is optional. If version is missing, the package will not be reported.
  - If a product is extracted from zip file or installed as an app, it will not be reported in the package list.

Inventory Filters

Package related information can be searched by defining an inventory filter with the package name and version (optional).

The syntax for this filter is as follows: PackageName#PackageVersion

Figure 226: Inventory package



+ Create an Inventory Filter

1 Define — 2 Summary

Name: Package filter

Create a query based on Inventory Attributes:

Inventory is matched dynamically based on the query. The labels can include Hostname, Address/Subnet, OS, and more. The full list is in the user guide.

A preview of matching inventory items will be shown in the next step.

Query: Package Info > Sed#4.2

Hide advanced options

Scope: Default

□ Restrict query to ownership scope

The following operations are supported:

- Equality - returns hosts with packages matching PackageName and the PackageVersion (if provided).
- Inequality - returns hosts with packages matching PackageName but not the PackageVersion (if provided).
- Greater Than - returns hosts with packages matching PackageName and with version greater than PackageVersion.
- Greater Than or Equal To - returns hosts with packages matching PackageName and with version greater than or equal to PackageVersion.
- Less Than - returns hosts with packages matching PackageName and with version less than PackageVersion.
- Less Than or Equal To - returns hosts with packages matching PackageName and with version less than or equal to PackageVersion.

Vulnerability data visibility

The **Vulnerability data visibility** feature allows for detecting and viewing vulnerabilities affecting packages and processes on a host. Inventory filters can be defined using:

```
- CVE IDs.- CVSS v2 and v3 scores.- CVSS v2 access vector and access complexity.- CVSS v3
attack vector, attack complexity, and privilege required.
```

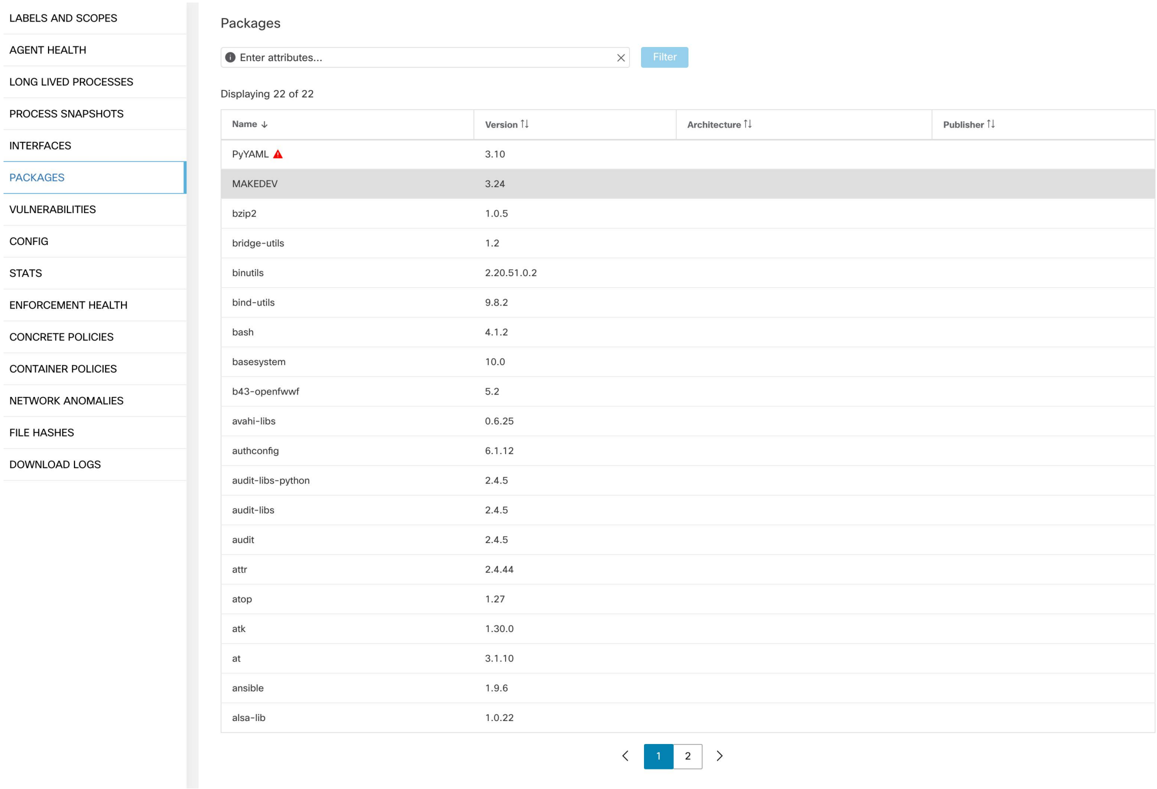
Workload Profile Page

Vulnerability related information affecting packages and processes on a system is displayed on the Workload Profile page.

Packages Tab

The packages tab lists packages installed on a host and vulnerabilities affecting them.

Figure 227: Workload profile packages



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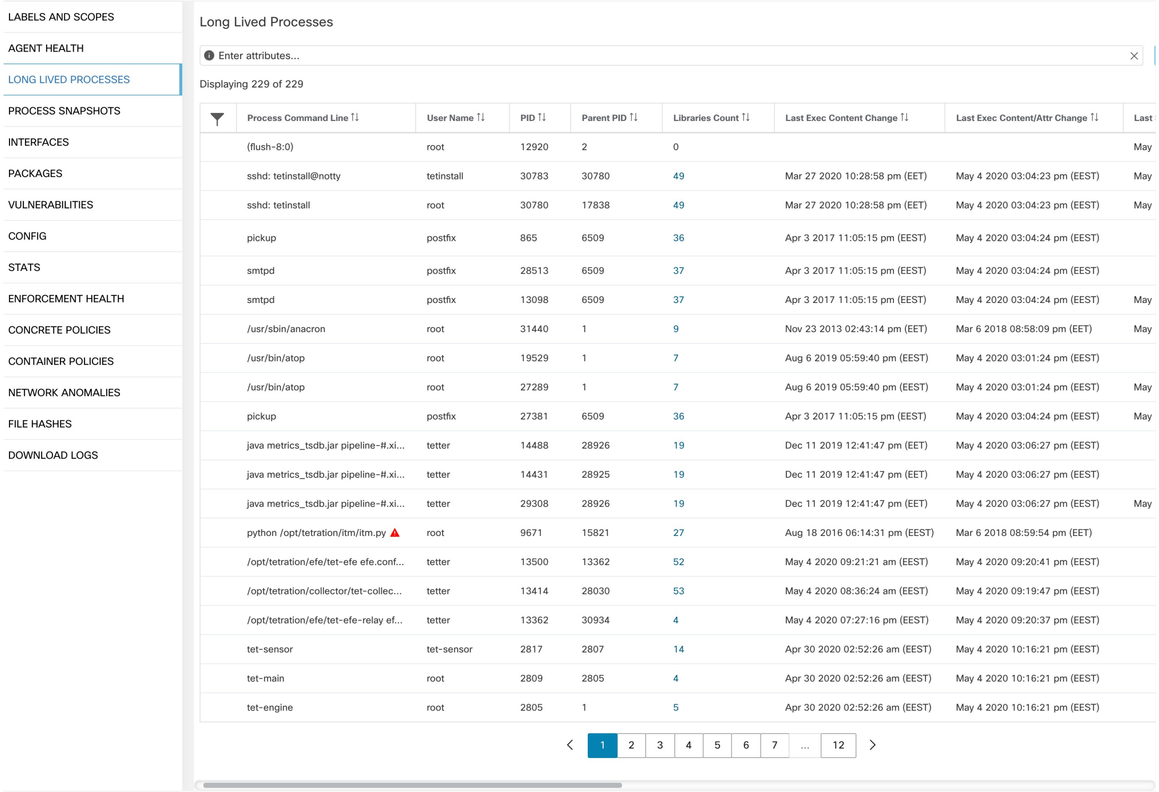
Name ↓	Version ↑↓	Architecture ↑↓	Publisher ↑↓
PyYAML ⚠	3.10		
MAKEDEV	3.24		
bzip2	1.0.5		
bridge-utils	1.2		
binutils	2.20.51.0.2		
bind-utils	9.8.2		
bash	4.1.2		
basesystem	10.0		
b43-openfwwf	5.2		
avahi-libs	0.6.25		
authconfig	6.1.12		
audit-libs-python	2.4.5		
audit-libs	2.4.5		
audit	2.4.5		
attr	2.4.44		
atop	1.27		
atk	1.30.0		
at	3.1.10		
ansible	1.9.6		
alsa-lib	1.0.22		

Process List Tab

Long-lived processes are displayed under the process list tab.

Figure 228: Workload profile process list



Long Lived Processes

Enter attributes...

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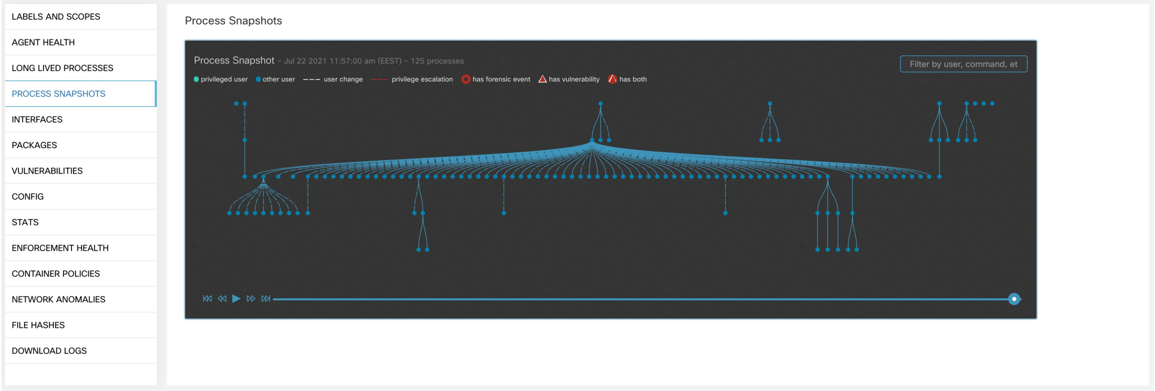
Process Command Line ⇅	User Name ⇅	PID ⇅	Parent PID ⇅	Libraries Count ⇅	Last Exec Content Change ⇅	Last Exec Content/Attr Change ⇅	Last
(flush-8:0)	root	12920	2	0			May
sshd: tetinstall@notty	tetinstall	30783	30780	49	Mar 27 2020 10:28:58 pm (EET)	May 4 2020 03:04:23 pm (EEST)	May
sshd: tetinstall	root	30780	17838	49	Mar 27 2020 10:28:58 pm (EET)	May 4 2020 03:04:23 pm (EEST)	May
pickup	postfix	865	6509	36	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	
smtpd	postfix	28513	6509	37	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	
smtpd	postfix	13098	6509	37	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	May
/usr/sbin/anacron	root	31440	1	9	Nov 23 2013 02:43:14 pm (EET)	Mar 6 2018 08:58:09 pm (EET)	May
/usr/bin/atop	root	19529	1	7	Aug 6 2019 05:59:40 pm (EEST)	May 4 2020 03:01:24 pm (EEST)	
/usr/bin/atop	root	27289	1	7	Aug 6 2019 05:59:40 pm (EEST)	May 4 2020 03:01:24 pm (EEST)	May
pickup	postfix	27381	6509	36	Apr 3 2017 11:05:15 pm (EEST)	May 4 2020 03:04:24 pm (EEST)	May
java metrics_tsdb.jar pipeline-#.xi...	tetter	14488	28926	19	Dec 11 2019 12:41:47 pm (EET)	May 4 2020 03:06:27 pm (EEST)	
java metrics_tsdb.jar pipeline-#.xi...	tetter	14431	28925	19	Dec 11 2019 12:41:47 pm (EET)	May 4 2020 03:06:27 pm (EEST)	
java metrics_tsdb.jar pipeline-#.xi...	tetter	29308	28926	19	Dec 11 2019 12:41:47 pm (EET)	May 4 2020 03:06:27 pm (EEST)	May
python /opt/tetration/itm/itm.py ⚠	root	9671	15821	27	Aug 18 2016 06:14:31 pm (EEST)	Mar 6 2018 08:59:54 pm (EET)	
/opt/tetration/efe/tet-efe efe.conf...	tetter	13500	13362	52	May 4 2020 09:21:21 am (EEST)	May 4 2020 09:20:41 pm (EEST)	
/opt/tetration/collector/tet-collec...	tetter	13414	28030	53	May 4 2020 08:36:24 am (EEST)	May 4 2020 09:19:47 pm (EEST)	
/opt/tetration/efe/tet-efe-relay ef...	tetter	13362	30934	4	May 4 2020 07:27:16 pm (EEST)	May 4 2020 09:20:37 pm (EEST)	
tet-sensor	tet-sensor	2817	2807	14	Apr 30 2020 02:52:26 am (EEST)	May 4 2020 10:16:21 pm (EEST)	
tet-main	root	2809	2805	4	Apr 30 2020 02:52:26 am (EEST)	May 4 2020 10:16:21 pm (EEST)	
tet-engine	root	2805	1	5	Apr 30 2020 02:52:26 am (EEST)	May 4 2020 10:16:21 pm (EEST)	

Process Snapshot Tab

Vulnerability information is displayed for all processes in the process tree under the process snapshot tab.

Figure 229: Workload profile process snapshot tab



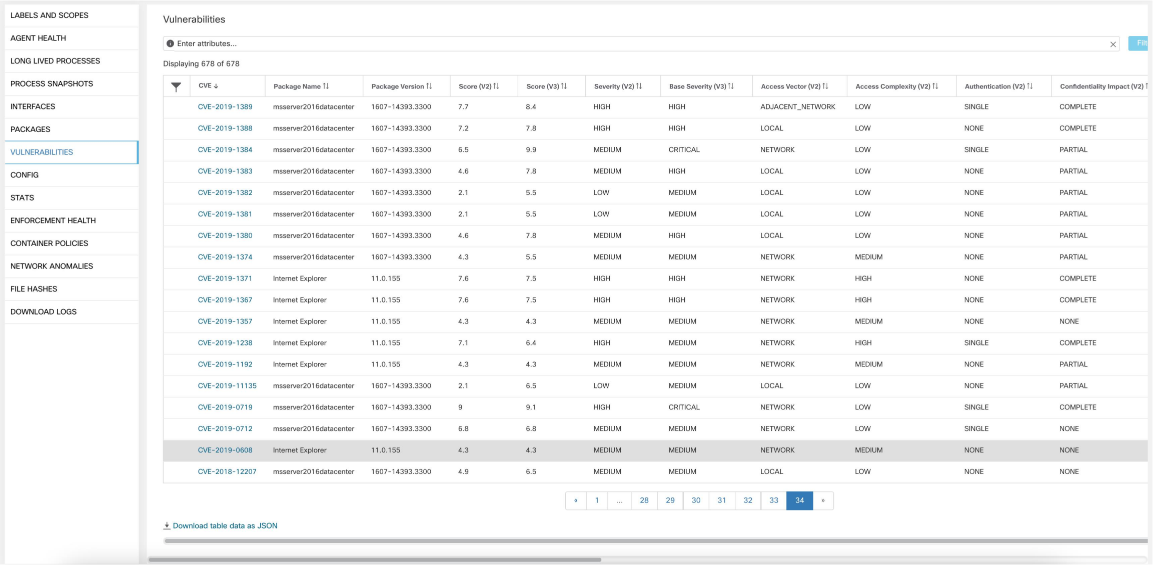
Vulnerabilities Tab

The vulnerability tab shows a list of vulnerabilities observed on the workload.

For each CVE, besides basic impact metrics, exploit information based on our threat intelligence is displayed:

- Exploit Count: number of times CVE was seen exploited in the wild in the last year
- Last Exploited: last time CVE was seen exploited in the wild by our threat intelligence

Figure 230: Workload profile vulnerabilities tab



Vulnerabilities

Enter attributes...

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CVE	Package Name	Package Version	Score (V2)	Score (V3)	Severity (V2)	Base Severity (V3)	Access Vector (V2)	Access Complexity (V2)	Authentication (V2)	Confidentiality Impact (V2)
CVE-2019-1389	msserver2016datacenter	1607-14393.3300	7.7	8.4	HIGH	HIGH	ADJACENT_NETWORK	LOW	SINGLE	COMPLETE
CVE-2019-1388	msserver2016datacenter	1607-14393.3300	7.2	7.8	HIGH	HIGH	LOCAL	LOW	NONE	COMPLETE
CVE-2019-1384	msserver2016datacenter	1607-14393.3300	6.5	9.9	MEDIUM	CRITICAL	NETWORK	LOW	SINGLE	PARTIAL
CVE-2019-1383	msserver2016datacenter	1607-14393.3300	4.6	7.8	MEDIUM	HIGH	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1382	msserver2016datacenter	1607-14393.3300	2.1	5.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1381	msserver2016datacenter	1607-14393.3300	2.1	5.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1380	msserver2016datacenter	1607-14393.3300	4.6	7.8	MEDIUM	HIGH	LOCAL	LOW	NONE	PARTIAL
CVE-2019-1374	msserver2016datacenter	1607-14393.3300	4.3	5.5	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	PARTIAL
CVE-2019-1371	Internet Explorer	11.0.155	7.6	7.5	HIGH	HIGH	NETWORK	HIGH	NONE	COMPLETE
CVE-2019-1367	Internet Explorer	11.0.155	7.6	7.5	HIGH	HIGH	NETWORK	HIGH	NONE	COMPLETE
CVE-2019-1357	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	NONE
CVE-2019-1238	Internet Explorer	11.0.155	7.1	6.4	HIGH	MEDIUM	NETWORK	HIGH	SINGLE	COMPLETE
CVE-2019-1192	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	PARTIAL
CVE-2019-11135	msserver2016datacenter	1607-14393.3300	2.1	6.5	LOW	MEDIUM	LOCAL	LOW	NONE	PARTIAL
CVE-2019-0719	msserver2016datacenter	1607-14393.3300	9	9.1	HIGH	CRITICAL	NETWORK	LOW	SINGLE	COMPLETE
CVE-2019-0712	msserver2016datacenter	1607-14393.3300	6.8	6.8	MEDIUM	MEDIUM	NETWORK	LOW	SINGLE	NONE
CVE-2019-0608	Internet Explorer	11.0.155	4.3	4.3	MEDIUM	MEDIUM	NETWORK	MEDIUM	NONE	NONE
CVE-2018-12207	msserver2016datacenter	1607-14393.3300	4.9	6.5	MEDIUM	MEDIUM	LOCAL	LOW	NONE	NONE

Download table data as JSON

Inventory Filters

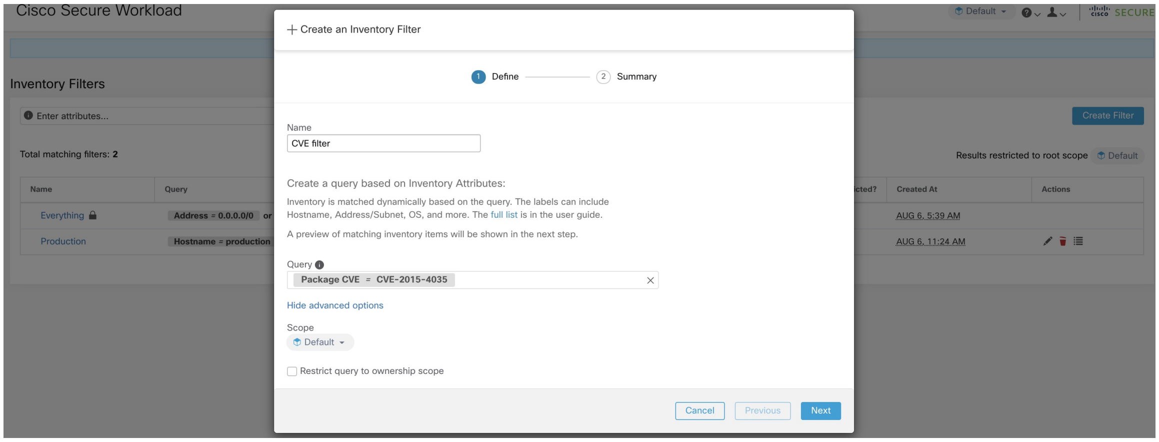
The following types of inventory filters can be defined to identify hosts with vulnerable packages:

CVE ID based filter

This filter allows searching for hosts affected by a specific CVE or any CVE.

To search for a host affected by a specific CVE, provide the CVE ID in the format: CVE-XXXX-XXXX

Figure 231: Inventory filter CVE



Create an Inventory Filter

1 Define — 2 Summary

Name: CVE filter

Create a query based on Inventory Attributes:

Inventory is matched dynamically based on the query. The labels can include Hostname, Address/Subnet, OS, and more. The full list is in the user guide.

A preview of matching inventory items will be shown in the next step.

Query: Package CVE = CVE-2015-4035

Hide advanced options

Scope: Default

□ Restrict query to ownership scope

The following operations are supported:

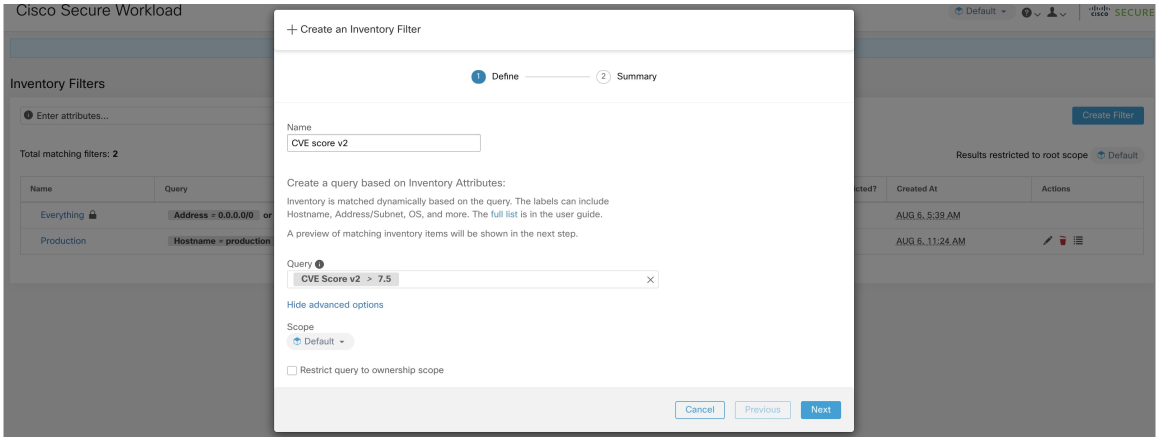
- Equality - returns hosts with packages affected by a CVE ID.
- Inequality - returns hosts with packages not affected by a CVE ID.
- Contains - returns hosts with packages affected by a CVE present in the input string (entering “cve” will return hosts affected by a CVE).
- Doesn’t contain - returns hosts with packages not affected by a CVE present in the input string (entering “cve” will return hosts not affected by a CVE).

CVSS (Common Vulnerability Scoring System) impact score based filter

This filter allows searching for hosts that have CVE with the specified CVSSv2 or CVSSv3 impact score. To search for hosts which have any CVE with impact score (v2 or v3), user can provide the score in numeric format.

To search for hosts which have CVE with CVSSv2 impact score greater than 7.5.

Figure 232: Inventory filter CVSS



Create an Inventory Filter

1 Define — 2 Summary

Name: CVE score v2

Create a query based on Inventory Attributes:

Inventory is matched dynamically based on the query. The labels can include Hostname, Address/Subnet, OS, and more. The full list is in the user guide.

A preview of matching inventory items will be shown in the next step.

Query: CVE Score v2 > 7.5

Hide advanced options

Scope: Default

□ Restrict query to ownership scope

The following operations are supported:

- Equality - returns hosts which have CVE with the specified CVSSv2 or CVSSv3 impact scores.
- Inequality - returns hosts which don’t have CVE with the specified CVSSv2 or CVSSv3 impact scores.
- Greater Than - returns hosts which have CVE with CVSSv2 or CVSSv3 impact scores greater than the specified CVSSv2 or CVSSv3 impact scores respectively.
- Greater Than or Equal To - returns hosts which have CVE with CVSSv2 or CVSSv3 impact scores greater than or equal to the specified CVSSv2 or CVSSv3 impact scores respectively.
- Less Than - returns hosts which have CVE with CVSSv2 or CVSSv3 impact scores less than the specified CVSSv2 or CVSSv3 impact scores respectively.
- Less Than or Equal To - returns hosts which have CVE with CVSSv2 or CVSSv3 impact scores less than or equal to the specified CVSSv2 or CVSSv3 impact scores respectively.

CVSSv2 based filters

Inventory filters can be created using access vectors and access complexities to identify vulnerable hosts. These filters support the following types of operations:

- Equality - returns hosts with packages affected by vulnerabilities matching the filter.
- Inequality - returns hosts with packages not affected by vulnerabilities matching the filter.

Access Vector

Access vector reflects how the vulnerability is exploited. The farther the attacker can get from the vulnerable system, the higher the base score. The table below lists different access vectors with their access requirements:

Value	Type of access
LOCAL	Physical or local (shell).
ADJACENT_NETWORK	Broadcast or collision.
NETWORK	Remotely exploitable.

Access Complexity

This metric measures the complexity in exploiting a vulnerability once the attacker is able to access the target system. The base score is inversely proportional to the access complexity. The different types of access complexities are as follows:

Value	Description
HIGH	Specialized access conditions exist.
MEDIUM	Access conditions are somewhat specialized.
LOW	Specialized access conditions do not exist.

CVSSv3 based filters

Attack vectors, attack complexities, and privilege required to influence the CVSSv3 score and can be used in inventory filters. These filters support the following operations:

- Equality - returns hosts with packages affected by vulnerabilities matching the filter.
- Inequality - returns hosts with packages not affected by vulnerabilities matching the filter.

Attack Vector

This metric reflects the context by which vulnerability exploitation is possible. The farther an attacker can get from the vulnerable component, the higher the base score. The table below lists different attack vectors with their access requirements:

Value	Type of access
LOCAL	Local (keyboard, console) or remote (SSH).

Value	Type of access
PHYSICAL	Physical access is needed.
ADJACENT_NETWORK	Broadcast or collision.
NETWORK	Remotely exploitable.

Attack Complexity

This metric describes the conditions that must exist in order to exploit the vulnerability. The base score is greatest for least complex attacks. The different types of access complexities are as follows:

Value	Description
HIGH	Significant effort needed in setting up and executing the attack.
LOW	Specialized access conditions do not exist.

Privileges Required

This metric describes the level of privileges an attacker must possess before successfully exploiting the vulnerability. The base score is highest when privileges aren’t needed to carry out an attack. The different values of privilege required are as follows:

Value	Privileges required
HIGH	Privileges providing significant control over the vulnerable component.
LOW	Low privileges that grant access to non-sensitive resources.
NONE	Privileges aren’t needed to carry out an attack.

Service Profile

Secure Workload provides visibility of all Kubernetes services and other Load Balancers ingested through an external orchestrator. Service profile page shows the details for a given service.

Note Service profile page is linked from various places. One of the ways to see a service profile is to perform a search for service as described in search

From the results of search, click on a Service Name under the Services tab to go to its profile. The following information is available for the service:

Header

Header consists of:

- **Orchestrator Name:** Name of the external orchestrator which reported this service.
- **Orchestrator Type:** Type of the external orchestrator.
- **Namespace:** Namespace of the service.
- **Service Type:** Type of the service. Possible values include ClusterIP, Node, Port, and LoadBalancer.

IP and Ports

This table lists all the possible IP and port combinations through which this service is accessible. For services of type NodePort, this table shows both ClusterIP:Port and NodeIp:NodePort association.

User Labels

The list of user uploaded and orchestrator system generated labels for this service.

Scopes

List of scopes that the pod belongs to.

Pod Profile

Secure Workload provides visibility of all Kubernetes pods ingested through a Kubernetes external orchestrator. Pod profile page shows the details for a given pod.

Note Pod profile page is linked from various places. One of the ways to see a pod profile is to perform a search for pod as described in search

From the results of search, click on a Pod Name under the Pods tab to go to its profile. The following information is available for the pod:

Header

Header consists of:

- **Orchestrator Name:** Name of the external orchestrator which reported this pod.
- **Orchestrator Type:** Type of the external orchestrator.
- **Namespace:** Namespace of the pod.
- **IP Address:** Pod’s IP Address.

User Labels

The list of user uploaded and orchestrator system generated labels for this pod.

Scopes

List of scopes that the service belongs to.

Container Vulnerability Scanning

To maintain health and identify potential security weaknesses, we recommend scanning the Kubernetes pods regularly.

Prerequisites

- Ensure that a Kubernetes cluster is on board.
- Install the CSW Kubernetes daemonset agent as part of the Kubernetes cluster. For more information, see Installing Kubernetes or OpenShift Agents for Deep Visibility and Enforcement.

Procedure

Step 1 Navigate to **Manage** > **Workloads** > **Kubernetes**.

Note The **Clusters** tab displays a list of all on-boarded clusters along with the associated inventory, such as services and pods.

Step 2 Click **Pod Vulnerability Scanning**.

Step 3 To start the scan, enable the toggle under **Actions**. By default, the toggle is disabled.

Step 4 Click the edit icon to modify the query and select a subset of pods running on the cluster.

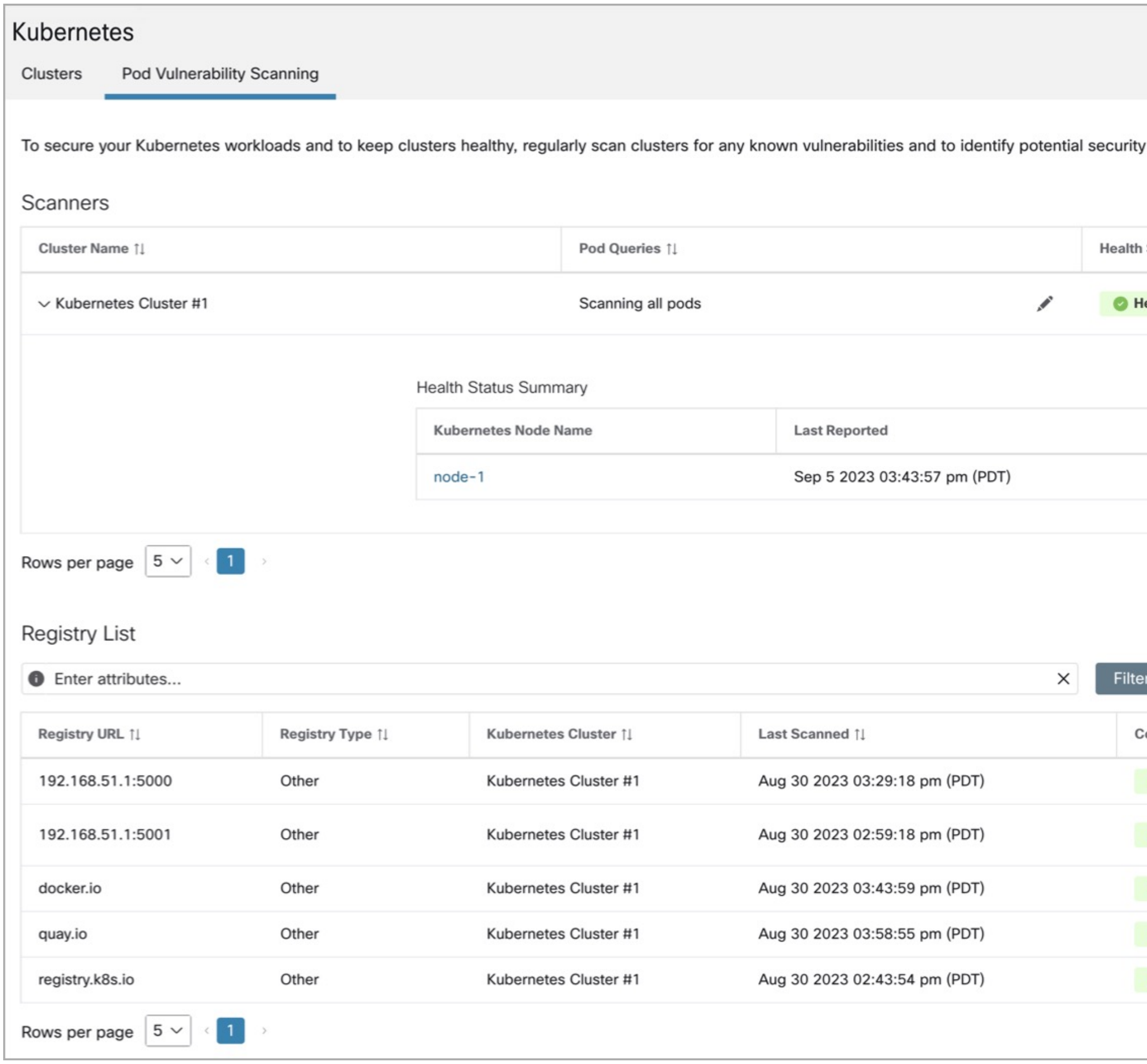
Note

- A pod query is populated by default to scan all pod inventories in the cluster. However, you can edit pod queries to select the pods to scan.
- Currently, scanning Windows container images is not supported.

Step 5 Expand a cluster to view the **Health Status Summary**.

- Click on a Kubernetes Node Name to view the Workload Profile.
- Enable the toggle to automatically download additional information to the host so that the scanner can execute.

Figure 233: Pod Vulnerability Scanning



To secure your Kubernetes workloads and to keep clusters healthy, regularly scan clusters for any known vulnerabilities and to identify potential security

Scanners

Cluster Name ⇅	Pod Queries ⇅	Health
Kubernetes Cluster #1	Scanning all pods	He

Health Status Summary

Kubernetes Node Name	Last Reported
node-1	Sep 5 2023 03:43:57 pm (PDT)

Registry List

Registry URL ⇅	Registry Type ⇅	Kubernetes Cluster ⇅	Last Scanned ⇅	C
192.168.51.1:5000	Other	Kubernetes Cluster #1	Aug 30 2023 03:29:18 pm (PDT)	
192.168.51.1:5001	Other	Kubernetes Cluster #1	Aug 30 2023 02:59:18 pm (PDT)	
docker.io	Other	Kubernetes Cluster #1	Aug 30 2023 03:43:59 pm (PDT)	
quay.io	Other	Kubernetes Cluster #1	Aug 30 2023 03:58:55 pm (PDT)	
registry.k8s.io	Other	Kubernetes Cluster #1	Aug 30 2023 02:43:54 pm (PDT)	

Step 6 Verify the connection status and enter the credentials, if necessary. The **Registry List** displays all detected registries.

Note Credentials vary based on the registry type.

Registry Type	Credentials
Azure	Tenant ID, Client ID, Secret Key
AWS	Access Key, Secret Key
GCP	Service account key in JSON format
Other	Username, Password

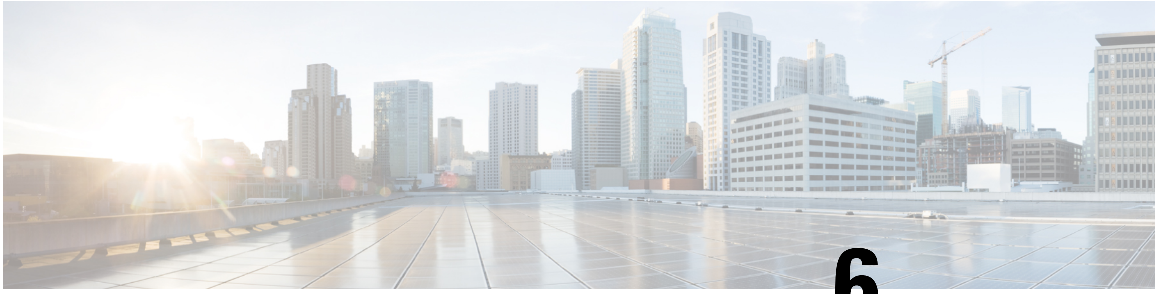
Troubleshooting

Follow these steps to ensure a successful connection:

a. The scanner pod is able to connect to the registry.

b. The required network policies are in place.

c. Credentials are entered, if necessary.



CHAPTER 6

Policies

Segmentation Policy Basics

The purpose of segmentation and microsegmentation policies is to allow only the traffic your organization needs to conduct business, and block all other traffic. The goal is to reduce your network's attack surface without disrupting business operations.

Secure Workload segmentation policies allow or block traffic based on its source, destination, port, protocol, and a few other attributes that are typically platform-specific.

You can create some policies manually, and use Secure Workload's powerful automatic policy discovery feature to generate other policies based on existing network traffic.

You can review, refine, and analyze your policies, then enforce them when you are confident that they allow only the traffic that your organization needs.

Important Microsegmentation essentially creates a firewall around each workload.

Therefore, for traffic to pass between each consumer-provider pair, both ends of the conversation must allow the conversation to happen: The consumer and the provider must each have a policy that allows the traffic.

Note The terms *firewall rule*, *edge*, and *cluster edge* are sometimes used to mean "policy."

Use Workspaces to Manage Policies

Workspaces (formerly called “Application workspaces” or “Applications”) are where you work with and manage policies.

You can perform all policy-related activities for a particular scope, such as creating, analyzing, and enforcing policies, in the workspace or workspaces associated with that scope.

Each workspace provides an isolated environment, allowing experimentation with no effect on other workspaces.

Controlling User Access to Workspaces

Workspaces are meant to be used by multiple users from the same team as shared documents.

To control access to a workspace, assign user roles for the scope associated with the workspace. See Roles, on page 716.

Working with Policies: Navigating to the Workspaces Page

- **To work with policies, or to view existing application workspaces or create new ones:**

  Choose **Defend** > **Segmentation** from the navigation bar at the left side of the window.

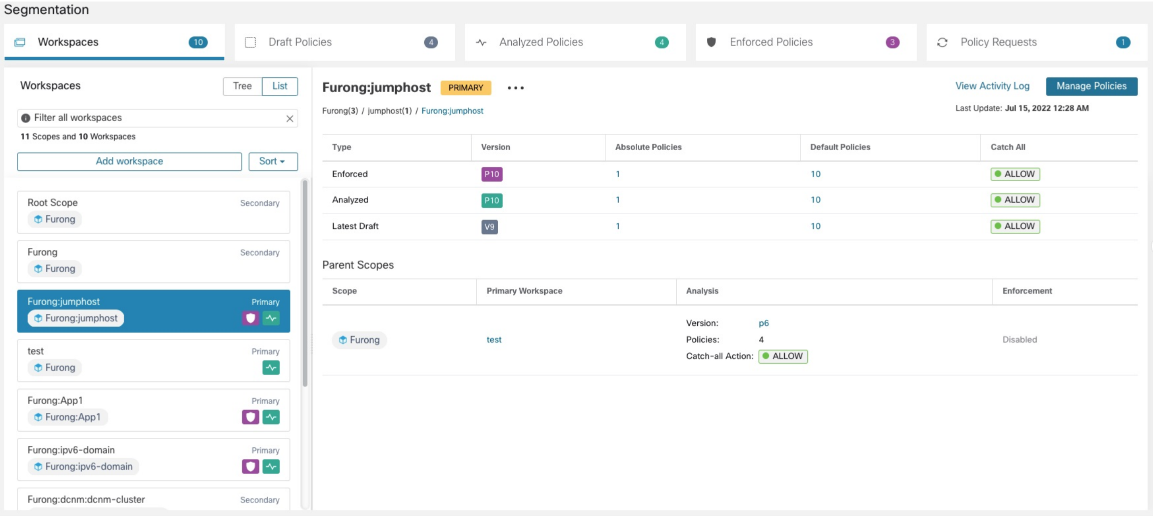
- **To view a particular workspace:**

  In the list of scopes at the left side of the Workspaces page, navigate to the scope associated with the workspace, then click the workspace. The current active workspace is highlighted in the list.

- **If you are looking at a workspace and want to return to the list of workspaces:**

  Click the **Workspaces** link near the left side of the page you are looking at.

Figure 234: Workspace Management Page



Last Update: **Jul 15, 2022 12:28 AM**

Type	Version	Absolute Policies	Default Policies	Catch All
Enforced	P10	1	10	● ALLOW
Analyzed	P10	1	10	● ALLOW
Latest Draft	V9	1	10	● ALLOW

Parent Scopes

Scope	Primary Workspace	Analysis	Enforcement
Furong	test	Version: p6 Policies: 4 Catch-all Action: ● ALLOW	Disabled

Create a Workspace

To create policies for a scope, first create a workspace for that scope.

To create a workspace:

1. From the navigation menu on the left side of the window, choose **Defend** > **Segmentation**.
2. In the scope listing on the left side of the page, search for or scroll to the scope for which you want to create policies.
3. Hover over the scope until you see a blue plus sign, then click it.
4. Complete the form and click **Create** when done.

If a workspace exists for the scope, any additional workspaces is created as a secondary workspaces.

Primary and Secondary Workspaces

For each scope, you can create one Primary workspace and multiple secondary workspaces.

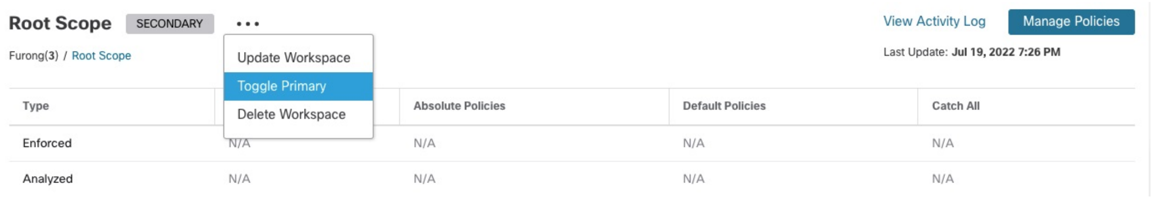
Only a primary workspace can be enforced. Other features that are available only for primary workspaces include the ability to manage policies in which consumer and provider reside in different scopes; live policy analysis; compliance reporting; and collaborative security policy definition.

Use secondary workspaces to experiment with policies when you want to preserve the existing policies in the primary workspace.

To change a workspace to primary or secondary:

You can switch a workspace from primary to secondary and conversely at any time by clicking the menu icon next to the workspace name at the top of the page and selecting **Toggle Primary**.

Figure 235: Switching a Workspace Between Primary and Secondary



Type		Absolute Policies	Default Policies	Catch All
Enforced	N/A	N/A	N/A	N/A
Analyzed	N/A	N/A	N/A	N/A

Rename a Workspace

To rename a workspace:

Click ••• beside the workspace type (Primary or Secondary) shown near the top of the page and choose **Update Workspace**.

View Workloads in a Scope

In any workspace, click the **Matching Inventories** tab.

Search Within a Workspace

To search within a workspace for workloads, clusters, or policies:

1. Select **Defend** > **Segmentation**.
2. From the list of scopes on the left, click the scope and workspace of interest.
3. Click **Manage Policies**.
4. Click the magnifying glass.
5. Enter search criteria.

Search Criteria

Multiple criteria are treated as logical AND.

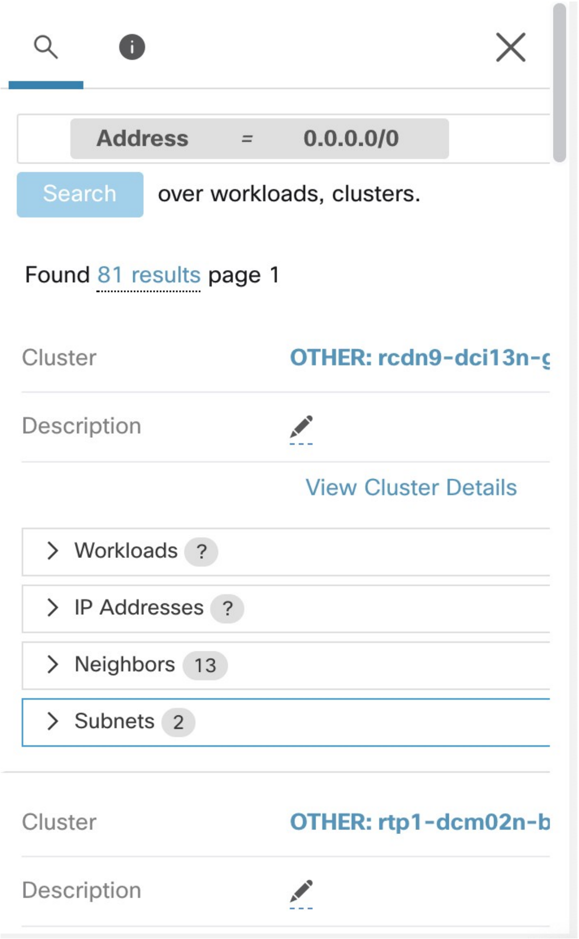
For IP addresses and numeric values:

- Indicate logical OR using a comma: ‘port: 80,443’.
- Range queries are also supported for number values: ‘port: 3000-3999’.

Filters	Description
Name	Enter a cluster or workload name. Performs case-sensitive substring search.
Description	Searches cluster descriptions.
Approved	Matches approved clusters using the values ‘true’ or ‘false’.

Filters	Description
Address	Enter a subnet or IP address using CIDR notation (for example, 10.11.12.0/24). Matches workloads or clusters which overlap this subnet.
Supernet	Enter a subnet using CIDR notation (for example, 10.11.12.0/24) to match clusters whose workloads are fully contained in this subnet.
Process	Searches workload processes using case-sensitive substring search.
Process UID	Searches workload process usernames.
Port	Searches both workload provider port and policy port.
Protocol	Searches both workload provider protocol and policy protocol.
Consumer Name	Matches a policy’s consumer cluster name. Performs a case-sensitive substring match.
Provider Name	Matches a policy’s provider cluster name. Performs a case-sensitive substring match.
Consumer Address	Matches policies whose consumer address overlaps with the provided IP or subnet.
Provider Address	Matches policies whose provider address overlaps with the provided IP or subnet.

Search Example



Address = 0.0.0.0/0

Search over workloads, clusters.

Found 81 results page 1

Cluster OTHER: rcdn9-dci13n-g

Description

View Cluster Details

Cluster OTHER: rtp1-dcm02n-b

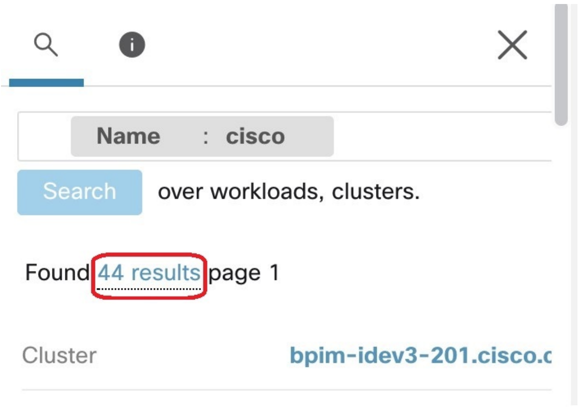
Description

Filtering Search Results by a Specific Type

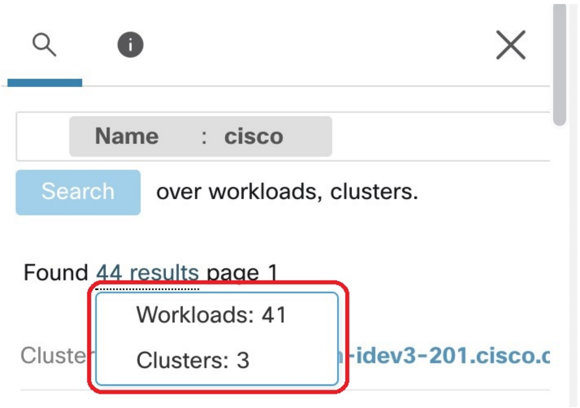
Search results may include multiple types of objects, for example workloads and clusters.

To filter search results by a specific type:

1. Click the result total:



2. Select the type from the dropdown:



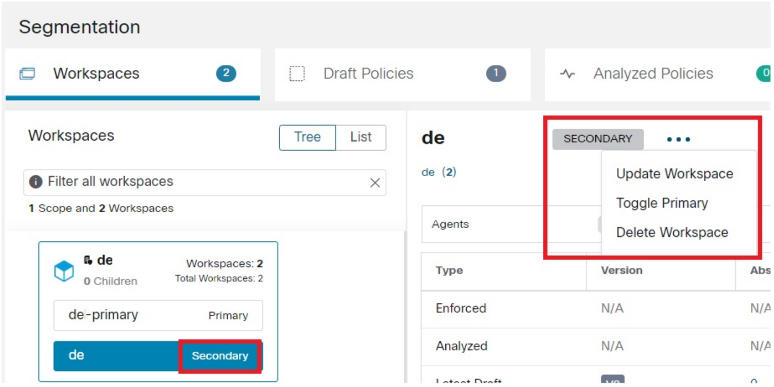
3. A type filter will be added and the search will be rerun.

Deleting Workspaces

Only secondary (nonprimary) workspaces can be deleted. To switch a workspace to secondary, see Primary and Secondary Workspaces, on page 415.

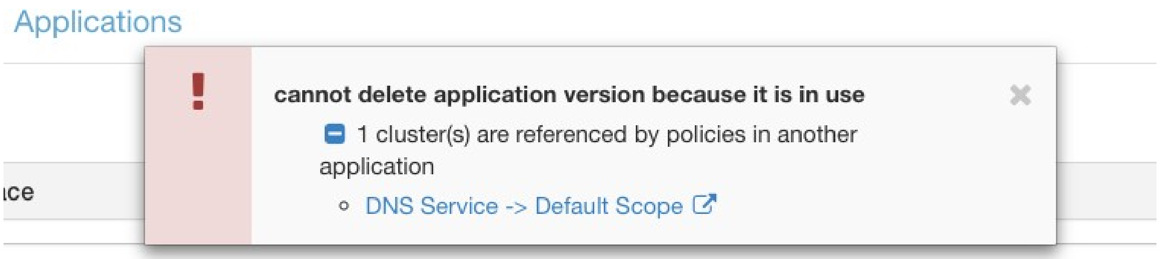
To delete a workspace:

1. Choose **Defend** > **Segmentation**.
2. In the list of scopes at the left side of the page, navigate to the scope containing the workspace to delete and click it.
3. Click the workspace to delete.
4. Click ••• beside **Secondary** and choose **Delete Workspace**.



If a workload or cluster in a workspace is referenced by a policy in another workspace as a result of a Provided Service, the dependent workspace cannot be deleted, and a list of the dependencies will be returned. This information can be used to fix the dependency.

Figure 236: List of Items Preventing the Deletion of the Workspace


Applications

cannot delete application version because it is in use

1 cluster(s) are referenced by policies in another application

- DNS Service -> Default Scope

In rare conditions there may be a cross dependency where Workspace A depends on a cluster in Workspace B and a Workspace B depends on a cluster in Workspace A. In this case, the individual policies or published policy versions (p*) must be deleted. The “delete restrictions” error provides links to all the policies so this can be accomplished.

To delete p* versions, see View, Compare, and Manage Analyzed Policy Versions, on page 532 or View, Compare, and Manage Enforced Policy Versions, on page 547.

About Policies

Policy Attributes

Table 21: Policy Properties

Security Policy Property	Description
Scope for which the policy is defined	A policy generally affects only workloads that are members of the scope associated with the workspace in which the policy is defined. (However, see also the topics under Address Policy Complexities, on page 494.) For more information, see Policy Example, on page 423.
Consumer	The client of a service or the initiator of a connection. Any scope, cluster, or inventory filter can be used as the consumer in a policy. See important information in About Consumer and Provider in Policies, on page 422.
Provider	The server or the recipient of a connection. Any scope, cluster, or inventory filter can be used as the provider in a policy. See important information in About Consumer and Provider in Policies, on page 422.
Protocols and Ports	The server (listening) port and IP protocol of the service made available by the provider that should be permitted or blocked.
Action	ALLOW or DENY: Whether to allow or drop traffic from consumer to provider on the given service port/protocol.
Rank and Priority	For more information the rank and priority of policies in a workspace, see Policy Rank: Absolute, Default, and Catch-All, on page 421.

Policy Rank: Absolute, Default, and Catch-All

Policy rank determines whether a policy is overridden by a more specific policy lower in the priority list (or in a scope lower in the scope tree). The lowest priority policy in every scope is always the Catch-all rule.

Policy Rank	Description
Absolute	Absolute policies take effect even if they contradict application-specific policies lower in the policy list (and thus, lower priority) or in scopes lower in the scope tree. Generally, use Absolute policies to enforce best practices, protect different zones, or quarantine-specific workloads. For example, use absolute policies to control traffic to DNS or NTP servers, or to meet regulatory requirements. Absolute policies are listed above default policies in the policy priority list.

Policy Rank	Description
Default	Default policies can be overridden by policies lower in the policy list or in scopes lower in the scope tree. Generally, fine-grained policies are Default policies. Default policies are listed below absolute policies in the policy priority list.
Catch-All	Each workspace has a catch-all policy that handles traffic in each direction that does not match any explicitly specified policies in the workspace. The catch-all action can be Allow or Deny. In general, set the Catch-All policy as follows: • **Allow** traffic in scopes higher in the scope tree, so that policies in scopes lower in the tree can evaluate the traffic. • **Deny** traffic at the most specific leaf at the bottom of the scope tree. This gives policies in all scopes in the tree the opportunity to match the traffic, while blocking traffic that does not match any policy in any scope. The catch-all rule is applied to all interfaces on each workload in the workspace.

Policy Inheritance and the Scope Tree

Because your workloads are organized into a hierarchical scope tree, you can create general policies once in a scope at or near the top of the tree, and the policies can optionally apply to all workloads in all scopes below that scope in the tree.

You specify whether the general policies can be overridden by more specific policies lower in the tree.

See Policy Rank: Absolute, Default, and Catch-All, on page 421.

About Consumer and Provider in Policies

The consumer and provider that is specified in a policy serve the following purposes:

- They specify the workloads or Secure Workload agents that receive policy or firewall rules.
- They specify the set of IP addresses to which the firewall rules that are installed on the workloads apply.

If a host has multiple interfaces (IP addresses), policies apply to all interfaces.

Important The above is the default behavior of how firewall rules are programmed on the workloads. If the IP addresses specified in the firewall rules differ from the IP addresses of the workloads that the policy is installed to, you need to separate the two purposes of consumers and providers in a policy. See Effective Consumer or Effective Provider, on page 513.

Policy Example

The following example policy illustrates the importance of the scope in which a policy is defined, the impact of policy inheritance, and the use of inventory filters to create precise policies or policies that apply to workloads in multiple scopes.

Consider the following example involving three scopes:

- **`Apps`**

  and its child scopes

  - **`Apps:HR`** and
  - **`Apps:Commerce`**

In addition, the inventory filters PRODUCTION and NON-PRODUCTION specify production and nonproduction hosts, respectively. (You can define an inventory filter to apply to hosts within a scope or across scopes.)

Assume that the following policy is defined in the **`Apps`** scope:

```
DENY PRODUCTION -> NON-PRODUCTION on TCP port 8000 (Absolute)
```

Since this policy is an absolute policy that is defined in the primary workspace under the **`Apps`** scope, it affects all PRODUCTION/NONPRODUCTION hosts that are members of the **`Apps`** scope, including members of its descendant scopes (hosts that belong to the **`Apps:HR`** and **`Apps:Commerce`** scopes).

Now consider the case where the exact same policy is defined under the workspace that is associated with the **`Apps:HR`** scope. In this scenario, the policy can only affect PRODUCTION/NONPRODUCTION hosts that are members of the **`Apps:HR`** scope. More precisely, this policy results in inbound rules on NONPRODUCTION HR hosts (if any) denying connections on TCP port 8000 from **any** PRODUCTION host, and outbound rules on PRODUCTION HR hosts (if any) dropping connection requests to **any** NONPRODUCTION host.

Create and Discover Policies

Best Practices for Creating Policies

- For an overview of the entire segmentation process, see Get Started with Segmentation and Microsegmentation, on page 2 and subtopics.
- Manually create policies that apply broadly across your network.

  For example, block unwanted traffic to your workloads from outside your network, or quarantine vulnerable hosts.

  - Create manual policies in scopes at or near the top of your scope tree.

    For example, to block all traffic from outside your network to every host in your network, put the policy into the scope at the top of the tree.

  - If you want to be able to override the general policy for some workloads (for example, following the example above, you want to block general access from outside your network but you want some workloads to be accessible from outside the network), create the high-level policies as Default policies. Then create specific policies for the applicable workloads.

  - Consider using templates to speed policy creation.

  - See Manually Create Policies, on page 424, Policies for Specific Purposes, on page 426, and Policy Templates, on page 428.

- (Optional) Initially, automatically discover policies at a scope near the top of your tree, for all scopes in a branch of the tree, to create coarse policies that allow all existing traffic and limit future unwanted traffic. You can then build granular policies that protects your network from unnecessary or unwanted traffic.

  See Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435 and Discover Policies Automatically, on page 432 for information.

- When you are ready to discover more granular policies, automatically discover policies for scopes at or near the bottom of your scope tree, especially in the scopes for individual applications.

  See Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435 and Discover Policies Automatically, on page 432 for information.

- Be sure you have policies that address uncommon or infrequent activities and scenarios, such as failover, restoration from backup, once-yearly activities, and so on.

- After you have identified and allowed the traffic that your applications require, then look for any traffic that shouldn't be occurring and block such instances.

  Look first at traffic to and from your most sensitive applications.

  For example, if you see traffic from your customer-facing web app to your top-secret research and development app's database, you want to investigate.

- Work with your colleagues to ensure that the correct policies are applied to the correct workloads.

- Initially, when you enforce policies, consider setting the catch-all to Allow. Then, monitor traffic to see what matches the catch-all rule. When no necessary traffic is matching the catch-all rule, you can set the catch-all to Deny.

Manually Create Policies

Typically, you can manually create policies that apply broadly across your network.

For example, you can manually create policies to:

- Allow access from all internal workloads to your NTP, DNS, Active Directory, or vulnerability scanning servers.

- Deny access from all hosts outside your organization to hosts inside your network unless explicitly permitted.

- Quarantine vulnerable workloads.

You can create absolute policies that cannot be overridden by more granularly applied policies, and default policies that can be overridden if a more specific policy exists.

You can create manual policies for scopes nearer the top of your tree.

Before you begin

- (Optional) Consider using one of the templates available from **Defend** > **Policy Templates**.
- (Optional) If you know you have a set of workloads that receive the same policies, use an inventory filter to group them so you can easily apply policies to the set. The inventory filter can apply to only one scope, or to workloads in any scope. See Create an Inventory Filter, on page 379.
- Make sure that the workloads in this scope are the workloads that you expect to be in this scope. See View Workloads in a Scope, on page 416.

Procedure

Step 1 Click **Defend** > **Segmentation**.

Step 2 In the list on the left, search for or navigate to the scope in which you want to create the policy.

Step 3 Click the scope and workspace in which you want to create the policy.

If you haven't yet created the workspace for this scope, see Create a Workspace, on page 415.

Step 4 Click **Manage Policies.**

Step 5 Click the **Policies** tab if it is not already selected.

Step 6 Click **Add Policy**.

If you don't see an Add Policy button, see If the Add Policy Button Is Not Available, on page 425.

Step 7 Enter information.

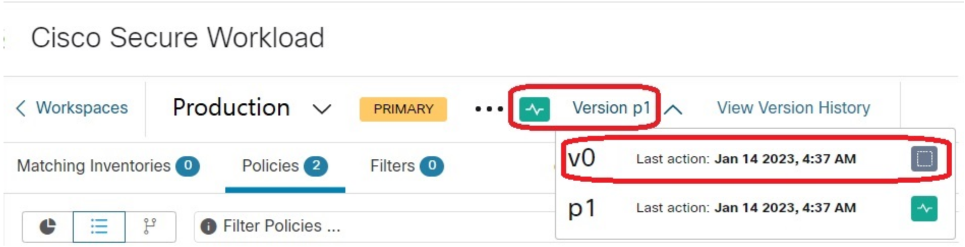
- For information about the **Absolute** checkbox, see Policy Rank: Absolute, Default, and Catch-All, on page 421. Generally, if you are creating policies that you don't expect exceptions for, enable this checkbox.
- **Priority** sets the order of the policy in the list. For more information about setting policy order, see Policy Priorities, on page 494 and subtopics. (You can set policy order later.)
- Consumer and provider can be entire scope, or, if you have created groups of workloads using inventory filters (or less optimally, clusters in the same workspace), you can choose those.

What to do next

Make sure the **Catch-all** action is appropriate for the workspace. See Policy Rank: Absolute, Default, and Catch-All, on page 421.

If the Add Policy Button Is Not Available

If you are trying to create a policy and the **Add Policy** button is not available, click the version showing at the top of the page and choose the latest "v" version, which is indicated with a gray square:



Policies for Specific Purposes

Create InfoSec Policies to Block Traffic from Outside Your Network

Use this procedure to quickly create a complete set of policies to control traffic entering your network from outside the network. The default set of policies allows only traffic using common ports and protocols and denies all other traffic. You can modify the default policy set to meet your needs.

Before you begin

Use this procedure if the following criteria are met:

- Your scope tree has a scope that is named **Internal** immediately below the root scope.

  This scope's members include, or will include, subnets encompassing all workloads on your internal network.

- The Internal scope does not yet have any policies defined in it.

Note Alternatively, you can use the **InfoSec** template available from **Defend** > **Policy Templates** to accomplish this with a few additional steps.

Procedure

Step 1 Choose **Defend** > **Segmentation**,

Step 2 Click the **Internal** scope and click the primary workspace.

If the Primary workspace does not yet exist, click the + button to create it.

Step 3 Click **Manage Policies**.

Step 4 Click **Add InfoSec Policies**.

Step 5 Verify that all the policies in the list, including protocols and ports, are policies you want and delete and modify policies as desired.

Step 6 Click **Create**.

What to do next

(Optional) Add any additional policies to your Internal scope, such as policies that allow certain external traffic to specific workloads.

Place any specific policies below the more general policies in the list.

Create Policies to Address Immediate Threats

If you must address an immediate threat, you can manually add a narrowly focused Absolute policy to a scope at or near the top of your scope tree, then enforce the primary workspace for that scope.

After you remediate the threat, you can remove that policy and reenforce the workspace.

Create a Policy to Quarantine Vulnerable Workloads

You can:

- Create policies in advance, to automatically quarantine workloads with specific known vulnerabilities or a vulnerability severity threshold you specify.
- Create policies, to immediately quarantine workloads with detected known vulnerabilities that you deem sufficiently problematic.

This topic outlines the process for doing either.

Before you begin

Look at the Vulnerability Dashboard, on page 689 to see what policies are required.

Procedure

Step 1 Create an inventory filter that defines the vulnerabilities or the vulnerability severity threshold that you want to quarantine:

a) From the navigation bar at the left of the window, choose **Organize > Inventory Filters**.
b) Click **Create Inventory Filter**
c) Click the **(i)** button beside **Query** and enter `CVE` to see the relevant filter options.
d) Enter filter criteria that determine which workloads you wish to quarantine.
e) Be sure **Restrict query to ownership scope** is NOT selected.

Step 2 Create a policy to quarantine affected workloads:

For general instructions, see Manually Create Policies, on page 424.

Recommendations:

- Create the policy in your **Internal** or other scope near the top of your scope tree.
- The policy should be an Absolute policy unless you want to allow exceptions. Be sure to create policies to address any exceptions.
- Create separate policies for consumer and provider.
- Set the priority of each policy to a low number so it will be hit before other policies in the list.
- Set the action to **Deny**.

Step 3 Review, analyze, and enforce the policy or policies.

What to do next

Create an alert so you are notified when traffic hits this policy so you can remediate the problem and restore traffic to the vulnerable workload. See Configure Alerts, on page 641.

Policy Templates

Policy Templates are used to apply similar sets of policies to multiple workspaces.

Secure Workload includes some predefined templates, and you can create your own templates.

Policy templates require the scope owner capability on the root scope.

System-Defined Policy Templates

To view available policy templates, navigate to **Defend** > **Policy Templates**.

To use a policy template, see Applying a Template, on page 431.

To modify a system-defined template, download the JSON file, edit it, then upload it.

Create Custom Policy Templates

JSON Schema for Policy Templates

The policy template JSON schema is designed to mimic the schema of Export a Workspace. You can create a set of policies in a workspace, export it as JSON, modify the JSON, then import as a policy template.

Attribute	Type	Description
name	string	(optional) Used as the name of the template during import.
description	string	(optional) Template description that is displayed during the apply process.
parameters	parameters object	Template parameters, see below.
absolute_policies	array of policy objects	(optional) Array of absolute policies.
default_policies	array of policy objects	(required) Array of default policies, can be empty.

Parameters Object

The parameters object is optional but can be used to dynamically define filters as parameters to the template. The parameters are referenced using the `consumer_filter_ref or provider_filter_ref` policy attributes.

The keys of the parameters object are the reference names. The values are an object with a required `"type": "Filter"` and an optional description. An example Parameters object is shown below:

```
{
  "parameters": {
    "HTTP Consumer": {
      "type": "Filter",
      "description": "Consumer of the HTTP and HTTPS service"
    },
    "HTTP Provider": {
      "type": "Filter",
      "description": "Provider of the HTTP and HTTPS service"
    }
  }
}
```

The parameters can be referenced in the policy objects, for example: `"consumer_filter_ref": "HTTP Consumer"` or `"provider_filter_ref": "HTTP Provider"`.

Special Parameter References

A few special references automatically map to a filter and do not need to be defined as parameters.

Ref	Description
_workspaceScope	Resolves to the scope of the workspace to which the template is being applied.
_rootScope	Resolves to the root/top level scope.

Policy Object

To maintain compatibility with the workspace export JSON, the policy object contains multiple keys for consumers and providers. They are resolved as follows:

```
if *_filter_ref is defined
  use the filter resolved by that parameter
else if *_filter_id is defined
  use the filter referenced by that id
else if *_filter_name is defined
  use the filter that has that name
else
  use the workspace scope.
```

If a filter cannot be resolved as defined above, an error is returned both at the time of application and at the time of upload.

Attribute	Type	Description
action	string	(optional) Action of the policy, ALLOW, or DENY (default ALLOW).
priority	integer	(optional) The priority of the policy (default 100).
consumer_filter_ref	string	Reference to a parameter.

Attribute	Type	Description
consumer_filter_name	string	Reference to a filter by name.
consumer_filter_id	string	ID of a defined Scope or Inventory Filter.
provider_filter_ref	string	Reference to a parameter.
provider_filter_name	string	Reference to a filter by name.
provider_filter_id	string	ID of a defined Scope or Inventory Filter.
l4_params	array of l4params	List of allowed ports and protocols.
Attribute	Type	Description
proto	integer	Protocol integer value (NULL means all protocols).
port	integer	Inclusive range of ports, for example, [80, 80] or [5000, 6000] (NULL means all ports).

L4param object

Attribute	Type	Description
proto	integer	Protocol integer value (NULL means all protocols).
port	integer	Inclusive range of ports, for example, [80, 80] or [5000, 6000] (NULL means all ports).

Template Sample

```
{
  "name": "Allow HTTP/HTTPS and SSH",
  "parameters": {
    "HTTP Consumer": {
      "type": "Filter",
      "description": "Consumer of the HTTP and HTTPS service"
    },
    "HTTP Provider": {
      "type": "Filter",
      "description": "Provider of the HTTP and HTTPS service"
    }
  },
  "default_policies": [
    {
      "action": "ALLOW",
      "priority": 100,
      "consumer_filter_ref": "__rootScope",
      "provider_filter_ref": "__workspaceScope",
      "l4_params": [
        { "proto": 6, "port": [22, 22] },
      ]
    },
    {
      "action": "ALLOW",
      "priority": 100,
      "consumer_filter_ref": "HTTP Consumer",
      "provider_filter_ref": "HTTP Provider",
      "l4_params": [
        { "proto": 6, "port": [80, 80] },
        { "proto": 6, "port": [443, 443] }
      ]
    }
  ]
}
```

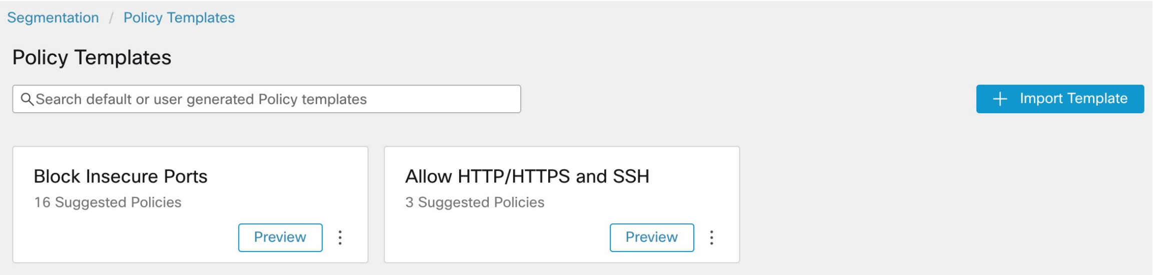
Template Import

Policy Templates shown on the Policy Templates page that can be accessed from the main Segmentation page. This is where templates can be imported/uploaded using the “Import Template” button.

Templates are validated for correctness when they are uploaded. A helpful list of errors is provided to debug any issues.

Once a template is uploaded, it can be applied, downloaded, or have its name and description updated.

Figure 237: Display of Available Templates



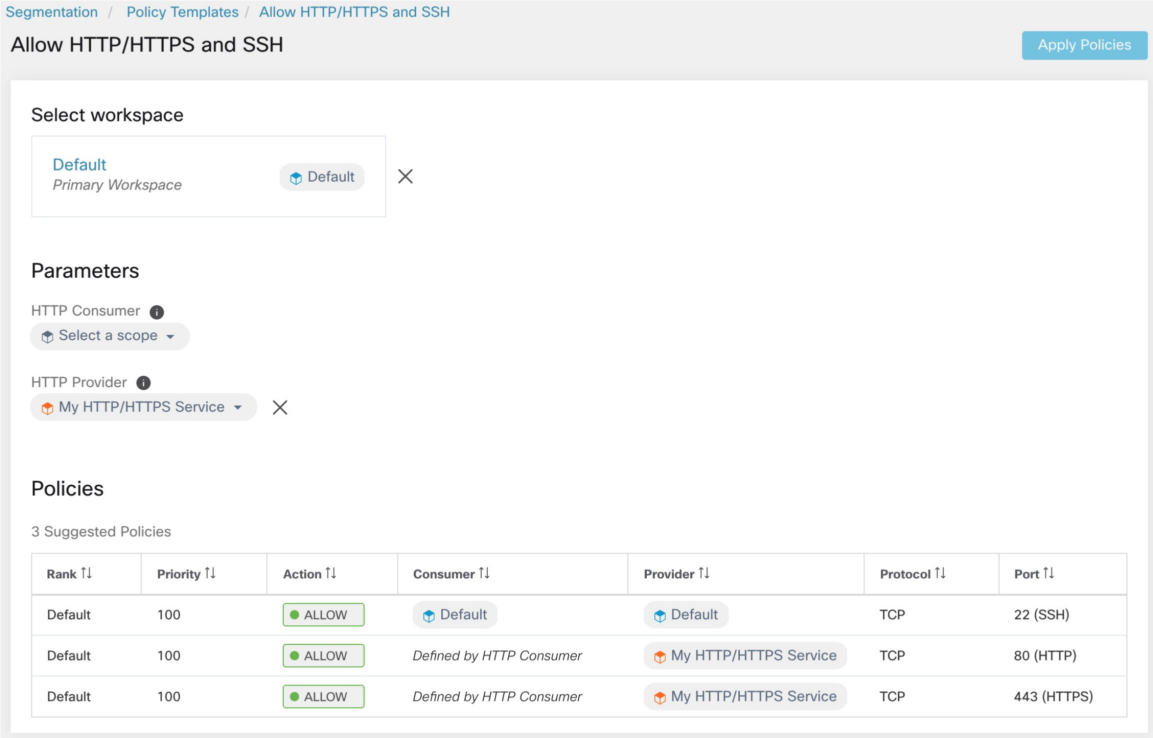
Applying a Template

Applying a template to a workspace takes several steps:

1. Select a template to preview.
2. Select a workspace to apply the template to.
3. Fill in parameters, if necessary.
4. Review the policies.
5. Apply the policies.

The policies will be added to the latest version of the selected workspace. Policies created via a template can be filtered using the `From Template? = true` filter.

Figure 238: Applying a Policy Template



Segmentation / Policy Templates / Allow HTTP/HTTPS and SSH

Allow HTTP/HTTPS and SSH

Apply Policies

Select workspace

Default
Primary Workspace
Default

Parameters

HTTP Consumer
Select a scope

HTTP Provider
My HTTP/HTTPS Service

Policies

3 Suggested Policies

Rank	Priority	Action	Consumer	Provider	Protocol	Port
Default	100	ALLOW	Default	Default	TCP	22 (SSH)
Default	100	ALLOW	*Defined by HTTP Consumer*	My HTTP/HTTPS Service	TCP	80 (HTTP)
Default	100	ALLOW	*Defined by HTTP Consumer*	My HTTP/HTTPS Service	TCP	443 (HTTPS)

Discover Policies Automatically

Automatic policy discovery, sometimes referred to as policy discovery, and formerly known as Application Dependency Mapping (ADM), uses existing traffic flows and other data to do the following:

- Suggest a set of “allow” policies based on existing successful network activity.

  The goal of these policies is to identify the traffic that your organization needs, and block all other traffic.

- Group workloads into clusters based on similarity of their computing behavior

  For example, if an application includes multiple web servers, those might be clustered together.

  For more information, see Clusters, on page 484.

You can discover policies for each scope. Typically, you discover policies for scopes at or near the bottom of your scope tree, for example at the application level. However, for initial deployment, you might want to discover policies at a higher-level scope, so you have general, temporary policies in place while you create more refined policies.

You can discover policies as often as desired, to refine the suggested policies based on additional information.

You can manually modify suggested policies and clusters, and/or approve any of them so they are carried forward and not modified by subsequent discovery runs.

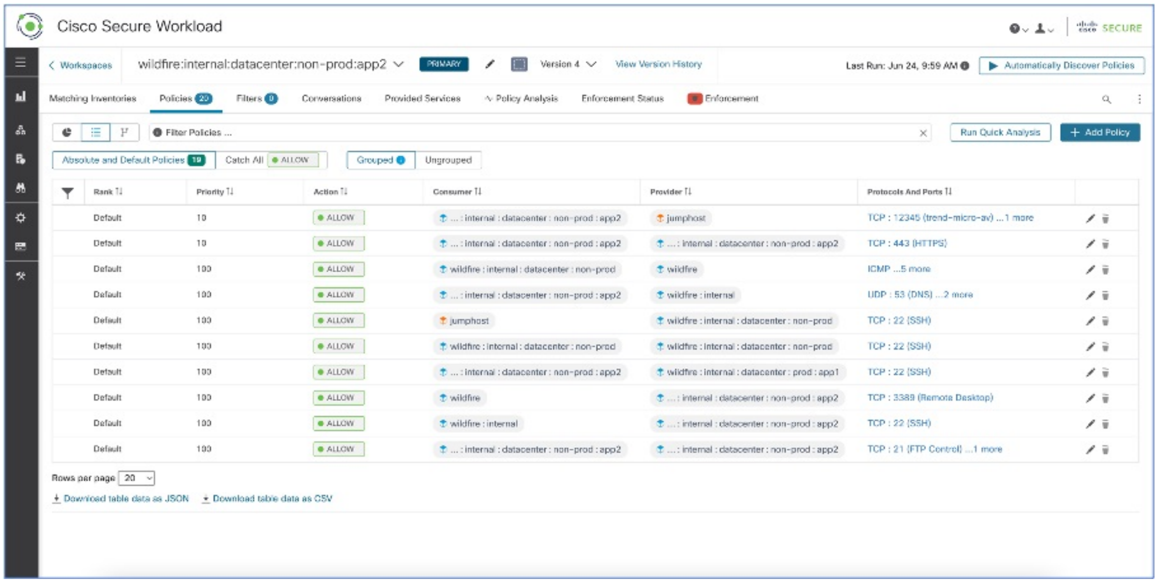
You can include both manually created policies and discovered policies in a workspace.

After you discover policies, you will review and analyze them before enforcing them.

To get started discovering policies, see How to Automatically Discover Policies, on page 433.

For more information, see Policy Discovery Details, on page 433.

Figure 239: Example: Automatically Discovered Policies



Rank	Priority	Action	Consumer	Provider	Protocols And Ports
Default	10	ALLOW	... : internal : datacenter : non-prod : app2	jumphost	TCP : 12345 (trend-micro-av) ...1 more
Default	10	ALLOW	... : internal : datacenter : non-prod : app2	... : internal : datacenter : non-prod : app2	TCP : 443 (HTTPS)
Default	100	ALLOW	wildfire : internal : datacenter : non-prod	wildfire	ICMP ...5 more
Default	100	ALLOW	... : internal : datacenter : non-prod : app2	wildfire : internal	UDP : 53 (DNS) ...2 more
Default	100	ALLOW	jumphost	wildfire : internal : datacenter : non-prod	TCP : 22 (SSH)
Default	100	ALLOW	wildfire : internal : datacenter : non-prod	wildfire : internal : datacenter : non-prod	TCP : 22 (SSH)
Default	100	ALLOW	... : internal : datacenter : non-prod : app2	wildfire : internal : datacenter : prod : app1	TCP : 22 (SSH)
Default	100	ALLOW	wildfire	... : internal : datacenter : non-prod : app2	TCP : 3389 (Remote Desktop)
Default	100	ALLOW	wildfire : internal	... : internal : datacenter : non-prod : app2	TCP : 22 (SSH)
Default	100	ALLOW	... : internal : datacenter : non-prod : app2	... : internal : datacenter : non-prod : app2	TCP : 21 (FTP Control) ...1 more

Policy Discovery Details

Additional information about automatic policy discovery:

- Automatic policy discovery considers conversations in which at least one end is a member workload of the scope within the time range selected. Membership in the scope is based only on the most current scope definition; former membership is not considered.
- By default, policy discovery produces policies and clusters by analyzing communication flows ("conversations"), but optionally can consider other information such as processes running on workloads or load balancer configurations.

  See Include Data From Load Balancers and Routers When Discovering Policies, on page 448.
- You can discover policies in any workspace within the scope. Discovery results in each workspace are independent of the results in other workspaces in the scope.
- For detailed discussions of complex concepts that are related to automatic policy discovery, see Advanced Features of Automatic Policy Discovery, on page 441 and Address Policy Complexities, on page 494.

How to Automatically Discover Policies

Perform the following steps. At any point, you can decide to discover policies again.

Work with colleagues as needed to complete these steps.

Step	Do This	More Information
1	Upload and label your workload inventory, and gather flow data that inform policy discovery.	See Get Started with Segmentation and Microsegmentation, on page 2 and subtopics.
2	Choose whether you discover policies for: • Workloads in a single scope • Workloads in all of the scopes in a branch of the scope tree	See Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435. (You can always discover policies again at any time.)
3	Choose the scope in which you discover policies.	This depends in part on whether you discover policies for a single scope or for a branch of the scope tree.
4	Choose the workspace in which you discover policies.	Generally, you will discover policies in the scope's primary workspace, because you can only analyze policies in a primary workspace. (However, you can always change a workspace to primary later.) If your chosen scope does not yet have a workspace, see Create a Workspace, on page 415.
5	Confirm the inventory that you expect to include in policy discovery.	Verify the Workloads That Policy Discovery Will Apply To, on page 437
6	(Optional) Create inventory filters to group workloads that you want to treat as a group.	See Create an Inventory Filter, on page 379.
7	Set the **Catch-all** action for the workspace.	See Policy Rank: Absolute, Default, and Catch-All, on page 421
8	Discover Policies	Discover Policies Automatically, on page 432 Be sure to complete the prerequisites in the "Before You Begin" section.
9	View and manage the clusters (groups of workloads) that policy discovery creates. (This step applies only when you discover policies for a single scope; clusters are not generated when you discover policies for a branch of the tree.)	See Clusters, on page 484 and subtopics. Evaluate the suggested clusters, optionally edit cluster membership as needed, and approve (or better, convert to inventory filters) any clusters that you want to make permanent.
10	Consider complexities such as policy inheritance and cross-scope policies.	See Address Policy Complexities, on page 494.
11	Review generated policies.	See Review Automatically Discovered Policies, on page 516 and subtopics

Step	Do This	More Information
12	Approve policies that you want to keep.	Approve Policies, on page 459
13	Discover policies again as desired, to reflect additional flow data, changes in scope membership, or other changes.	Important: Before You Re-run Automatic Policy Discovery, on page 462 You can rerun policy discovery at any time. Review and approve policies and clusters each time you discover policies.
14	Run live analysis to see how your policies affect your actual traffic.	When you believe that your policies do what you expect them to do, start Live Policy Analysis, on page 523. If you change policies or rediscover policies, restart policy analysis (to analyze the current policies).
15	If you re-discover policies or make other changes, restart live analysis.	See After Changing Policies, Analyze Latest Policies, on page 531.
16	When you are confident that the policies will not block essential traffic, enforce the workspace.	See Enforce Policies, on page 534 and subtopics.
17	Verify that enforcement is working as expected.	See Verify That Enforcement Is Working as Expected, on page 543
18	(Optional) Configure default policy discovery settings that optionally apply when discovering policies in any workspace.	See Default Policy Discovery Config, on page 457 and linked topics. Because these are advanced settings, we recommend that you change them only if you have a specific need to change them. You can change them at any time during your process as you realize a need.

Discover Policies for One Scope or for a Branch of the Scope Tree

If either option is not possible when you discover policies for a particular scope, the selection is made for you and you will not see a choice of options.

Table 22: Discovering Policies For

A Branch of the Scope Tree	A Single Scope
Use this method as a starting point, when you are beginning to use Secure Workload, to quickly generate a temporary set of coarse policies that allow existing traffic while helping to protect your network from future threats.	Use this method to fine-tune segmentation policies and ensure that all allowed flows are expected; the smaller number of policies makes it easier to see any existing anomalies that require investigation.

A Branch of the Scope Tree	A Single Scope
Typically, you use this method for scopes nearer the top of your scope tree. The top of the branch can be any scope in the tree.	Typically, you use this method for scopes at or near the bottom of your scope tree, for example for scopes dedicated to a single application.
Discover policies only in one scope – the scope at the top of the branch that you choose.	Discover policies for each scope in the branch as needed.
All workloads in the chosen scope and all child and descendant scopes are included in discovery.	Workloads that are also members of any child scope are not included in discovery for this scope. Policies are generated only for workloads that appear in the **Uncategorized Inventory** tab for that scope on the **Organize** > **Scopes and Inventory** page. You can discover policies for workloads in child and descendant scopes separately.
All policies for workloads in all scopes in the branch reside in the scope at the top of the branch.	Assuming you also create policies for workloads in child and descendant scopes, policies reside in multiple scopes.
This method typically generates a large number of policies.	This method generates fewer policies in any individual scope.
Discovered policies apply to entire scopes; this option cannot create policies specific to subsets of workloads within scopes.	This option can generate policies that apply to subsets of workloads within the consumer and/or provider scope. (Workloads can be grouped by generated clusters and/or by configured inventory filters, and policies applied just to these subsets.)
All policies are created in a single scope at the top of the branch, so extra steps are not required when a policy's consumer and provider are in different scopes.	Allowing traffic between consumers and providers in different scopes requires extra steps. See When Consumer and Provider Are In Different Scopes: Policy Options, on page 500.
Discovery can run even if a scope does not have any member workloads with installed agents, as long as descendant scopes have agents or external orchestrators or connectors that gather flow data.	The scope must have member workloads with installed agents or external orchestrators or connectors that gather flow data.
This option is available to root scope owners and site admins only.	You must have privileges to create policies for this scope.
The maximum number of agents and conversations is different for each option. See Limits Related to Policies, on page 950.	
This option was formerly the Deep Policy Generation advanced configuration option for automatic policy discovery. The behavior has not changed.	This was formerly the default behavior for automatic policy discovery.

A Branch of the Scope Tree	A Single Scope
For additional details, see Discovering Policies for a Branch of the Scope Tree: Additional Information, on page 437.	--

Discovering Policies for a Branch of the Scope Tree: Additional Information

- All workloads that are conversation endpoints, whether or not they are members of the scope in which policy discovery is run, are assigned the highest matching scope label according to the top-down order given in the external dependencies list.
- For advanced configuration options available when you generate policies for a branch of the scope tree, see:
  - Enable redundant policy removal, on page 454
  - Policy Compression, on page 450 and related subtopic, Hierarchical policy compression, on page 450
- Currently, the count of workloads shown for automatic policy discovery includes only those that are not also members of a subscope.

Verify the Workloads That Policy Discovery Will Apply To

Before you automatically discover policies, verify that the workloads on which policy discovery will be based are in fact the set of workloads you expect. Discovered policies will be generated from flow data captured by agents on these workloads.

Before you begin

Decide which of the options in Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435 you can use.

Procedure

Step 1 From the navigation menu on the left, choose **Defend** > **Segmentation**.

Step 2 Click the scope for which you want to discover policies.

Step 3 Click the workspace in which you want to discover policies.

Step 4 Click **Manage Policies**.

Step 5 Click **Matching Inventories**.

Step 6 If you discover policies for a single scope:

a) Click **Uncategorized Inventory**

This page shows workloads that are not also members of child scopes. (In standard automatic policy discovery, policies and clusters are generated in this scope only for workloads that are not also members of child scopes.)

b) Click **IP addresses**.

IP addresses on this page do not have Secure Workload agents installed.

Because they do not have agents that are installed, these IP addresses are not considered during automatic policy discovery for this scope UNLESS:

- Policy is being managed via a cloud connector
- The IP addresses are container-based inventory, in which case individual workloads appear on the **Pods** tab, or
- The workloads happen to communicate with a workload in this scope that is considered during policy discovery.

Before discovering policies, consider installing agents on workloads that need them and allowing some time to pass for flow data to accumulate.

c) Click **Workloads**.

Policies and clusters are generated only for workloads on this page and for IP addresses on the IP addresses tab that meet the criteria specified above for consideration.

d) If you have Kubernetes or OpenShift inventory, you will see a **Services** tab and a **Pods** tab.

If you have installed agents on your Kubernetes/OpenShift workloads, check the inventory on those tabs as well.

e) If you have load-balancer inventory, that inventory appears on the **Services** tab.

Step 7 If you discover policies for a branch of the tree:

a) Click **All Inventory**

This process generates policies (but not clusters) for all workloads in this scope, whether they are also members of child scopes.

b) Click **IP addresses**.

IP addresses on this page do not have Secure Workload agents installed.

Because they do not have agents installed, these IP addresses will not be considered during automatic policy discovery for this scope unless:

- Policy is managed via a cloud connector
- The IP addresses are container-based inventory, in which case individual workloads appear on the **Pods** tab, or
- The workloads happen to communicate with a workload in this scope that is considered during policy discovery.

Before discovering policies, consider installing agents on these workloads and allowing some time to pass for flow data to accumulate.

c) Click **Workloads**.

Policies are generated only for workloads on this page and for IP addresses on the IP addresses tab that meet the criteria specified above for consideration.

d) If you have Kubernetes or OpenShift inventory, you will see a **Services** tab and a **Pods** tab.

If you have installed agents on your Kubernetes/OpenShift workloads, check the inventory on those tabs as well.

e) If you have load-balancer inventory, that inventory appears on the **Services** tab.

Step 8 Verify that the workloads are the set you expect.

Automatically Discover Policies

Use this procedure to generate suggested Allow policies based on existing traffic on your network.

You can rediscover policies at any time.

Before you begin

- Gather flow data before you can effectively automatically discover policies.

  Typically, this means you have installed agents on the workloads in the scope, or have configured and gathered data using a cloud connector or external orchestrator.

  Flow summary data that is used by automatic policy discovery is computed every 6 hours. Thus, upon initial deployment of Secure Workload, automatic policy discovery is not possible until such data is available.

  More flow data generally produces more accurate results.

  Before you enforce policy, you should gather enough data to include traffic that occurs only periodically (monthly, quarterly, annually, and so on.) For example, if an application generates a quarterly report that gathers information from sources that the application does not access at other times, ensure that the flow data includes at least one instance of that report-generation process.

- Complete the steps up to this point in How to Automatically Discover Policies, on page 433.

- Meet the policy discovery-related Limits Related to Policies, on page 950.

  If necessary, break larger scopes into smaller child scopes.

- Commit any scope changes before discovering policies, or any configured exclusion filters may not match (exclude) flows as expected. See Commit Changes, on page 365.

Important If you are rerunning policy discovery, see important considerations first: Important: Before You Re-run Automatic Policy Discovery, on page 462.

Procedure

Step 1 Choose **Defend** > **Segmentation**.

Step 2 In the scope tree or list of scopes in the pane on the left, scroll to or search for the scope for which you want to generate policies.

Step 3 Click a workspace (primary or secondary) in the scope.

Step 4 Click **Manage Policies**.

Step 5 Click **Automatically Discover Policies**.

Step 6 If you see an option to discover policies for a branch or an entire scope, choose an option.

If you don't see an option, only one option is possible for the scope for which you are discovering policies.

For more information, see Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435.

Step 7 Choose the time range for the flow data that you want to include.

Experiment to find the right time range; you can generate policies as often as needed to get optimal results.

A shorter time range generates results faster, and may generate fewer results.

In general, a longer time range produces more accurate policies. However, if the scope definition has changed, donot include dates before the change is made.

Your time range should include traffic that occurs only periodically (monthly, quarterly, annually, and so on.) if applicable. For example, if an application generates a quarterly report that gathers information from sources that it does not access at other times, be sure that the time range includes at least one instance of that report-generation process.

To configure a time range beyond the last 30 days, select **custom** range, and fill in the desired start and end times under the drop-down time selection widget.

Step 8 (Optional) Specify advanced settings.

Generally, we suggest that you don't change advanced settings for initial discovery runs, then make changes only as needed to address specific issues.

For details, see Advanced Configurations for Automatic Policy Discovery, on page 447.

Step 9 Click **Discover Policies**. Generated policies appear on this page.

What to do next

- View Stop Automatic Policy Discovery in Progress, on page 440.
- Return to How to Automatically Discover Policies, on page 433 and continue with the next step in the table.
- You can rediscover policies at any time. For actions you should take first, see Important: Before You Re-run Automatic Policy Discovery, on page 462.

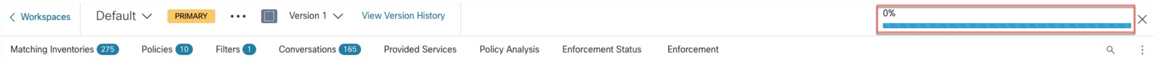
Stop Automatic Policy Discovery in Progress

Progress of automatic policy discovery is always visible in the header. Navigating to other workspaces does not affect the progress.

To stop the run while it is in progress, click the **abort** button.

Once the run is complete, a message is displayed. If successful, **Click to see results** navigates to a different view showing the changes before and after the run. If automatic policy discovery fails, it is indicated with a different message and a reason.

Figure 240: Automatic Policy Discovery Progress



Advanced Features of Automatic Policy Discovery

You must specify a time range for the discovery run. If necessary, you can configure advanced options.

You can configure advanced options for each workspace, or set defaults for all workspaces (the entire root scope), then modify the settings for individual workspaces as needed.

Table 23: Configure Advanced Options for Automatic Policy Discovery

For a Workspace	For All Workspaces
Option descriptions for individual workspaces (in column 1) apply also for all workspaces (column 2)	
External Dependencies, on page 444	Default Policy Discovery Config, on page 457
Advanced Configurations for Automatic Policy Discovery, on page 447	Default Policy Discovery Config, on page 457
Exclusion Filters, on page 441	Default Exclusion Filters, on page 457

Exclusion Filters

If certain flows are generating unwanted policies, you can exclude those flows from automatic policy discovery using exclusion filters.

For example, to disallow certain protocols like ICMP in the final allow list model, you can create an exclusion filter with a protocol field set to ICMP.

Note

- Conversations that match exclusion filters are excluded for the purposes of policy generation and clustering, but remain in the Conversations View with red 'excluded' icon (see the Table View in Conversations). Likewise, workloads of the workspace incident on such conversations remain viewable as well.
- An exclusion filter that uses a cluster or a filter definition from a workspace is effective only in primary workspaces (otherwise, its cluster definitions are not visible to the label system, and any matching conversations are not excluded).
- Exclusion filters are versioned; to track modifications, see Activity Logs and Version History.
- For limits on the number of exclusion filters, see Limits Related to Policies, on page 950.

You can create one or both of the following, then enable either or both when discovering policies:

- A list of exclusion filters for each workspace.
- A list of default exclusion filters that is available to all workspaces in your tenant.

You can also enable or disable either or both lists for the Default Policy Discovery Config.

For instructions, see Configure, Edit, or Delete Exclusion Filters, on page 442 and Enable or Disable Exclusion Filters, on page 443.

Configure, Edit, or Delete Exclusion Filters

You can use this procedure to create a list of exclusion filters for a single workspace, or a list of default exclusion filters that are available to all workspaces.

Procedure

Step 1 Do one of the following:

To	Do This
Configure exclusion filters for a specific workspace	Navigate to the workspace, then do one of the following: • Click **Manage Policies**, then click ⋮ near the top right of the page and select **Exclusion Filters**. • From the automatic policy discovery configuration page, click the **Exclusion filters** link in the Advanced Configurations section. • Delete a discovered policy; you will see an option to create an exclusion filter.
Configure default exclusion filters that are available to any workspace	**a.** Choose **Defend** > **Segmentation**, **b.** Click the caret at the right side of the page to expand the Tools menu, then choose **Default Policy Discovery Config**. **c.** Scroll to the bottom of the page. **d.** Click **Default Exclusion Filters**.

Step 2 To create an exclusion filter, click **Add Exclusion Filter**.

Step 3 Specify parameters for the flows to exclude from consideration during policy discovery:

You do not need to enter values for all of the fields. Any empty field is treated as a wildcard for matching flows.

Any conversation that matches all the fields of any exclusion filter is ignored for the purposes of policy creation and clustering.

Option	Description
Consumer	Matches conversations where the consumer address is a member of the selected scope, inventory filter, or (for workspace-specific exclusion filters only, cluster). You can specify any arbitrary address space by creating a new custom filter.
Provider	Matches conversations where the provider address is a member of the selected scope, inventory filter, or (for workspace-specific exclusion filters only, cluster). You can specify any arbitrary address space by creating a new custom filter.
Protocol	Matches conversations with specified protocol.

Option	Description
Port	Matches conversations with provider (server) port matching the specified port, or port range. Enter port ranges using a dash separator, for example, “100-200”

Step 4 To edit or delete an exclusion filter, hover over the applicable row to see the **Edit** and **Delete** buttons.

Step 5 If you are configuring default exclusion filters:

When the configured filters are ready to use, return to the **Default Policy Discovery Config** page, and click **Save** to make the changes available to individual workspaces.

What to do next

Important Exclusion filters are enabled by default in the workspace in which they are configured.

Default exclusion filters are enabled by default in all workspaces.

Both types of exclusion filters are enabled by default in the Default Policy Discovery Config.

Before discovering policies:

- Enable or disable exclusion filters and default exclusion filters.
  - In each workspace
  - On the Default Policy Discovery Config page

  For instructions, see Enable or Disable Exclusion Filters, on page 443.
- Commit any scope changes, or the filters may not match (and therefore exclude) the expected flows. See Commit Changes, on page 365.

Enable or Disable Exclusion Filters

You can create exclusion filters in each workspace and/or create a set of default exclusion filters that you can apply to all workspaces.

By default, both types of exclusion filters are enabled.

To make changes

- To enable or disable exclusion filters for a single workspace:

  In the workspace, click **Manage Policies**, then click **Automatically Discover Policies**, then click **Advanced Configurations**. You can enable exclusion filters and/or default exclusion filters for this workspace.
- To enable or disable exclusion filters in the Default Policy Discovery Config:

  Choose **Defend** > **Segmentation**, then click the caret at the right side of the page to expand the Tools menu. Then choose **Default Policy Discovery Config**. Scroll to or click **Advanced Configurations**. You can enable exclusion filters and/or default exclusion filters.

External Dependencies

External dependencies are relevant only when you use the process that is described in (Advanced) Create Cross-Scope Policies, on page 501.

External Dependencies settings apply to automatically discovered policies involving communications to and from workloads that are members of a scope other than the scope in which policies are discovered. (That is, communications involving "external workloads.")

A workload that is not a member of the scope in which the policy exists is an *external workload*. Such workloads are the other end of a conversation with a *target workload* (which *is* a member of the scope in which the policy exists).

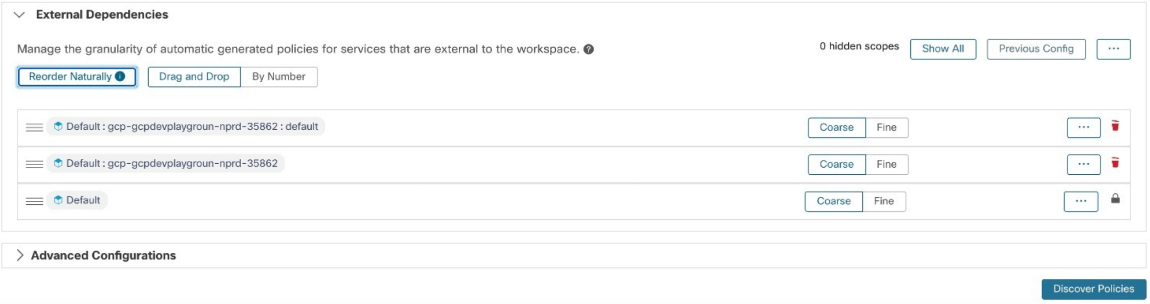
The External Dependencies list is an ordered list of all scopes in your hierarchy. Each scope in the list is set to one of the following:

- Generate specific or refined policies (more secure), or
- Generate coarse policies in higher scopes, which may generalize better (that is, be more likely to allow legitimate flows that were not seen in the time range specified when discovering policies).

During policy discovery, the first scope (or cluster, or inventory filter – see below) that matches th workload will be used to generate the “allow” policy, where the matching order (and consequent granularity level) is determined by the top-down ranking that is displayed in the External Dependencies section.

A default scope order is configured for you, with all scopes set to "Coarse" by default.

Figure 241: Default External Dependencies



External Dependencies

Manage the granularity of automatic generated policies for services that are external to the workspace.

0 hidden scopes

Default : gcp-gcpdevplaygroun-nprd-35862 : default

Default : gcp-gcpdevplaygroun-nprd-35862

Default

Advanced Configurations

To	Do This
View or fine-tune external dependencies for a workspace:	Navigate to the workspace and click **Automatically Discover Policies**, then click **External Dependencies**. To reorder the scopes and choose granularity options for each, see Fine-Tune External Dependencies for a Workspace, on page 445.
Configure default external dependencies for an entire root scope:	See Default Policy Discovery Config, on page 457.

External Dependencies: Granular Policies Involving Subsets of Scopes

You can optionally discover policies at a more granular level than scope-to-scope, to control traffic to a specified subset of the workloads in a scope.

For example, you may want to create policies specific to a certain type of host within an application, such as API servers; you can group those workloads into a subset within the application scope.

To generate policies specific to a subset of workloads within a scope, see Fine-Tune External Dependencies for a Workspace, on page 445.

Tips for Exploring External Dependencies

Use the following tips to explore the behavior of automatic policy discovery for policies involving workspaces that are not members of the scope that is associated with the workspace in which the policies reside.

Tip

- You can remove and rearrange the list to generate policies at a desired granularity. For example, removing all Company: RTP subscopes will help generate wide policies to the whole Company:RTP scope, but not its individual components, while maintaining the higher granularity for Company: SJC scope. Furthermore, you can click on the **Fine** button next to any scope and see if there are finer grain candidates defined under that scope.

- By default, the root scope is configured as the lowest entry in the External Dependencies list, so that automatic policy discovery always generates policies to more specific scopes whenever possible. Initially, to view relatively few coarse-grained policies, you can temporarily place the root scope on the top of the external dependencies. This way, after automatic policy discovery, you will see all external policies of the workspace connecting to only one scope, the root scope (as every external workload maps to the root scope). The resulting number of generated policies are smaller and easier to examine and comprehend.

- You can also temporarily bundle all workloads that are members of the scope associated with the workspace ("internal workloads") into one cluster, approve the cluster, and then discover policies. Again, this results in a reduced set of policies, as no clustering (subpartitioning of the workspace/scope) takes place, so you can view policies that are either internal (connect to internal workloads), or external (connect an internal to an external workload). Later, you can view progressively more refined policies by unbundling internal workloads and/or placing one or a few external scopes of interest above the root.

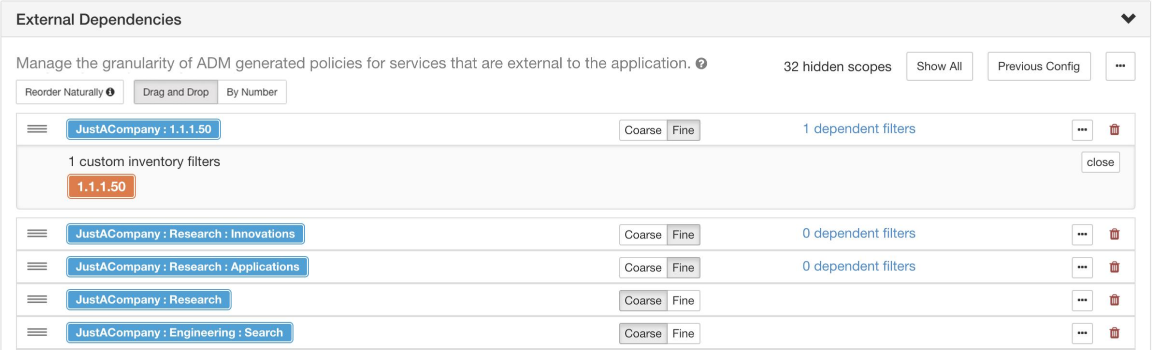
- **Important** Always carefully examine policies involving the root scope, since these policies allow all traffic to and from the entire network. This is especially important when the root scope is placed low in the External Dependencies list and it is not your intention to generate coarse policies. Such policies may not have resulted from network-wide traffic in or out of the workspace scope. Rather they can be triggered by a few external endpoints which failed to receive finer scopes or inventory filter assignments beyond simply the root scope.

  While auditing these policies, you should examine the associated conversations (See Conversations) to identify these endpoints and subsequently categorize them into finer scopes or inventory filters, to avoid less-secure policies at the root-scope level.

Fine-Tune External Dependencies for a Workspace

Use this procedure to create policies between specified subsets of workloads within scopes (rather than between entire scopes) during automatic policy discovery, when the provider of a policy belongs to a different scope than the scope in which policies are being discovered.

Figure 242: Fine-tuning External Dependencies



External Dependencies

Manage the granularity of ADM generated policies for services that are external to the application.

32 hidden scopes

JustACompany : 1.1.1.50	Coarse Fine	1 dependent filters
1 custom inventory filters 1.1.1.50		
JustACompany : Research : Innovations	Coarse Fine	0 dependent filters
JustACompany : Research : Applications	Coarse Fine	0 dependent filters
JustACompany : Research	Coarse Fine	
JustACompany : Engineering : Search	Coarse Fine	

Before you begin

- Configure an inventory filter for each subset of workloads for which you want to generate specific policies. You can create any number of inventory filters, in any scope.

  There are several ways to create inventory filters:

  - Convert clusters of interest to inventory filters.

    (See Convert a Cluster to an Inventory Filter, on page 489),

    and/or

  - Create new inventory filters.

    See Create an Inventory Filter, on page 379.

  These filters must have the following options enabled:

  - **Restrict query to ownership scope**

    Provides a service external of its scope

- See also Tips for Exploring External Dependencies, on page 445.

Procedure

Step 1 Navigate to the workspace in which you will discover policies.

Step 2 Click **Automatically Discover Policies**.

Step 3 Click **External Dependencies**.

Step 4 If necessary, click **Show All** scopes.

Step 5 (Optional) Leverage previous configurations:

- To reuse the changes you made to the list the last time you discovered policies, click **Previous Config**.
- If you have set up external dependencies in the global “Default Policy Discovery Config”, you can use the global list by clicking **Default Config**. Or, after obtaining the default list, you can modify it as desired (for that workspace only), and then use the customized version on subsequent runs by clicking **Previous Config** once.

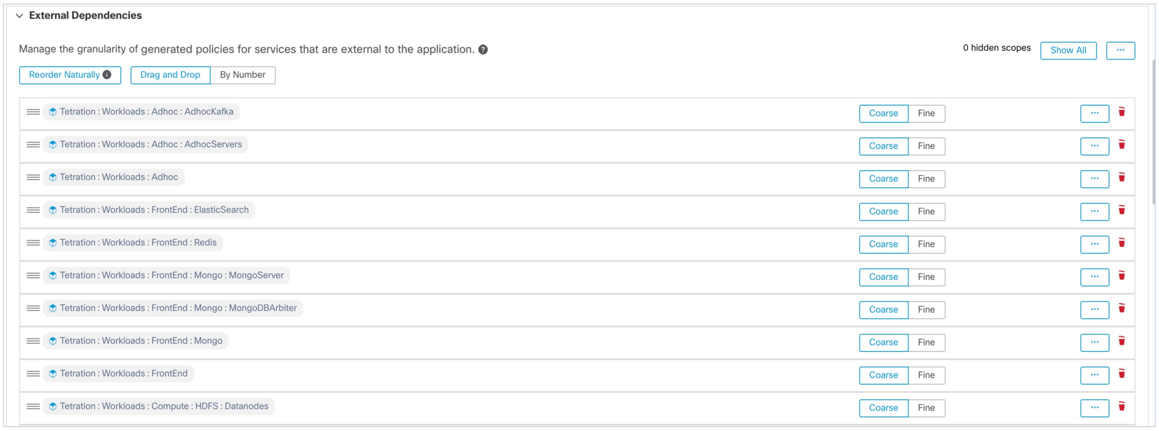
Step 6 Reorder scopes (and inventory filters, if applicable) as needed.

Policy is applied based on the first scope or inventory filter in the list (starting from the top) that matches the traffic. For this purpose, you generally want to apply the most specific policy that matches traffic, so you want child scopes (more specific) above their parents (less specific).

- If you have recently created new child scopes, which by default are added to the bottom of the list, reorder the entire list to place child scopes above their parents:

  (Recommended) Click **Reorder Naturally**.

  Figure 243: Reorder naturally

  External Dependencies

  Manage the granularity of generated policies for services that are external to the application.

  Tetration : Workloads : Adhoc : AdhocKafka
  Tetration : Workloads : Adhoc : AdhocServers
  Tetration : Workloads : Adhoc
  Tetration : Workloads : FrontEnd : ElasticSearch
  Tetration : Workloads : FrontEnd : Redis
  Tetration : Workloads : FrontEnd : Mongo : MongoServer
  Tetration : Workloads : FrontEnd : Mongo : MongoDBArbiter
  Tetration : Workloads : FrontEnd : Mongo
  Tetration : Workloads : FrontEnd
  Tetration : Workloads : Compute : HDFS : Datanodes

- (If you have a specific reason) To reorder the list manually:
  - Click **Drag and Drop**.
  - Click **By Number**:

    The external dependencies will be assigned priority values in multiples of 10. Change the values to change the order.

    Once numbers are modified, click **View** to update the list order and reassign multiples of 10 to each of the priorities.

Step 7 Specify granularity for each row:

- Click **Fine** for each row for which you want to generate policies specific to configured inventory filters or clusters.

  Click **Coarse** to generate policies that apply to the entire scope.

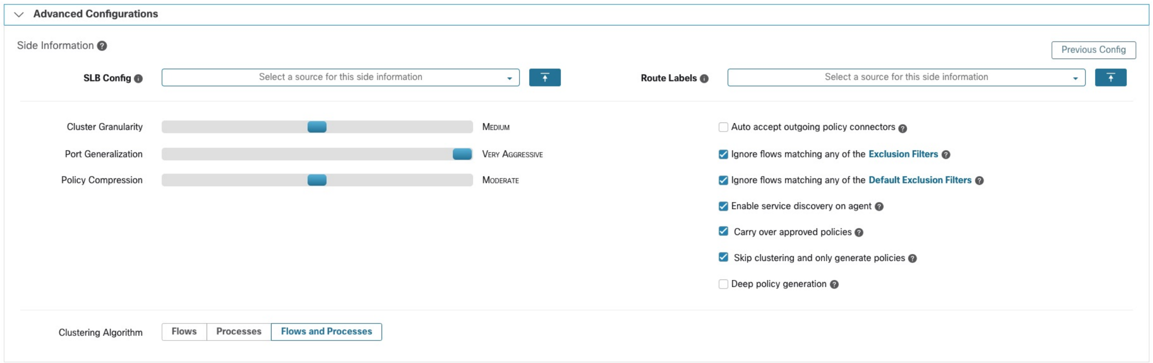
- To apply granularity to all subscopes of a scope: Click the ··· button at the end of the scope's row.

Advanced Configurations for Automatic Policy Discovery

Use advanced settings to include additional information when discovering policies or to adapt to a particular environment.

- To access these settings for a specific workspace, click **Automatically Discover Policies** in the applicable workspace.
- To change the defaults for all workspaces, see Default Policy Discovery Config, on page 457.

Figure 244: Advanced Automatic Policy Discovery Configurations



Advanced Configurations

Side Information

SLB Config: Select a source for this side information

Route Labels: Select a source for this side information

Cluster Granularity: Medium

Port Generalization: Very Aggressive

Policy Compression: Moderate

☐ Auto accept outgoing policy connectors

☑ Ignore flows matching any of the Exclusion Filters

☑ Ignore flows matching any of the Default Exclusion Filters

☑ Enable service discovery on agent

☑ Carry over approved policies

☑ Skip clustering and only generate policies

☐ Deep policy generation

Clustering Algorithm: Flows | Processes | [✓ Flows and Processes]

Include Data From Load Balancers and Routers When Discovering Policies

You can upload data from load balancers and routers to inform automatic policy discovery.

To access the following options, click **Advanced Configurations** in the automatic policy discovery settings and look at the "Side Informaton" or "sideinfo" section.

Option	Description
SLB Config (Upload load balancer configurations)	To download data from your load balancer in the correct format, see Retrieving LoadBalancer Configurations for Advanced Policy Discovery Configuration. Supported formats for uploading loadbalancer configs: • **F5 BIG-IP** • **Citrix Netscaler** • **HAProxy** • Others: Use the **Normalized JSON** schema. You must convert any unsupported load balancer config into this schema. This simple schema includes basic information on Virtual IPs (VIPs) and backend IPs. To download a sample JSON file, click the info button beside **SLB Config**.

Option	Description
Upload **Route Labels**	You can upload a list of provisioned subnets/routes from the routers to help partition hosts based on pre-provisioned set of subnets. The clustering results generated by automatic policy discovery never span the subnet boundaries as defined by the uploaded data. You can modify the results after automatic policy discovery is complete. To download a sample JSON file, click the info button beside **Route Labels**.

Note Clusters do not span partition boundaries, meaning a cluster computed by automatic policy discovery does not contain target workloads from two different partitions. Partitions are computed from the uploaded load balancer or router data. However, you can freely move workloads from one cluster to another, for example by changing cluster query definitions (manual cluster editing), or disable the upload of any side info.

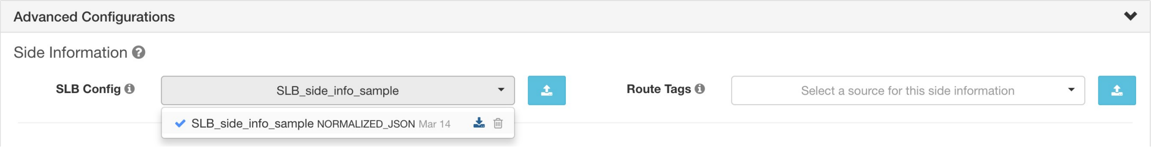
To view or delete a previously uploaded Load Balancer (SLB Config) or Route Labels file:

1. Click into the respective box labeled **Select a source for this side information**.

   A list of uploaded files will appear.

2. Click the download or trash icon beside the file to view or delete.

   Figure 245: Uploaded Side Information



Advanced Configurations

Side Information

SLB Config: SLB_side_info_sample

✓ SLB_side_info_sample NORMALIZED_JSON Mar 14

Route Tags: Select a source for this side information

Cluster Granularity

Clustering Granularity allows you to control the size of the clusters generated by automatic policy discovery.

- **Fine** results in more but smaller clusters
- **Coarse** results in fewer but larger clusters

Note You may not observe a significant change in the results due to many other signals that our algorithms take into account. For example, if there is a very high confidence in the generated clusters, changing this control will make little change in the results.

Port Generalization

The **Port Generalization** option in **Advanced Configurations** for automatic policy discovery controls the level of statistical significance required when performing port generalization, i.e., replacing numerous ports being used as server ports on a single workload, with a port interval.

This setting can affect accuracy, number, and compactness of policies and the time required to generate them.

To disable port generalization, move the slider to the extreme left. Note that if disabled, automatic policy discovery and/or automatic policy discovery UI rendering time may be slowed substantially, in case many server ports are used by the workloads.

As the slider is moved to the right toward more aggressive generalization, less evidence is required to create port-intervals and also the criterion for replacing original policies (involving single ports) with port-intervals is relaxed.

Background

Some applications such as Hadoop use and change many server ports in some interval, for instance in 32000 to 61000. Automatic policy discovery attempts to detect such behavior for each workload, using the workload's server port usages in the observed flows: by observing only a fraction of total possible ports (but numerous ports, eg 100s), automatic policy discovery may 'generalize' that any port in, say 32000 to 61000, could be used as a server port by the workload. Ports that fall within intervals are replaced with such intervals (when certain criteria on minimum observed counts are met). This results in fewer, more compact policies. Interval estimation is important for computing accurate policies: without sufficient generalization many legitimate future flows would be dropped if the policy is enforced. By merging numerous ports into one or a few intervals, the rendering time of the UI is sped up significantly as well.

You can control the degree of port generalization including disabling it.

Policy Compression

When policy compression is enabled, if policies in multiple clusters in the workspace are similar, then those policies can be replaced with one or more policies applicable to the entire parent scope. For example, if all or almost all clusters in the workspace provide the same port to the same consumer, then all of those cluster-specific policies are replaced with one policy in the parent scope. This reduces the number of policies significantly, minimizes clutter, and may also allow legitimate future flows that would have been dropped (accurate generalization).

The more aggressive the compression setting, the smaller is the required threshold on policy frequency in order to replace cluster-specific policies with a policy applicable to the entire parent.

When generating policies for a branch of the scope tree:

This knob can be used to alter the level of aggressiveness in Hierarchical policy compression.

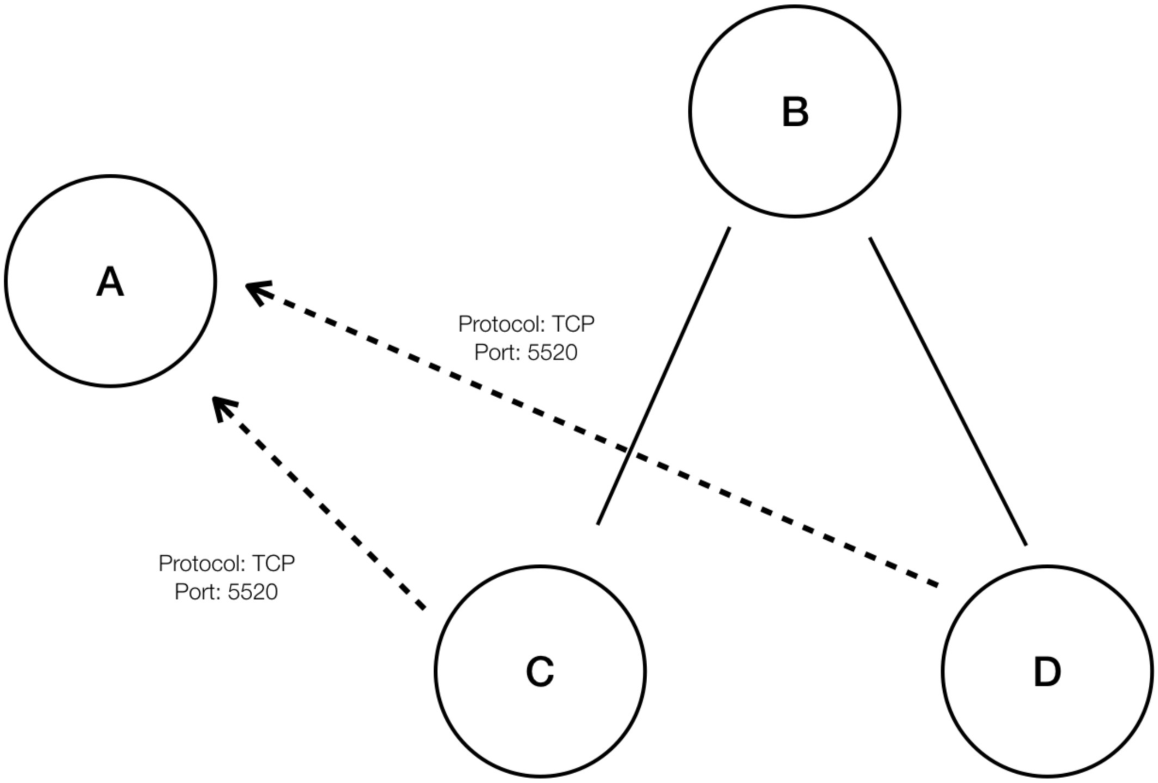
Note Currently, the automatic policy discovery conversations page does not support showing the conversations that led to a compressed policy (you may need to disable compression or use flow search).

Hierarchical policy compression

Policy compression can also be done when generating policies for a branch of the scope tree. The Policy Compression knob can be used to alter the level of aggressiveness in hierarchical policy compression. An example of hierarchical policy compression is illustrated below.

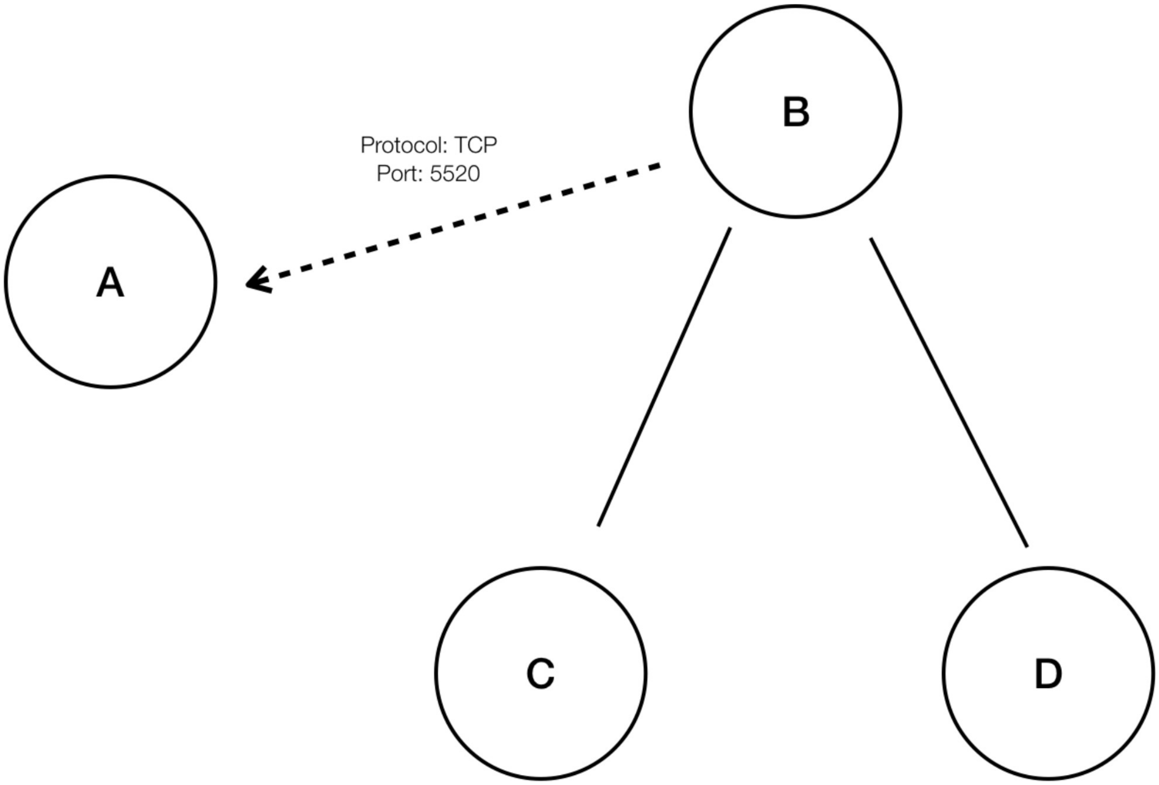
- Let A, B, C and D be scopes part of a scope tree, where "C" and "D" are the child scopes of "B". Let "C" → "A" be a TCP "ALLOW" policy on port 5520 and "D" → "A" be TCP "ALLOW" policy on port 5520.

Figure 246: Before hierarchical policy compression



- With hierarchical policy compression if a sufficiently large group child scopes involves in policies sharing the same port, protocol and destination or source, these policies will be replaced by a generalized policy that connects the parent scope to the common source or destination. In the above mentioned case “C” and “D” are child scopes of “B” and the policies “C” → “A” and “D” → “A” share the same destination, port and protocol. Since 100% of child scopes of “B” contain the similar policy the policy will be promoted to be “B” → “A”, resulting in the following. Furthermore, hierarchical compression can be repeated so a generalized policy can go all the way to the root of the subtree (branch of the scope tree) .

Figure 247: After hierarchical policy compression



- The policy compression knob allows you to tune the aggressiveness of such compression, by changing the minimum required proportion of the policy-sharing child scopes (usually measured as the fraction of total number of child scopes) to trigger the compression. When disabled, each policy is generated between highest priority scopes based on the External Dependencies list. Subsequently, if you choose to impose the naturally ordered External Dependencies list, the policies generated will be the most granular policies among scopes.

Clustering Algorithm (Input to Clustering)

Advanced users can choose the main source of data for clustering algorithms, that is, live network flows, or running processes, or both.

Auto accept outgoing policy connectors

This option is applicable only when you use automatic policy discovery to create cross-scope policies using the method described in (Advanced) Create Cross-Scope Policies, on page 501.

Any outgoing policy requests created during automatic policy discovery will be automatically accepted.

For complete information, see Auto Accept Policy Connectors, on page 510 and Policy Requests.

Note This option is only available for root scope owners and site admins.

Auto Approve Generated Policies

This option is applicable if you want to approve all policies generated by policy discovery.

Note Be aware that if you choose this option, and later on if you need to modify or undo any changes, you can only do so manually.

For more information, see Auto Accept Policy Connectors, on page 510 and Policy Requests.

Note This option is available for root scope owners and site administrators.

Ignore Flows Matching Exclusion Filters

To ignore conversation flows that you specify, enable the applicable option. To view or modify either filters list, click the applicable **Exclusion Filters** link. For more information, see Exclusion Filters, Default Exclusion Filters, on page 457, and Configure, Edit, or Delete Exclusion Filters, on page 442.

Enable service discovery on agent

In certain applications, a large range of ports might be designated for use, but actual traffic might use only a subset of those ports during the time period included in policy discovery. This option allows the entire designated pool of ports for these applications to be included in policies for those applications, rather than just the ports seen in actual traffic.

Enabling this option allows ephemeral port-range information regarding services present on the agent node to be gathered. Policies are then generated based on this port-range information.

Example:

- Windows Active Directory Domain Server uses default Windows ephemeral port-range **49152-65535** to serve requests. When this flag is set this port range information is reported by the agent and policies are generated based on this information.

Figure 248: Service discovery enabled on the agent

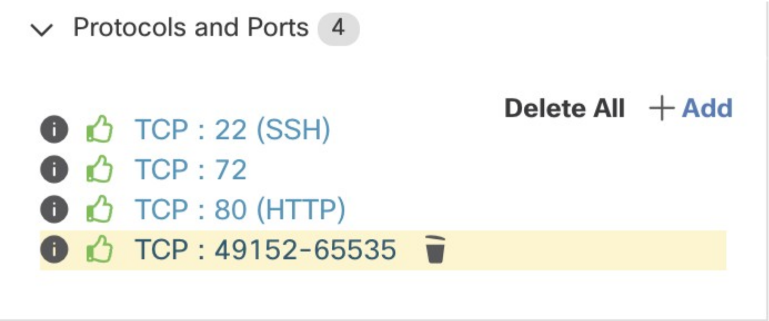
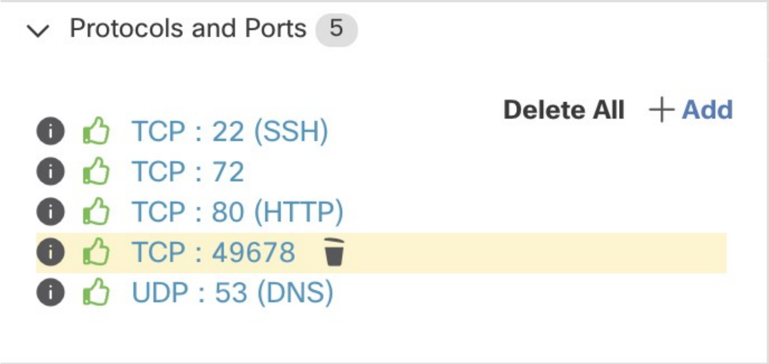


Figure 249: Service discovery not enabled on the agent



Protocols and Ports 5

Delete All + Add

- TCP : 22 (SSH)
- TCP : 72
- TCP : 80 (HTTP)
- TCP : 49678
- UDP : 53 (DNS)

Carry over Approved Policies

This option is enabled by default.

When this flag is set, all the policies that you have marked as approved (including those approved using OpenAPI) will be preserved. This helps you to not have to re-define a particular broad DENY rule that should take effect regardless of the “allow” policies that are discovered by automatic policy discovery.

For details, see Approved Policies, on page 459.

Skip clustering and only generate policies

If this option is selected, no new clusters are generated, and policies are generated from any existing approved clusters or inventory filters and otherwise involve the entire scope associated with the workspace (in effect, treating the entire scope as a single cluster). This option can result in substantially fewer (but coarser) policies.

Enable redundant policy removal

This option is only available when generating policies for a branch of the scope tree.

This option enables/disables removal of redundant granular policies.

Example:

- Let Root, A, B, C, A1 and A2 be scopes part of a scope tree. Let the following be the policies:

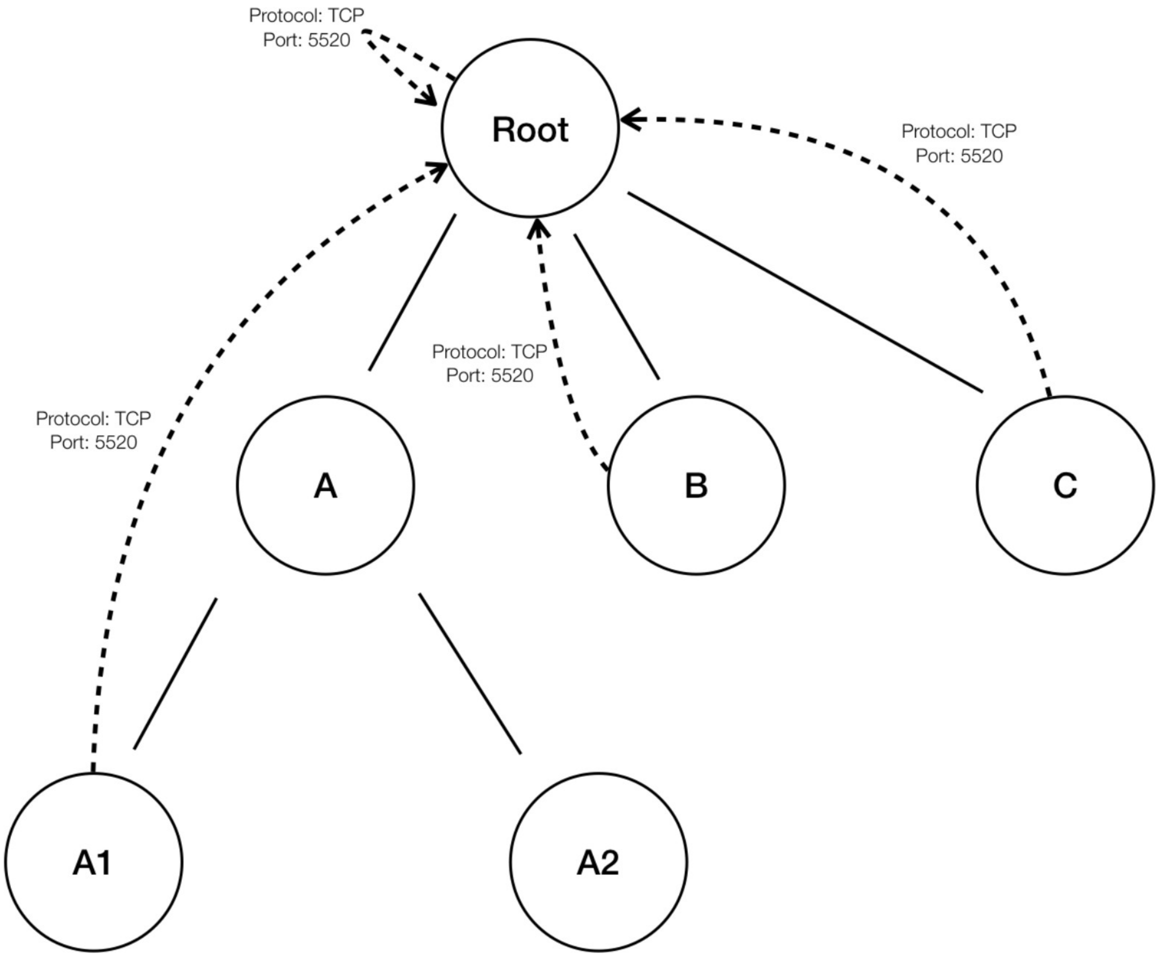
1. “Root” → “Root”

2. “B” → “Root”

3. “C” → “Root”

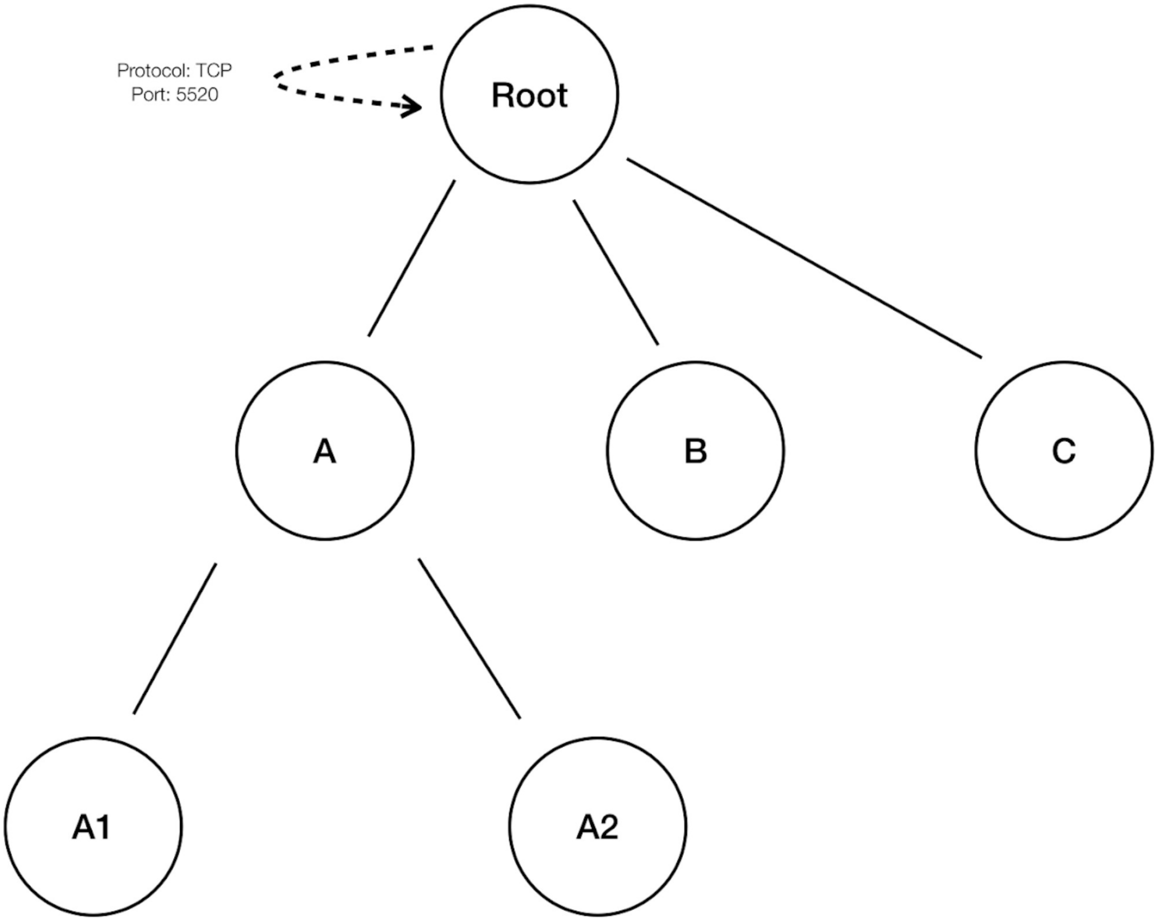
4. “A1” → “Root”

Figure 250: Before removal of redundant policies



- The policies “B” →“Root”, “C” →“Root” and “A1”→ “Root” are redundant as the policy “Root” “Root” covers these policies. The remove redundant policies feature will check and remove such policies resulting in only one policy “Root” → “Root” as follows.

Figure 251: After removal of redundant policies



Redundant policy removal can be very useful in maintaining a succinct set of interpretable policies. The reduced policy set contains the minimal number of policies at the chosen compression level to cover all the workload traffic. However, you should always audit the policy through policy analysis and examine the corresponding conversations to evaluate the tightness of the resulting policies. This is especially important when there exists traffic to or from endpoints that are not categorized into finer scopes or inventory filters. Such endpoints may trigger the generation of coarser policies than intended, such as policies involving the root scope. If at the same time, redundant policy removal is enabled, more granular policies will be removed and will not be presented to you. To diagnose the source of (compressed) policies and to view finer level policies, turn off policy compression and redundant policy removal. Also note that currently, the automatic policy discovery conversations page may fail to show the conversations that lead to a compressed/generalized policy; so to get around this, you can turn off compression and redundant policy removal, so it is easier to find the conversations that lead to the generated policies.

Tip

Since discovering policies for a branch of the scope tree discovers all policies for the scope subtree rooted at the workspace scope, these policies will cover all the legal traffic seen by automatic policy discovery for all the workloads under the subtree. When analyzing these policies using tools such as Policy Analysis (See Policies), you should turn off Policy Analysis in all the workspaces associated with the subscopes. This way, the policies (if any) residing in the subscope workspaces (usually receive a high priority due to more specific scope definition) will not take priority and interfere with the results. However, exceptions apply when the policies in the subscope workspaces are configured to cover different sets of traffic that usually involve finer inventory filters or clusters specific to the subscopes.

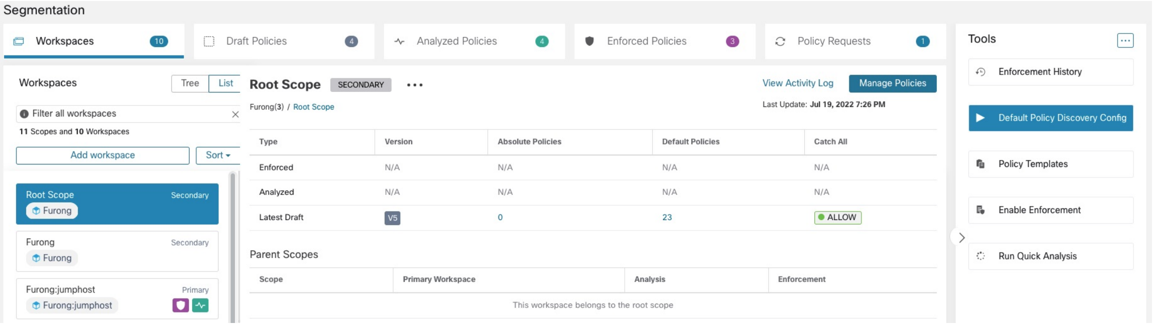
Default Policy Discovery Config

You can configure default automatic policy discovery settings that can optionally be used in any workspace in the entire root scope.

To configure default options for policy discovery:

Choose **Defend** > **Segmentation**, then click the caret at the right side of the page to expand the Tools menu. Then choose **Default Policy Discovery Config**.

Figure 252: Navigating to the Default Policy Discovery Config page



Type	Version	Absolute Policies	Default Policies	Catch All
Enforced	N/A	N/A	N/A	N/A
Analyzed	N/A	N/A	N/A	N/A
Latest Draft	V5	0	23	ALLOW

Scope	Primary Workspace	Analysis	Enforcement

This workspace belongs to the root scope

For information about options on the Default Policy Discovery Config page, see:

- External Dependencies, on page 444 and subtopics
- Advanced Configurations for Automatic Policy Discovery, on page 447 and subtopics
- Default Exclusion Filters, on page 457

Important

When your default configurations are complete and ready to use in individual workspaces, click **Save**.

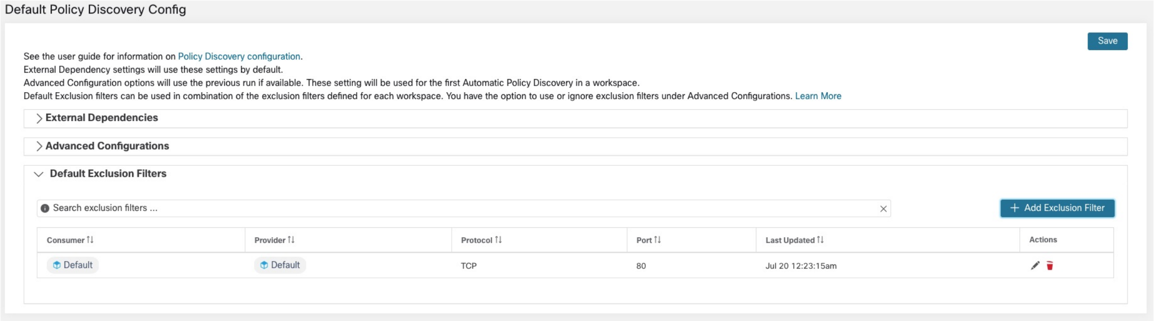
Default Exclusion Filters

Exclusion Filters help you fine-tune policies and clusters suggested by automatic policy discovery by specifying traffic flows to exclude from discovery input.

For details, see Exclusion Filters.

You can make a global Default Exclusion Filters list that is available to all workspaces in your tenant, then specify for each workspace whether or not to use this default list when discovering policies.

Figure 253: Default Exclusion Filters



Default Policy Discovery Config

See the user guide for information on Policy Discovery configuration.
External Dependency settings will use these settings by default.
Advanced Configuration options will use the previous run if available. These setting will be used for the first Automatic Policy Discovery in a workspace.
Default Exclusion filters can be used in combination of the exclusion filters defined for each workspace. You have the option to use or ignore exclusion filters under Advanced Configurations. Learn More

Consumer	Provider	Protocol	Port	Last Updated	Actions
Default	Default	TCP	80	Jul 20 12:23:15am	

To configure default exclusion filters, see Configure, Edit, or Delete Exclusion Filters, on page 442.

To enable or disable default exclusion filters, see Enable or Disable Exclusion Filters, on page 443.

Retrieving LoadBalancer Configurations for Advanced Policy Discovery Configuration

Below are the instructions for retrieving supported load balancer configuration files in a format that can be directly uploaded to Secure Workload for use in policy discovery. For more information, see Advanced Configurations for Automatic Policy Discovery and Include Data From Load Balancers and Routers When Discovering Policies, on page 448.

Note that all files must be encoded as ASCII.

Citrix Netscaler

Concatenate the output of `show run` in your console and upload the file.

See Sample config file

F5 BIG-IP

Upload the `bigip.conf` file.

Note If you have a file with a .UCS extension, unzip the archive folder and upload only the `bigip.conf file` within the configuration dump. If there are multiple `bigip.conf files`, concatenate and then upload the files.

See Sample config file

HAProxy

Upload your `haproxy.cfg` file. The path is typically `/etc/haproxy/haproxy.cfg`.

See Sample config file

Normalized JSON

If you find the above options limiting, convert your configs to the following JSON schema and upload them directly. The example JSON file can be directly downloaded by clicking the **i** icon next to SLB Config in Advanced Run Configurations for automatic policy discovery.

See Sample config file

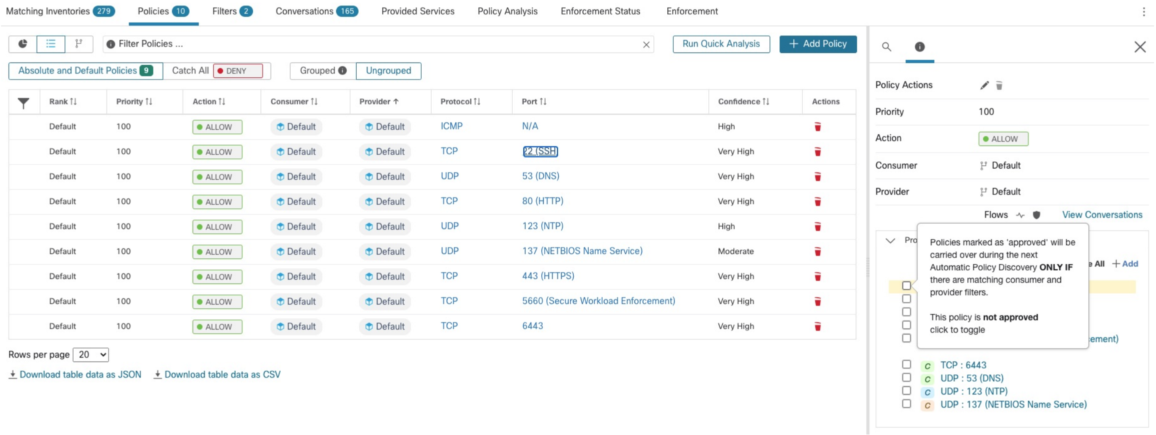
Approve Policies

As you review policy discovery results, approve discovered policies that you want to keep, to carry them forward intact when you discover policies in future. For complete details, see Approved Policies, on page 459.

To approve a policy:

1. On the Policies page, for the policy you want to protect, click the value in the **Protocols and Ports** column.
2. In the panel that opens on the right, select the checkbox to the left of each protocol-and-port for which you want to retain the policy during future policy discovery.

Figure 254: Approve Policies



Rank	Priority	Action	Consumer	Provider	Protocol	Port	Confidence	Actions
Default	100	ALLOW	Default	Default	ICMP	N/A	High	
Default	100	ALLOW	Default	Default	TCP	22 (SSH)	Very High	
Default	100	ALLOW	Default	Default	UDP	53 (DNS)	Very High	
Default	100	ALLOW	Default	Default	TCP	80 (HTTP)	Very High	
Default	100	ALLOW	Default	Default	UDP	123 (NTP)	High	
Default	100	ALLOW	Default	Default	UDP	137 (NETBIOS Name Service)	Moderate	
Default	100	ALLOW	Default	Default	TCP	443 (HTTPS)	Very High	
Default	100	ALLOW	Default	Default	TCP	5660 (Secure Workload Enforcement)	Very High	
Default	100	ALLOW	Default	Default	TCP	6443	Very High	

Policy Actions	
Priority	100
Action	ALLOW
Consumer	Default
Provider	Default

Policies marked as 'approved' will be carried over during the next Automatic Policy Discovery **ONLY IF** there are matching consumer and provider filters.

This policy is **not approved**
click to toggle

□ C TCP : 6443
□ C UDP : 53 (DNS)
□ C UDP : 123 (NTP)
□ C UDP : 137 (NETBIOS Name Service)

You can also use this procedure to remove approval from a policy.

Approved Policies

In general, approved policies are not changed during automatic policy discovery, and automatic policy discovery does not suggest policies that would duplicate or overlap the effects of approved policies.

The following are approved policies:

- Manually created policies.
- Discovered policies that are manually approved.

  (When you are satisfied that a policy behaves as intended, you approve it to protect it from changes during future automatic policy discovery. See Approve Policies, on page 459.)
- Uploaded policies, unless explicitly marked as `approved: false`.
- Approved policies defined in parent and ancestor scopes (specifically, from the latest versions of their primary workspaces) that apply to workloads in this scope.
- Policies created when policy requests are accepted from another workspace when cross-scope policies are handled using the advanced method described in When Consumer and Provider Are In Different Scopes: Policy Options, on page 500. For example, this includes policies included from the Provided Services, on page 512 tab.

Approved policies are shown with a thumbs-up icon next to the protocol type when you click a policy's ports/protcols link and view details in the panel at the right side of the page.

Exceptions to Approved Policy Protections

Approved policies are preserved during future automatic policy discovery if *both* ends of the policy are any of: approved cluster; inventory filter; accepted policy request (for cross-scope policies); or a cluster that doesn't significantly change membership. (However, the cluster membership may have changed in the last case.)

Approved policies may not be protected during future automatic policy discovery runs if either end of the policy is a non-approved cluster, and if, upon automatic policy discovery, no newly generated cluster has sufficiently high overlap with such cluster.

To protect a policy that involves an unapproved cluster, you should explicitly approve the cluster(s) at each end of the policy.

There is also an advanced configuration for automatic policy discovery that is enabled by default. If you do not want to protect approved policies from changes, you can deselect this option for a workspace or for the global default policy discovery configuration:. See Carry over Approved Policies, on page 454.

Troubleshoot Approved Policies

Approved policies are not being carried forward

If approved policies are not being carried forward as expected, make sure the **Carry over approved policies** option is selected in the advanced and/or default configuration settings for automatic policy discovery.

Finding conversations that are excluded from policy generation

During automatic policy discovery, any conversations that match the criteria for an existing approved policy are excluded from the policy generation. This omission prevents redundant policies covering the same conversations from being generated. (This process differs from the exclusion filters (See Exclusion Filters), in which you define matching filters instead of policies. Exclusion filters prevent matching conversations from being visible to all parts of automatic policy discovery.)

Note that while redundant policies are not generated from these conversations, the conversations are still considered when automatic policy discovery analyzes and generates clusters.

To see which conversations are excluded from automatic policy discovery by existing approved policies:

In the conversations view (See Conversations), use the **excluded** flag to filter conversations. You can also explore which existing approved policies result in the exclusion of these conversations in the policy details view that opens on the right side of the page when you click the ports and protocols link in a policy, then click the exclusion icon next to the conversation. (Hover over the icons to find the right icon.)

Iteratively Revise Policies

Defining and refining policies, for a single scope and for an entire network, will be an iterative process.

You can expect to revise both discovered and manually created policies.

Re-running Automatic Policy Discovery

You can rerun automatic policy discovery at any time. The main reasons to rerun automatic policy discovery are to include additional information that was not included in the previous run, or to exclude information that is not helpful. For example, you can:

- Install additional agents or configure additional connectors, and allow some flow data to accumulate.

- Increase the timespan used for discovery, to include more data.
- Approve clusters (with or without editing them first), which can improve the clustering of other workloads upon rerun. See Approving Clusters, on page 492.
- Exclude flows that you know you don't want to influence policy so you don't have to edit them out. See Exclusion Filters, on page 441.
- Change advanced settings (for details, see Advanced Configurations for Automatic Policy Discovery, on page 447.)
- Capture changes after you have made changes to Address Policy Complexities, on page 494.

Automatically discovering policies again on an existing workspace may generate different clusters and policies in the workspace.

If a host is no longer in the scope of the workspace, upon a subsequent automatic policy discovery run, that host will not appear in any cluster; if it were in an approved cluster, it will no longer appear in that cluster. Even with the same set of member workloads but with a different timeframe or configuration, automatic policy discovery may result in different clusters.

Note For a list of the types of policies that are not modified during policy discovery, see Approved Policies, on page 459.

Note *Removal of Redundant Policies* On subsequent automatic policy discovery, approved policies in primary workspaces will remove matching conversations for policy generation, so redundant policies are not generated. Note that, as is the case for exclusion filters, this functionality may not work perfectly on non-primary workspaces if the policy uses a Cluster filter defined in the workspace. Cluster filters from a non-primary workspaces are not active, and will not match any flows, thus redundant policies may still be generated in non-primary workspaces during automatic policy discovery.

Important: Before You Re-run Automatic Policy Discovery

Important Address each of the following before re-discovering policies in a workspace:

- By default, each time you discover policies in a particular workspace, the previous set of discovered policies and clusters are overwritten based on the data included in the new discovery period. If you want to keep some policies and clusters but not others, approve those policies and clusters.
- If you want to preserve any existing generated clusters, see Preventing Cluster Modification During Automatic Policy Discovery Reruns or Approving Clusters, on page 492.
- If you want to preserve any existing generated policies, see Approve Policies, on page 459.
- Any existing **Advanced Configuration** settings configured in the previous discovery run are used unless you change them.

  However, any configured *default* External Dependencies will be used over those of the previous run.
- If the currently displayed version of the discovered policies is not the latest version, and you want to keep previously discovered versions, click the version displayed at the top of the page and choose the latest v* version.

  If a previous version is displayed, any versions between that version and the new discovered version will be deleted.

  For details, see View, Compare, and Manage Discovered Policy Versions, on page 462.

To re-run policy discovery, see Automatically Discover Policies, on page 439. After you have addressed the points in this topic, the process is the same each time you discover policies.

View, Compare, and Manage Discovered Policy Versions

Each time you discover policies in a workspace, the version number (v*) assigned to the set of policies increments.

For information, see About Policy Versions (v* and p*), on page 550.

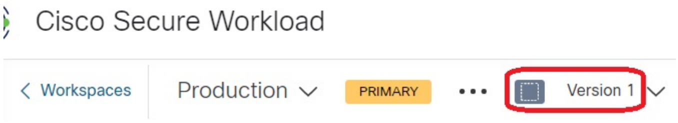
Procedure

Step 1 Click **Defend** > **Segmentation**.

Step 2 Navigate to the workspace.

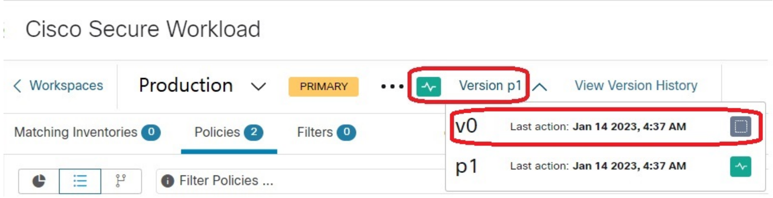
Step 3 Click **Manage Policies**.

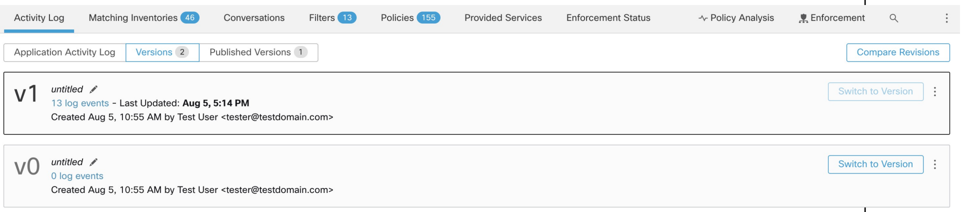
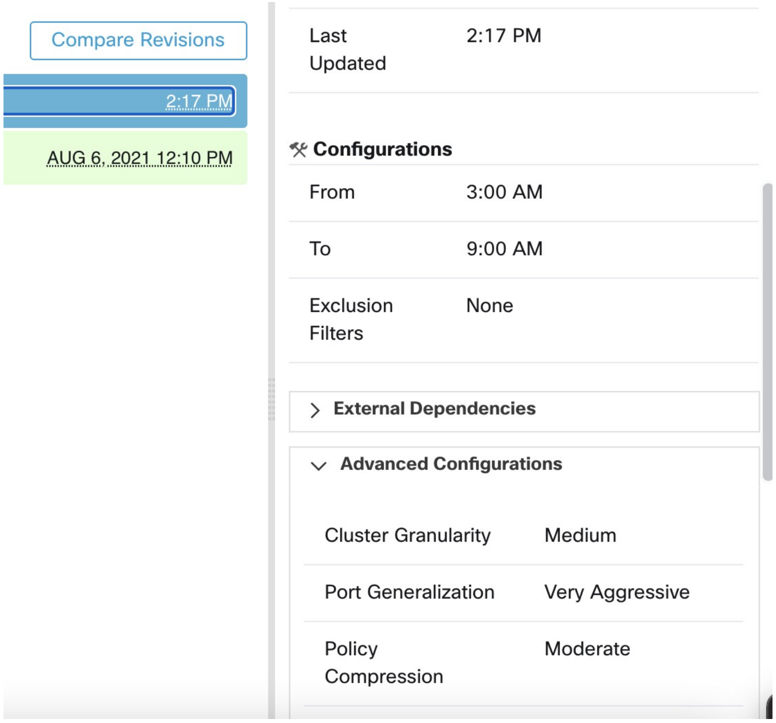
Step 4 The currently displayed version of the policies generated by automatic policy discovery is shown at the top of the page:



If you have already analyzed or enforced policies, the displayed version may be a policy discovery version, an analyzed policy version, or an enforced version.

Step 5 Do one of the following:

Display a different version of the policies generated by automatic policy discovery:	Click the current version and choose a different v* version. (If you see p* versions, those are analyzed and/or enforced versions, not versions of discovered policies.)  Cisco Secure Workload Workspaces Production PRIMARY Version p1 View Version History Matching Inventories 0 Policies 2 Filters 0 Filter Policies ... v0 Last action: Jan 14 2023, 4:37 AM p1 Last action: Jan 14 2023, 4:37 AM **Important!!** See the caveat in the What To Do Next section at the end of this procedure.

View details about a version	**a.** Click **View Version History** at the top of the page beside the current version. **b.** Click the **Versions** tab to see the versions of discovered policies. (Not the Published Versions tab.) The list of versions displays: ***Figure 255: List of generated policy versions with summary information***  Activity Log Matching Inventories 46 Conversations Filters 13 Policies 155 Provided Services Enforcement Status Policy Analysis Enforcement Application Activity Log Versions 2 Published Versions 1 Compare Revisions Switch to Version Switch to Version v1 *untitled* 13 log events - Last Updated: **Aug 5, 5:14 PM** Created Aug 5, 10:55 AM by Test User <tester@testdomain.com> v0 *untitled* 0 log events Created Aug 5, 10:55 AM by Test User <tester@testdomain.com> **c.** Click the **log events** link in the version. **d.** Click a link in an event row. Available details include statistics, exclusion filters, external dependencies, and configurations for the run. ***Figure 256: Configurations used for particular automatic policy discovery runs***  Compare Revisions 2:17 PM AUG 6, 2021 12:10 PM External Dependencies Last Updated: 2:17 PM **Configurations** From: 3:00 AM To: 9:00 AM Exclusion Filters: None **Advanced Configurations** Cluster Granularity: Medium Port Generalization: Very Aggressive Policy Compression: Moderate
Compare two versions to see what has changed:	**a.** Click **Compare Revisions**. **b.** Choose the versions to compare. **c.** For result details, see Comparison of Policy Versions: Policy Diff, on page 552.

Delete an unwanted version:	Click ⋮ for the version and choose **Delete**. You cannot delete the last remaining version generated by automatic policy discovery (v* version).
Export a version:	Click ⋮ for the version and choose **Export...**.

What to do next

Important

If you want to preserve previous versions of the discovered policies, always display the current version of the discovered policies when you are done working with older versions.

If the most current version of the discovered policies is not displayed the next time you discover policies for this workspace, older versions may be deleted.

For example, if the most current version of discovered policies is v4, and v2 is displayed when you discover policies again, then the existing v3 and v4 will be deleted and the new discovered policy version will be v3.

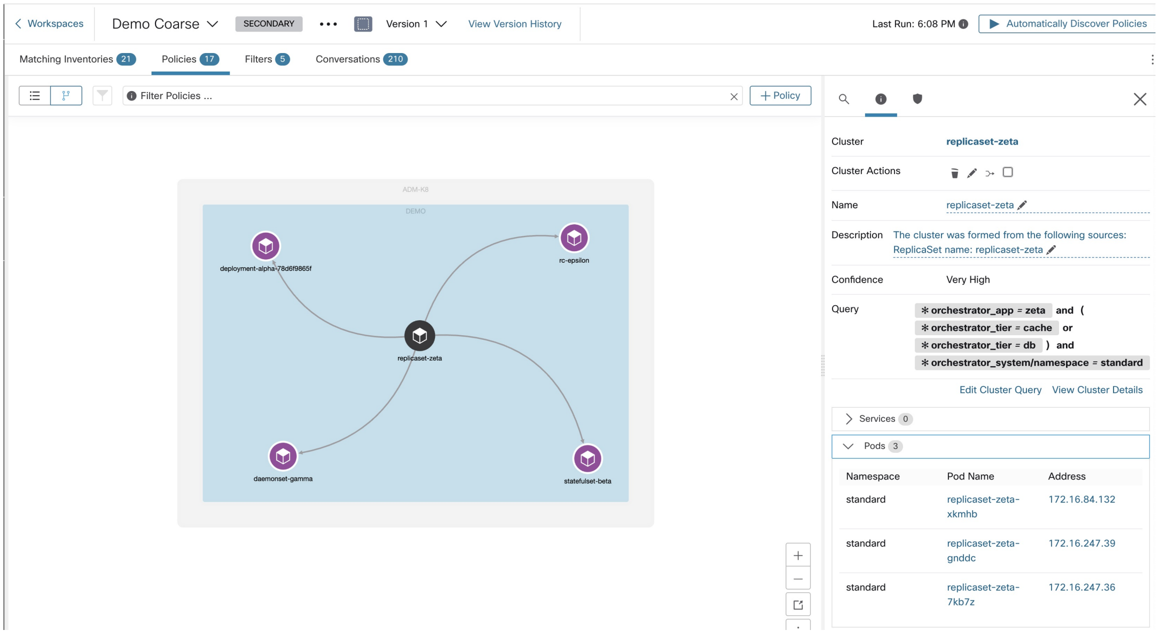
This behavior ensures a linear version history, which simplifies reverting to a previous version if desired.

In addition, you can manually create policies only if the latest v* version is displayed.

Policy Discovery Kubernetes Support

Policy discovery utilizes the information on pods and services from kubernetes configuration to create clusters for both pods and services and the respective policies are generated.

If the Cluster Granularity is set to COARSE or VERY COARSE then the services and the pods backing them is clustered together.



Cluster replicaset-zeta

Cluster Actions

Name replicaset-zeta

Description The cluster was formed from the following sources: ReplicaSet name: replicaset-zeta

Confidence Very High

Query
* orchestrator_app = zeta and (
* orchestrator_tier = cache or
* orchestrator_tier = db) and
* orchestrator_system/namespace = standard

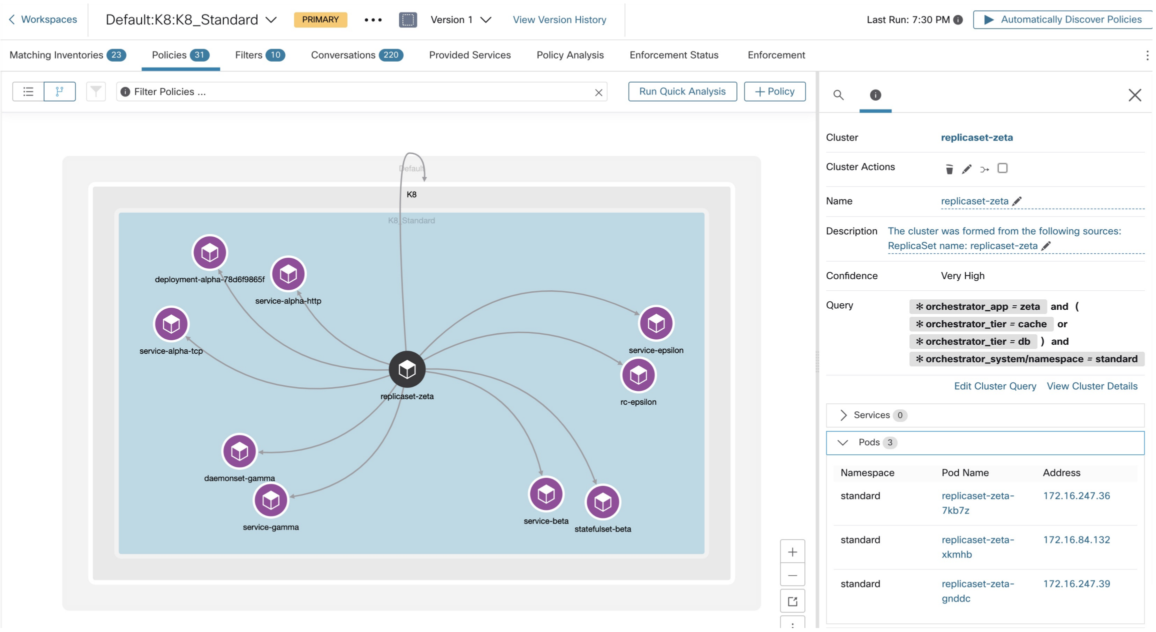
Edit Cluster Query View Cluster Details

Services 0

Pods 3

Namespace	Pod Name	Address
standard	replicaset-zeta-xkmhb	172.16.84.132
standard	replicaset-zeta-gnddc	172.16.247.39
standard	replicaset-zeta-7kb7z	172.16.247.36

If the the Cluster Granularity is set to Medium or Fine or very fine then the services and the pods backing them is clustered seperately.



Cluster replicaset-zeta

Cluster Actions

Name replicaset-zeta

Description The cluster was formed from the following sources: ReplicaSet name: replicaset-zeta

Confidence Very High

Query
* orchestrator_app = zeta and (
* orchestrator_tier = cache or
* orchestrator_tier = db) and
* orchestrator_system/namespace = standard

Edit Cluster Query View Cluster Details

Services 0

Pods 3

Namespace	Pod Name	Address
standard	replicaset-zeta-7kb7z	172.16.247.36
standard	replicaset-zeta-xkmhb	172.16.84.132
standard	replicaset-zeta-gnddc	172.16.247.39

For pod clusters, the source information is added as part of the cluster description and each cluster in the description contain the information of which entity has caused the cluster to be formed.

For example, **Description**: “*The cluster was formed from the following sources: ReplicaSet name: replicaset-zeta*”.

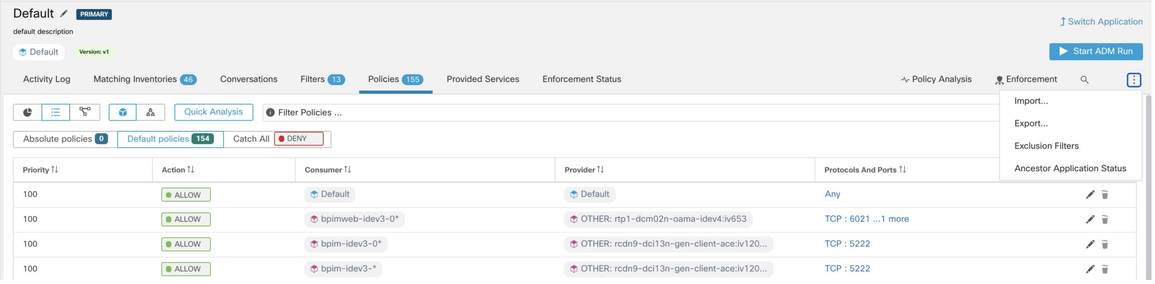
Import/Export

Export a Workspace

All the relevant contents of clusters and policies in each workspace can be downloaded as a single file in a number of popular structured document formats like JSON, XML and YAML. One can use such files for further in-house processing or ingestion by other policy enforcement or analysis tools.

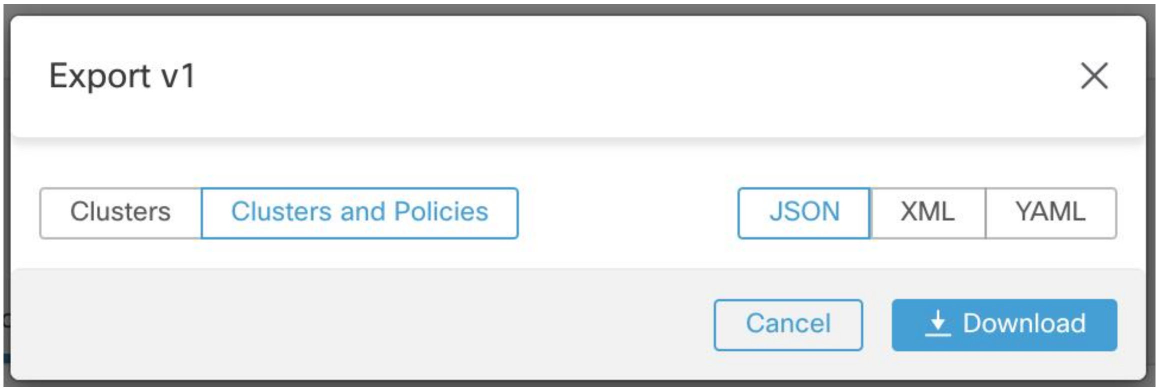
Navigate to the **. . .** menu item on the workspace header and click on the **export** item. This will show the export dialog. You can choose whether the exported file should include only the cluster contents or cluster contents as well as the security policies among the clusters generated by automatic policy discovery based on real network flows. Choose the desired format and click download to download the file into the local file system.

Figure 257: Import/Export menu items



Priority ↑↓	Action ↑↓	Consumer ↑↓	Provider ↑↓	Protocols And Ports ↑↓
100	ALLOW	Default	Default	Any
100	ALLOW	bpimweb-idev3-0*	OTHER: rtp1-dcm02n-oama-idev4:iv653	TCP : 6021 ...1 more
100	ALLOW	bpim-idev3-0*	OTHER: rcdn9-dci13n-gen-client-ace:iv120...	TCP : 5222
100	ALLOW	bpim-idev3-*	OTHER: rcdn9-dci13n-gen-client-ace:iv120...	TCP : 5222

Figure 258: Exporting Policies of a workspace



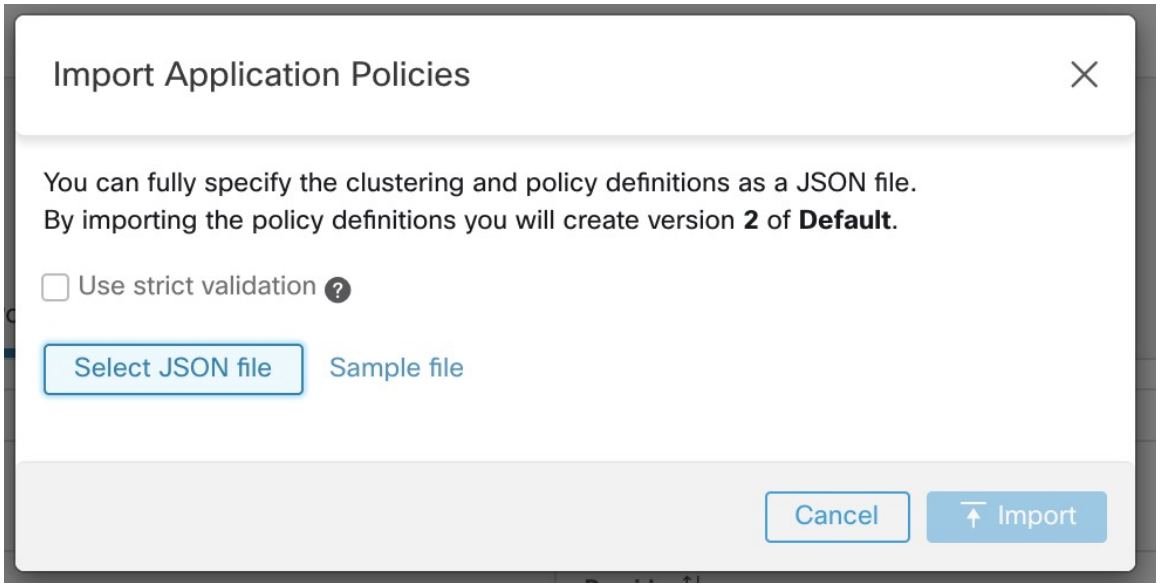
When you export a workspace, the "Auto accept outgoing policy connectors" setting in the automatic policy discovery configuration is included and will be active in the imported workspace.

Import

You can import known cluster and policy definitions into a workspace by directly uploading a JSON file. Similar to automatic policy discovery, uploading policies into an existing workspace creates a new version and places the cluster and policy definitions under the new version. Missing filters and incorrect property values will return an error.

Click on the **Import** menu item from the **. . .** menu in the workspace header. In the import dialog, you can select a JSON file with a valid format. A small sample JSON file demonstrating the schema for policies and clusters can be found by clicking on the **Sample** button.

Figure 259: Importing Clusters/Policies



Import Application Policies

You can fully specify the clustering and policy definitions as a JSON file.
By importing the policy definitions you will create version **2** of **Default**.

□ Use strict validation ?

Strict Validation if enabled, will return an error if the JSON contains unrecognized attributes. This is useful for locating typos or incorrectly identified optional fields.

Note All imported policies are marked as approved by default unless explicitly marked as `approved: false`. You have the option to maintain such approved policies during automatic policy discovery to generate a new set of policies. See Approved Policies, on page 459 for more info.

Pro Tip: The schema of the JSON file retrieved by exporting an application workspace is schema-compatible with the expected format for importing policies into a workspace. Therefore, you can clone policies from one application workspace to another using an export followed by an import. Note that many features may not work the same when exporting and then importing policies. For example, the conversations backing the policies are not included in the export and will not be present when importing the policies either.

Platform-Specific Policies

For important details about how agents enforce policy on each platform, see Policy Enforcement with Agents, on page 39. For Kubernetes/OpenShift, see Enforcement on Containers, on page 542.

Windows

Recommended Windows OS-Based Policy Configuration

Always specify ports and protocols in policies when possible; we recommend not to allow ANY port, ANY protocol.

For example, a generated policy with port and protocol restrictions might look like this:

```
dst_ports {
      start_port: 22
      end_port: 22
      consumer_filters {
        application_name: "c:\\test\\putty.exe"
      }
     }}
     ip_protocol: TCP
```

In contrast, if you allow network connections that are initiated by iperf.exe with ANY protocol and ANY port, the generated policy looks like this:

```
  match_set {
    dst_ports {
      end_port: 65535
      consumer_filters {
        application_name: "c:\\test\\iperf.exe"
      }
    }
    address_family: IPv4
    inspection_point: EGRESS
    match_comment: "PolicyId=61008290755f027a92291b9d:61005f90497d4f47cedacb86:"
  }
```

For the above filter, Secure Workload creates a policy rule to allow the network traffic on the provider as follows:

```
  match_set {
      dst_ports {
      end_port: 65535
    }
    address_family: IPv4
    inspection_point: INGRESS
    match_comment: "PolicyId=61008290755f027a92291b9d:61005f90497d4f47cedacb86:"
  }
```

This network rule opens all the ports on the Provider. We strongly recommend not to create OS-based filters with *Any* protocol.

Configure Policies for Windows Attributes

For more granularity when enforcing a policy on Windows-based workloads, you can filter network traffic by:

- Application Name
- Service Name
- User Names with or without User Groups

This option is supported in both WAF and WFP modes. Windows OS-based filters are categorized as *consumer filters* and *provider filters* in the generated network policy. The Consumer filters filter the network traffic that is initiated on the consumer workload and Provider filters filter the network traffic that is destined for the provider workload.

Before you begin

This procedure assumes you are modifying an existing policy. If you have not yet created the policy to which you want to add a Windows OS-based filter, create that policy first.

Important See Caveats, on page 50 and Known limitations, on page 50 for policies involving Windows attributes.

Procedure

Step 1 In the navigation pane, click **Defend** > **Segmentation**.

Step 2 Click the scope that contains the policy for which you want to configure Windows OS-based filters.

Step 3 Click the workspace in which you want to edit the policy.

Step 4 Click **Manage Policies**.

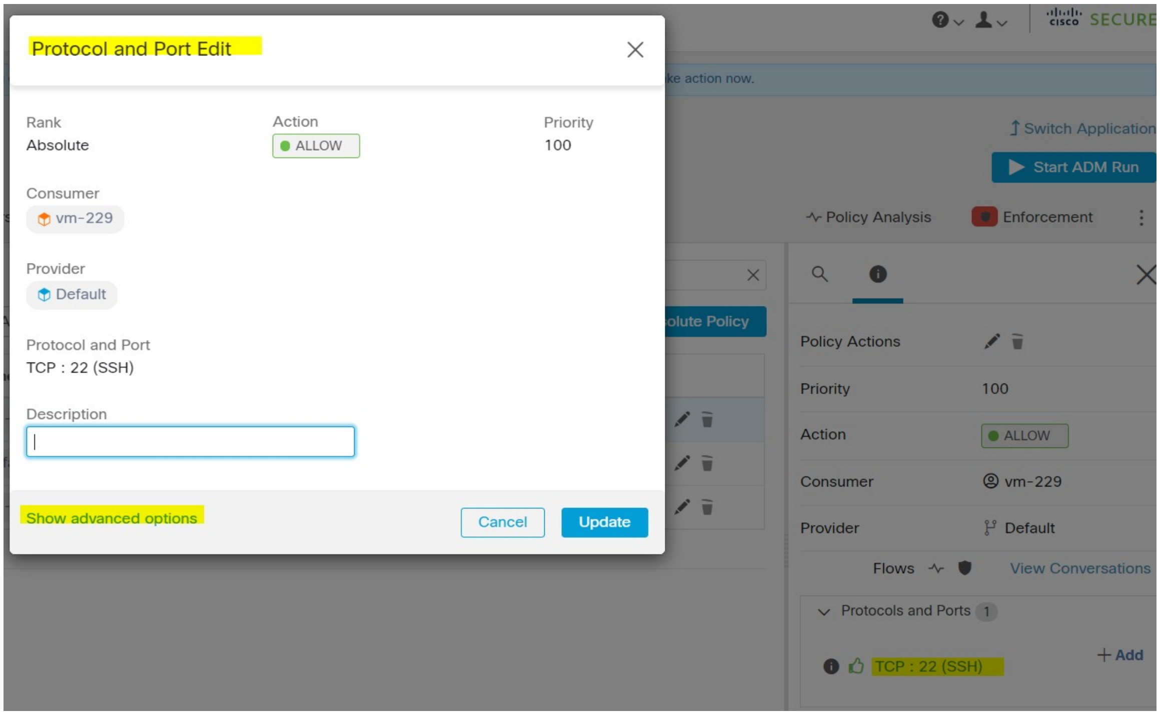
Step 5 Choose the policy to edit.

Important Consumer and Provider must include only Windows workloads.

Step 6 In the table row for the policy to edit, click the existing value in the **Protocols and Ports** column.

Step 7 In the pane on the right, click the existing value under **Protocols and Ports**.

In the example, click `TCP : 22 (SSH)`.



Protocol and Port Edit

Rank: Absolute
Action: ALLOW
Priority: 100

Consumer: vm-229

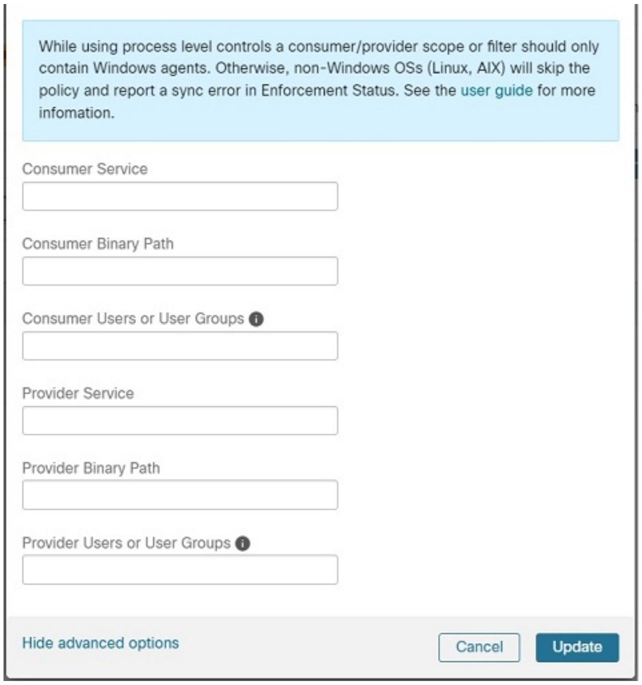
Provider: Default

Protocol and Port: TCP : 22 (SSH)

Description:

Show advanced options

Step 8 Click **Show advanced options**.



While using process level controls a consumer/provider scope or filter should only contain Windows agents. Otherwise, non-Windows OSs (Linux, AIX) will skip the policy and report a sync error in Enforcement Status. See the user guide for more infomation.

Step 9 Configure consumer filters based on Application name, Service name, or User name.

- The application name must be a full pathname.
- Service name must be a short service name.
- User name can be a local user name (For example, tetter) or domain user name (For example, sensor-dev@sensor-dev.com or sensor-dev\sensor-dev)
- User group can be local user group (For example, Administrators) or domain user group (For example, domain users\\sensor-dev)
- Multiple user names and/ or user group names can be specified, separated by ",".(For example, sensor-dev\@sensor-dev.com,domain users\\sensor-dev)
- Service name and User name cannot be configured together.

Step 10 Configure provider filters based on Application name, Service name, or User name.

Follow the same guidelines as given for consumer filters in the previous step.

Step 11 Enter the paths to the binary, as applicable.

For example, enter **`c:\test\putty.exe`**

Step 12 Click **Update**.

Known limitations

- Windows 2008 R2 does not support Windows OS based filtering policies.

- Network policy can be configured with a single user name whereas MS Firewall UI supports multiple users.

Caveats

- While using the Windows OS-based policies, a consumer/ provider scope or filter should only contain Windows agents. Otherwise, non-Windows OSs (Linux, AIX) skip the policy and report a sync error in Enforcement Status.
- Avoid creating Windows OS filters with *loose* filtering criteria. Such criteria may open unwanted network ports.
- If OS filters are configured for consumer, then the policies are applicable only to consumer, similarly if it is configured for provider then it is applicable only to provider.
- Due to limited or no knowledge of the process context, user context or service context of the network flows, there will be discrepancy in the policy analysis if the policies have Windows OS-based filters.

Verify and Troubleshoot Policies with Windows OS-Based Filtering Attributes

If you use Windows OS-based filtering attributes, the following topics provide you with verification and troubleshooting information.

Cisco TAC can use this information as needed to troubleshoot such policies.

Policies Based on Application Name

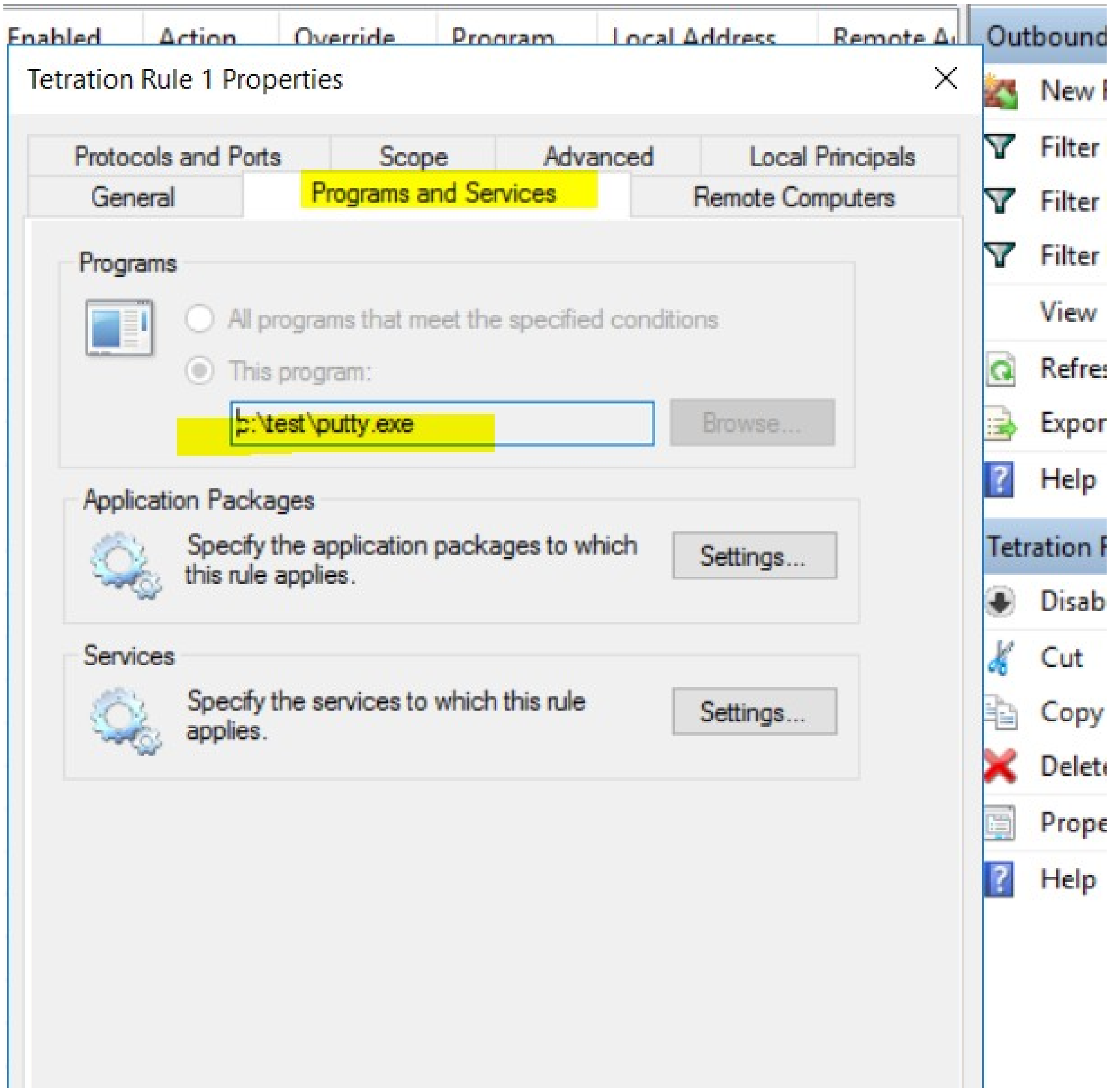
Use the following information to verify and troubleshoot policies based on application name on Windows OS workloads.

The following sections describe the way policies should appear on the workload for an application binary entered as **`c:\test\putty.exe`**.

Sample Policy Based on Application Name

```
dst_ports {
start_port: 22
end_port: 22
consumer_filters {
application_name: “c:\test\putty.exe”
}
}}
ip_protocol: TCP
address_family: IPv4
inspection_point: EGRESS
```

Generated Firewall Rule



Tetration Rule 1 Properties

This program: c:\test\putty.exe

Application Packages: Specify the application packages to which this rule applies.

Services: Specify the services to which this rule applies.

Generated Filter Using netsh

To verify, using native Windows tools, that a filter has been added to an advanced policy:

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- The output file, **filters.xml**, is generated in the current directory.
- Check FWPM_CONDITION_ALE_APP_ID for the application name in the output file: filters.xml.

```
<fieldKey>FWPM_CONDITION_ALE_APP_ID</fieldKey>
                     <matchType>FWP_MATCH_EQUAL</matchType>
                     <conditionValue>
                            <type>FWP_BYTE_BLOB_TYPE</type>
                            <byteBlob>
                                   <data>
↪→5c0064006500760069006300650005c00680061007200640064006900730006b0076006f006
↪→</data>
                                  <asString>\device\harddiskvolume2\temp\putty.exe</
↪→asString>
               </byteBlob>
       </conditionValue>
```

Generated WFP Filter Using tetenf.exe -l -f

```
Filter Name:                   Secure Workload Rule 1
------------------------------------------------------
EffectiveWeight:               18446744073709551592
LayerKey:                      FWPM_LAYER_ALE_AUTH_CONNECT_V4
Action:                        Permit
RemoteIP:                      10.195.210.15-10.195.210.15
Remote Port:                   22
Protocol:                      6
AppID:                         \device\harddiskvolume2\test\putty.exe
```

Invalid Application Name

- In WAF mode, Firewall rule is created for an invalid application name.
- In WFP mode, the WFP filter is not created for an invalid application name but the NPC is not rejected. The agent logs a warning message and configures the rest of the policy rules.

Policies Based on Service Name

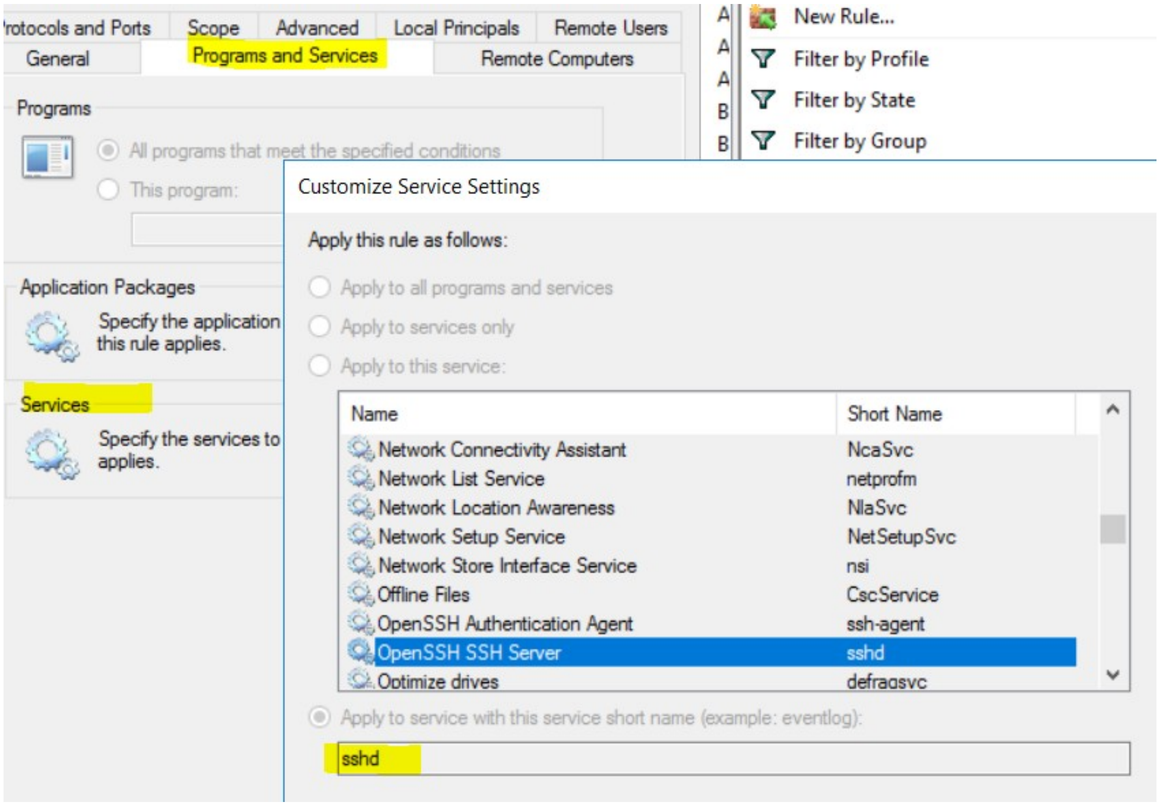
Use the following information to verify and troubleshoot policies based on Service name on Windows OS workloads.

The following sections describe the way that the policies should appear on the workload.

Sample Policy Based on Service Name

```
    dst_ports {
             start_port: 22
             end_port: 22
             provider_filters {
                    service_name: “sshd”
             }
         }}
         ip_protocol: TCP
         address_family: IPv4
         inspection_point: INGRESS
```

Generated Firewall Rule



Customize Service Settings

Apply this rule as follows:

○ Apply to all programs and services

○ Apply to services only

○ Apply to this service:

Name	Short Name
Network Connectivity Assistant	NcaSvc
Network List Service	netprofm
Network Location Awareness	NlaSvc
Network Setup Service	NetSetupSvc
Network Store Interface Service	nsi
Offline Files	CscService
OpenSSH Authentication Agent	ssh-agent
OpenSSH SSH Server	sshd
Optimize drives	defragsvc

● Apply to service with this service short name (example: eventlog):

sshd

Generated Filter Using netsh

To verify using native Windows tools, that a filter has been added for an advanced policy:

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- The output file, **filters.xml**, is generated in the current directory.
- Check FWPM_CONDITION_ALE_USER_ID for user name in the output file: filters.xml.

```
<item>
                     <fieldKey>FWPM_CONDITION_ALE_USER_ID</fieldKey>
                     <matchType>FWP_MATCH_EQUAL</matchType>
                     <conditionValue>
                                <type>FWP_SECURITY_DESCRIPTOR_TYPE</type>

<sd>O:SYG:SYD:(A;;CCRC;;;S-1-5-80-3847866527-469524349-687026318-
→516638107)</sd>
                     </conditionValue>
</item>
```

Generated WFP Filter Using tetenf.exe -l -f

```
Filter Name:       Secure Workload Rule 3
------------------------------------------------------
EffectiveWeight:            18446744073709551590
```

```
LayerKey:                   FWPM_LAYER_ALE_AUTH_RECV_ACCEPT_V4
Action:                     Permit
Local Port:                 22
Protocol:                   6
User or Service:            NT SERVICE\sshd
```

Invalid Service Name

- In WAF mode, the Firewall rule is created for a nonexistent service name.
- In WFP mode, the WFP filter is not created for a nonexistent service name.
- Service SID type must be *Unrestricted* or *Restricted*. If the service type is *None*, the Firewall Rule and WFP filter can be added but they have no effect.

  To verify the SID type, run the following command:

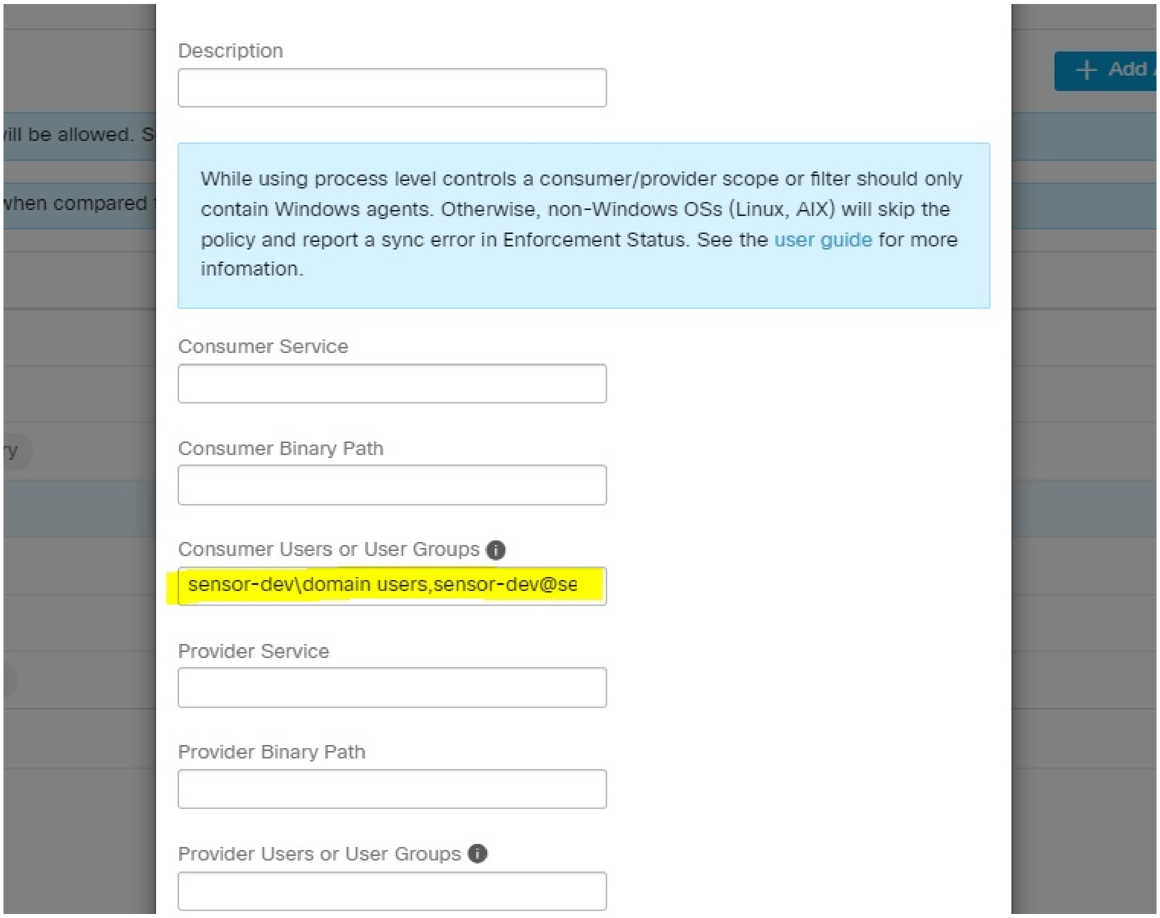
  ```
  sc qsidtype <service name>
  ```

Policies Based on User Group or User Name

Use the following information to verify and troubleshoot policies based on user name (with and without user group name) on Windows OS workloads.

Sections in this topic describe the way that the policies should appear on the workload.

Examples in this topic are based on policies that are configured with the following information:



Description

While using process level controls a consumer/provider scope or filter should only contain Windows agents. Otherwise, non-Windows OSs (Linux, AIX) will skip the policy and report a sync error in Enforcement Status. See the user guide for more infomation.

Consumer Service

Consumer Binary Path

Consumer Users or User Groups

sensor-dev\domain users,sensor-dev@se

Provider Service

Provider Binary Path

Provider Users or User Groups

Sample Policy Based on User Name

```
dst_ports {
          start_port: 30000
          end_port: 30000
          provider_filters {
               user_name: “sensor-dev\sensor-dev”
           }
}}
ip_protocol: TCP
address_family: IPv4
inspection_point: EGRESS
```

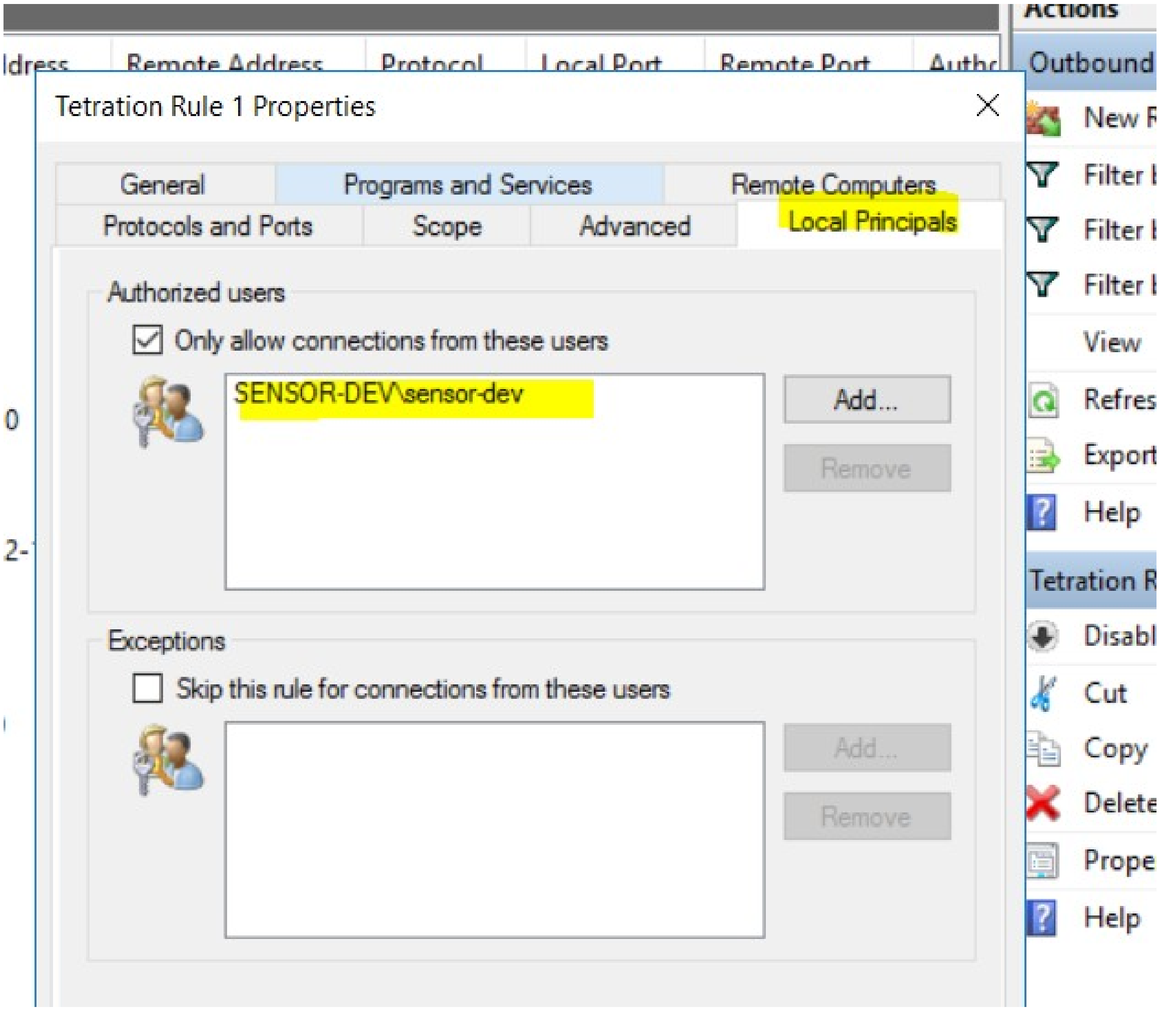
Sample Policy Based on User Group and User Name

```
dst_ports {
start_port: 30000
end_port: 30000
provider_filters {
user_name: “sensor-dev\domain users,sensor-dev\sensor-dev”
}
}}
ip_protocol: TCP
address_family: IPv4
inspection_point: EGRESS
```

Generated Firewall Rule

Firewall Rule Based on User Name

Example: Firewall rule based on User Name, sensor-dev\\sensor-dev



Tetration Rule 1 Properties

Local Principals

Authorized users

☑ Only allow connections from these users

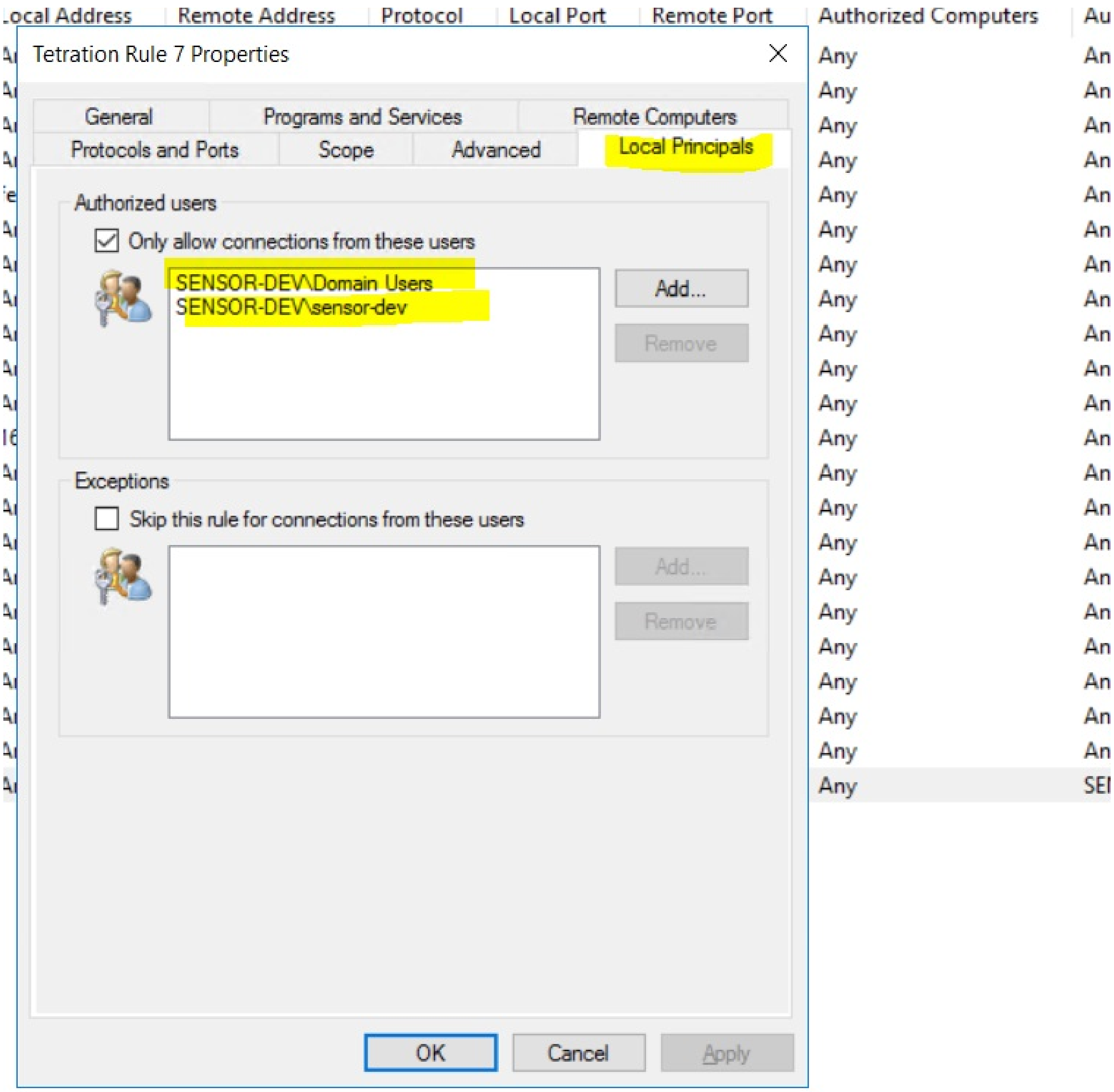
SENSOR-DEV\sensor-dev

Exceptions

☐ Skip this rule for connections from these users

Firewall Rule Based on User Group and User Name

Example: Firewall rule based on User Name, sensor-dev\\sensor-dev and user group, domain users\\sensor-dev



Tetration Rule 7 Properties

Authorized users

☑ Only allow connections from these users

SENSOR-DEV\Domain Users
SENSOR-DEV\sensor-dev

Exceptions

□ Skip this rule for connections from these users

Generated Filter Using netsh

To verify using native Windows tools that a filter has been added for an advanced policy:

- With administrative privileges, run `cmd.exe`.
- Run `netsh wfp show filters`.
- The output file, **filters.xml**, is generated in the current directory.
- Check FWPM_CONDITION_ALE_USER_ID for user name in the output file: filters.xml.

```
<item>
            <fieldKey>FWPM_CONDITION_ALE_USER_ID</fieldKey>
            <matchType>FWP_MATCH_EQUAL</matchType>
            <conditionValue>
                   <type>FWP_SECURITY_DESCRIPTOR_TYPE</type>
```

```
                       <sd>O:LSD:(A;;CC;;;S-1-5-21-4172447896-825920244-2358685150)</sd>
                <</conditionValue>
    </item>
```

Generated WFP Filters Using tetenf.exe -l -f

Filter based on User Name

Example: WFP Rule based on User Name, SENSOR-DEV\sensor-dev

```
Filter Name:                   Secure Workload Rule 1
------------------------------------------------------
EffectiveWeight:               18446744073709551590
LayerKey:                      FWPM_LAYER_ALE_AUTH_CONNECT_V4
Action:                        Permit
RemoteIP:                      10.195.210.15-10.195.210.15
Remote Port:                   30000
Protocol:                      6
User or Service:               SENSOR-DEV\sensor-dev
```

Filter based on User Group and User Name

Example: WFP Rule based on User Name, SENSOR-DEV\\sensor-dev and User Group name, SENSOR-DEV\\Domain Users

```
Filter Name:         Secure Workload Rule 1
------------------------------------------------------
EffectiveWeight:             18446744073709551590
LayerKey:                    FWPM_LAYER_ALE_AUTH_CONNECT_V4
Action:                      Permit
RemoteIP:                    10.195.210.15-10.195.210.15
Remote Port:                 30000
Protocol:                    6
User or Service:             SENSOR-DEV\Domain Users, SENSOR-DEV\sensor-dev
```

Service name and user name cannot be configured for a Network policy rule.

Note The network policy is rejected by the Windows agent if the user name or the user group is invalid.

Kubernetes and OpenShift

(Optional) Additional Policies for Kubernetes Workloads

The following procedures are optional, depending on your Kubernetes environment.

Policies for Kubernetes Nginx Ingress controller running in Host- network mode

Secure Workload will enforce policies both at the nginx ingress controller and at the backend pods when the pods are exposed to the external clients using Kubernetes ingress object.

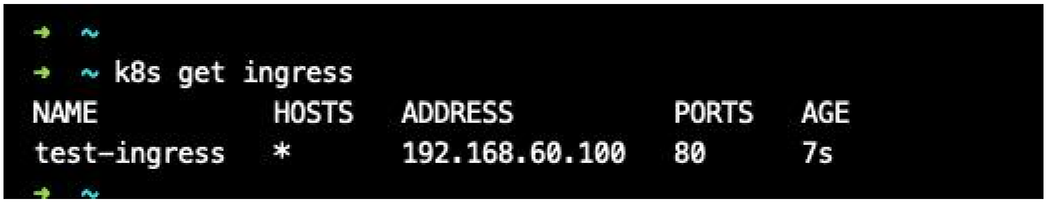
Note If the ingress controller is not running in hostnetwork mode refer IngressControllerAPI

Note IBM-ICP uses Kubernetes Nginx Ingress controller by default and runs on control plane nodes in hostnetwork mode.

Following are the steps to enforce policy using Kubernetes Nginx Ingress controller.

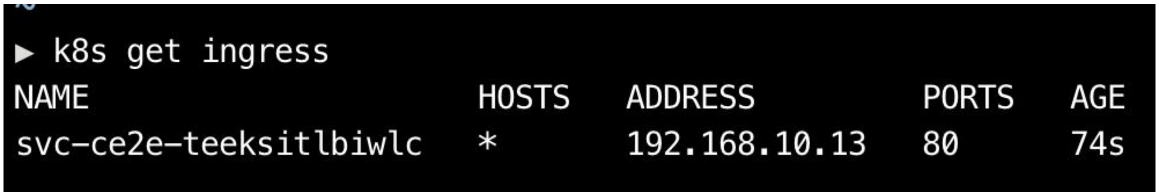
Procedure

Step 1 Create an external orchestrator for Kubernetes/OpenShift as described here.

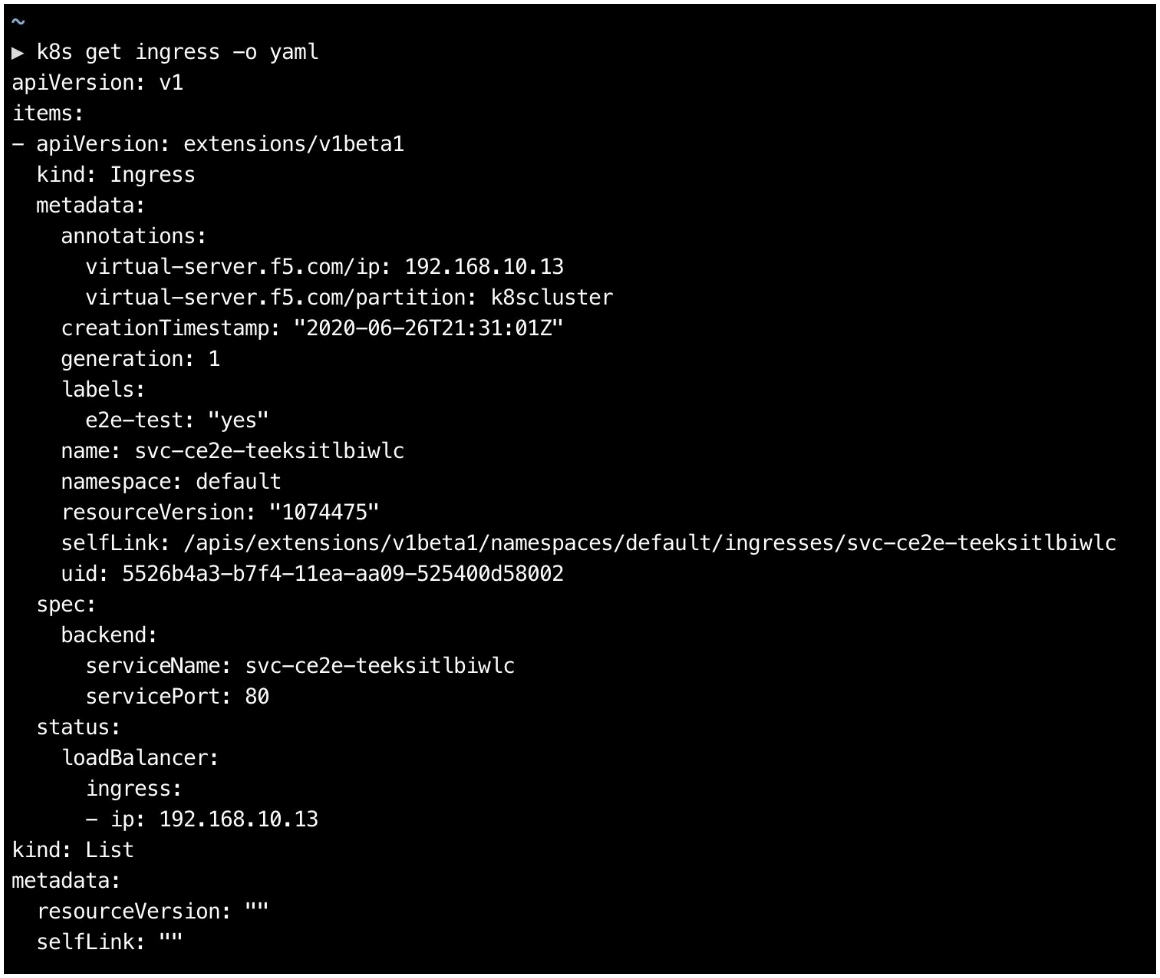


```
➜  ~
➜  ~ k8s get ingress
NAME           HOSTS   ADDRESS          PORTS   AGE
test-ingress   *       192.168.60.100   80      7s
➜  ~
```

Step 2 Create an ingress object in the Kubernetes cluster. A snapshot of the yaml file used to create ingress object is provided in the following picture.

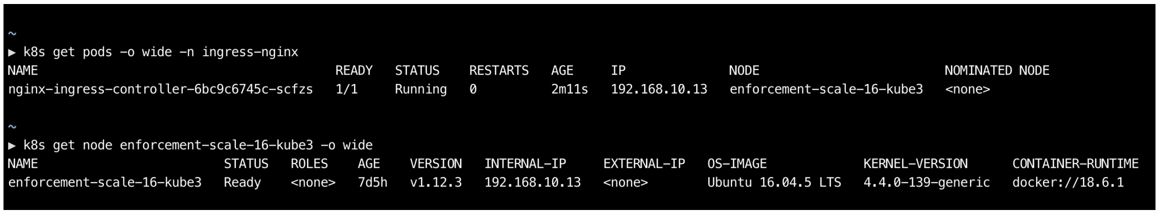


```
▶ k8s get ingress
NAME                    HOSTS   ADDRESS         PORTS   AGE
svc-ce2e-teeksitlbiwlc  *       192.168.10.13   80      74s
```



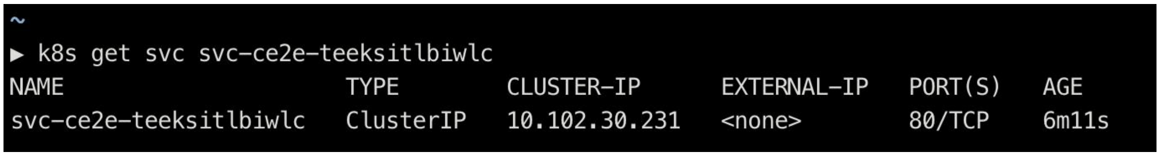
```
~
▶ k8s get ingress -o yaml
apiVersion: v1
items:
- apiVersion: extensions/v1beta1
  kind: Ingress
  metadata:
    annotations:
      virtual-server.f5.com/ip: 192.168.10.13
      virtual-server.f5.com/partition: k8scluster
    creationTimestamp: "2020-06-26T21:31:01Z"
    generation: 1
    labels:
      e2e-test: "yes"
    name: svc-ce2e-teeksitlbiwlc
    namespace: default
    resourceVersion: "1074475"
    selfLink: /apis/extensions/v1beta1/namespaces/default/ingresses/svc-ce2e-teeksitlbiwlc
    uid: 5526b4a3-b7f4-11ea-aa09-525400d58002
  spec:
    backend:
      serviceName: svc-ce2e-teeksitlbiwlc
      servicePort: 80
  status:
    loadBalancer:
      ingress:
      - ip: 192.168.10.13
kind: List
metadata:
  resourceVersion: ""
  selfLink: ""
```

Step 3 Deploy Kubernets Nginx Ingress controller in the Kubernetes cluster. IBM-ICP Ingress controller pods are running on control plane nodes by default.



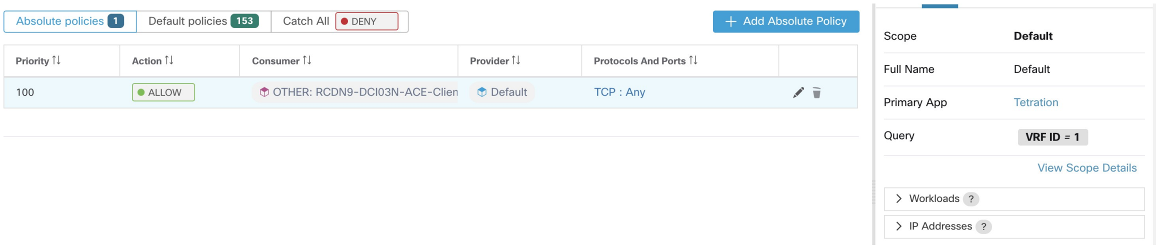
```
~
▶ k8s get pods -o wide -n ingress-nginx
NAME                                        READY   STATUS    RESTARTS   AGE     IP              NODE                        NOMINATED NODE
nginx-ingress-controller-6bc9c6745c-scfzs   1/1     Running   0          2m11s   192.168.10.13   enforcement-scale-16-kube3   <none>

~
▶ k8s get node enforcement-scale-16-kube3 -o wide
NAME                         STATUS   ROLES    AGE    VERSION   INTERNAL-IP     EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION       CONTAINER-RUNTIME
enforcement-scale-16-kube3   Ready    <none>   7d5h   v1.12.3   192.168.10.13   <none>        Ubuntu 16.04.5 LTS   4.4.0-139-generic    docker://18.6.1
```

Step 4 Create a backend service which will be accessed by the consumers outside the cluster. In the example provided below we have created a simple *svc-ce2e-teeksitlbiwlc* (http-echo) service.



```
~
▶ k8s get svc svc-ce2e-teeksitlbiwlc
NAME                     TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)   AGE
svc-ce2e-teeksitlbiwlc   ClusterIP   10.102.30.231   <none>        80/TCP    6m11s
```

Step 5 Create a policy between external consumer and backend service.



Priority	Action	Consumer	Provider	Protocols And Ports
100	ALLOW	OTHER: RCDN9-DCI03N-ACE-Clien	Default	TCP : Any

Scope	Default
Full Name	Default
Primary App	Tetration
Query	VRF ID = 1

Step 6 When you are ready, enforce the policy.

Step 7 In case of Nginx ingress controller Secure Workload software will apply the appropriate allow/drop rule where the source will be consumer specified in the above step and destination will be corresponding Ingress controller pod IP. In case of backend pods, Secure Workload software will apply the appropriate allow/drop rule where the source will be Ingress pod and destination will be the backend pod IP.

Policies for Kubernetes Nginx/Haproxy Ingress controller running as Deployment/Daemonset

Secure Workload will enforce policies both at the ingress controller and at the backend pods when the pods are exposed to the external clients using Kubernetes ingress object.

Following are the steps to enforce policies on Ingress controller.

Procedure

Step 1 Create/Update an external orchestrator for Kubernetes/OpenShift using OpenAPI. See Orchestratorsfor information on creating the external orchestrator using OpenAPI. Add information of Ingress Controllers for External Orchestrator config.

Step 2 Create an ingress object in the Kubernetes cluster.

Step 3 Deploy Ingress controller in the Kubernetes cluster.

Step 4 Create a backend service which will be accessed by the consumers outside the cluster

Step 5 Create a policy between external consumer and backend service.

Step 6 When you are ready, enforce the policy.

Step 7 In case of Ingress controllers Secure Workload software will apply the appropriate allow/drop rule where the source will be consumer specified in the above step and destination will be corresponding Ingress controller pod IP. In case of backend pods, Secure Workload software will apply the appropriate allow/drop rule where the source will be Ingress pod and destination will be the backend pod IP.

Grouping Workloads: Clusters and Inventory Filters

Clusters and inventory filters serve similar purposes, but have some important differences:

Table 24: Comparison of Clusters and Inventory Filters

Clusters	Inventory Filters
Are used to apply policy to a subset of the workloads in a scope.	Can be used to apply policy to a subset of the workloads in a scope. Can also be used to apply policy to workloads regardless of scope (for example, to apply policy to all workloads running a particular operating system.)
Are defined by a query	Are defined by a query.
Can include only workloads in a single scope.	Can have membership restricted to a single scope or include workloads in any scope (for example, if the filter is based on operating system.)
Can only be used by policies in the same workspace and workspace version.	Can be used by policies in any scope and any workspace.
Can be automatically created during automatic policy discovery.	Must be manually created or converted from an existing cluster.
Can be overwritten during automatic policy discovery if not approved. Approving known good clusters can improve accuracy of other clusters in future discovery runs.	Are never modified by automatic policy discovery.
Benefit from important features of automatic policy discovery. They: • Have a confidence rating that helps you evaluate whether the workloads in the group belong together. • Can be compared with clusters generated during other policy discovery runs on the same workspace.	--
Cannot be used when configuring External Dependencies, on page 444 and other features related to cross-scope policies and policy discovery.	Can be used to configure granular policies involving external dependencies and other features related to cross-scope policies, such as auto-pilot rules.
See Clusters, on page 484 and subtopics.	See Create an Inventory Filter, on page 379 and Convert a Cluster to an Inventory Filter, on page 489

Clusters

A cluster is a set of workloads grouped together within a workspace. (A Secure Workload deployment can also be called a cluster, but the two usages are unrelated.)

For example, if your application scope includes several web servers among many other types of servers and hosts that comprise your application, you might want a cluster of web servers within this application scope, so you can assign specific policies only to these web servers.

Automatic policy discovery groups workloads into clusters based on the signals observed in the timeframe specified during the run configuration.

Each cluster is defined by a query

Cluster queries are dynamic unless you define them with specific IP addresses. With dynamic queries, cluster membership can change over time to reflect changes in your inventory: More, fewer, or different workloads can match the query.

For example, if a cluster query is based on hostname containing the substring ‘HR’, and more hosts with hostname containing HR are added to the workspace, the cluster automatically includes the additional hosts.

Automatic policy discovery examines the hostnames and labels associated with workloads. For each cluster, automatic policy discovery generates a short list of candidate queries based on the hostnames and these labels. From these queries, you can select one, possibly edit it, and associate it with the cluster. Note that, in certain cases, when automatic policy discovery cannot formulate simple enough queries based on the hostnames and labels, no (alternate) queries are suggested.

Workloads in approved clusters are not affected by future policy discovery

Only workloads that are not already members of an approved cluster in the relevant workspace are affected by policy discovery. An **approved cluster** is a cluster that you have manually approved. For details, see Approving Clusters, on page 492.

Edit clusters to improve grouping

In the following sections, we describe a few workflows to edit, enhance and approve the clustering results. Note that one can change/approve clusters only in the latest version of a workspace (see Activity Logs and Version History).

See Making Changes to Clusters, on page 487.

Clusters involving Kubermentes inventory

Note If your workspace includes inventory from multiple Kubernetes namespaces, each cluster query must filter by namespace. Add the namespace filter to each query if it is not already present. If you change any query, automatically discover policies again.

A cluster may consist of a single workload.

You may want to create policies involving just a single workload.

Clusters may be converted to inventory filters

Like approved clusters, clusters promoted to inventory filters are not changed during subsequent policy discovery.

Unlike clusters, inventory filters are not tied to a workspace, but are globally available within your Secure Workload deployment.

For a comparison of clusters and inventory filters, see Grouping Workloads: Clusters and Inventory Filters, on page 483.

See Convert a Cluster to an Inventory Filter, on page 489.

Cluster Confidence

Use the confidence or quality score of a cluster to identify clusters needing improvement.

The confidence for a cluster is the average of the confidences for member workloads. In general, the more similar a workload is to other members of the cluster it was assigned, and the more dissimilar it is to the workloads of the closest (most similar) alternative cluster, the higher the confidence for that workload.

When flows are used for clustering, two workloads are similar when they have a similar pattern of conversations (such as similar sets of neighbors in the conversation graph, i.e., similar sets of consumer and provider workloads and ports).

Note

- Cluster confidence is not computed (undefined) for:
  - clusters containing only one workload
  - approved clusters
  - workloads in the scope for which no communication was observed (or no process information is available, if process-based clustering was chosen)
- Clusters do not span partition boundaries (such as subnet boundaries, see route labels in the advanced automatic policy discovery configurations). However, in computing confidence and alternate cluster, such boundaries are ignored. This indicates the potential existence of workloads or clusters that behave very similarly even though they are in different subnets.
- After editing clusters, the confidence scores may become inaccurate as they are NOT recomputed until you discover policies again.

To view cluster confidence, see View Clusters, on page 486.

View Clusters

The clusters view supports query-to-cluster association and query editing.

In the clusters view, you can click a table column heading to sort the clusters based on that column (such as name, the number of workloads, or confidence).

For each cluster, by clicking on its row, you can view further cluster information such as description, suggested or approved queries, and the member workloads in the right panel. Several of these fields are editable.

To view clusters and details about them:

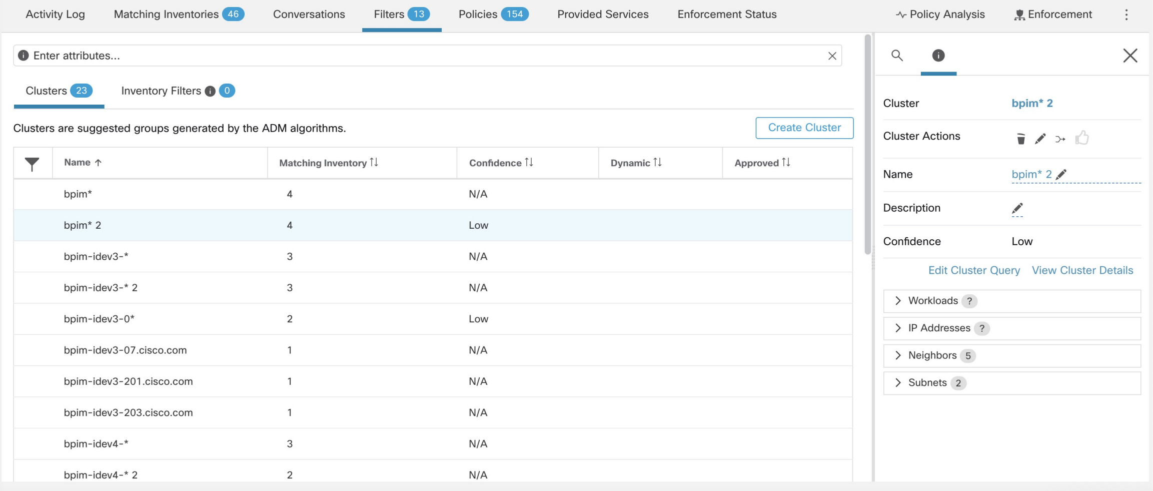
1. Navigate to the scope and workspace of interest.

   Clusters are specific to a workspace; each workspace in a scope can have different clusters. To make clusters available outside their current workspace, see Convert a Cluster to an Inventory Filter, on page 489.

2. Click **Manage Policies**.
3. Click **Filters**.
4. Click **Clusters**.
5. To view information about a cluster, click a cluster.
   a. Look in the panel that opens on the right.
   b. For more details, click **View cluster details**.

The Cluster Details page opens in a separate browser tab.

Figure 260: Clusters View



Clusters are suggested groups generated by the ADM algorithms.

Name	Matching Inventory	Confidence	Dynamic	Approved
bpim*	4	N/A		
bpim* 2	4	Low		
bpim-idev3-*	3	N/A		
bpim-idev3-* 2	3	N/A		
bpim-idev3-0*	2	Low		
bpim-idev3-07.cisco.com	1	N/A		
bpim-idev3-201.cisco.com	1	N/A		
bpim-idev3-203.cisco.com	1	N/A		
bpim-idev4-*	3	N/A		
bpim-idev4-* 2	2	N/A		

Cluster	bpim* 2
Cluster Actions	
Name	bpim* 2
Description	
Confidence	Low

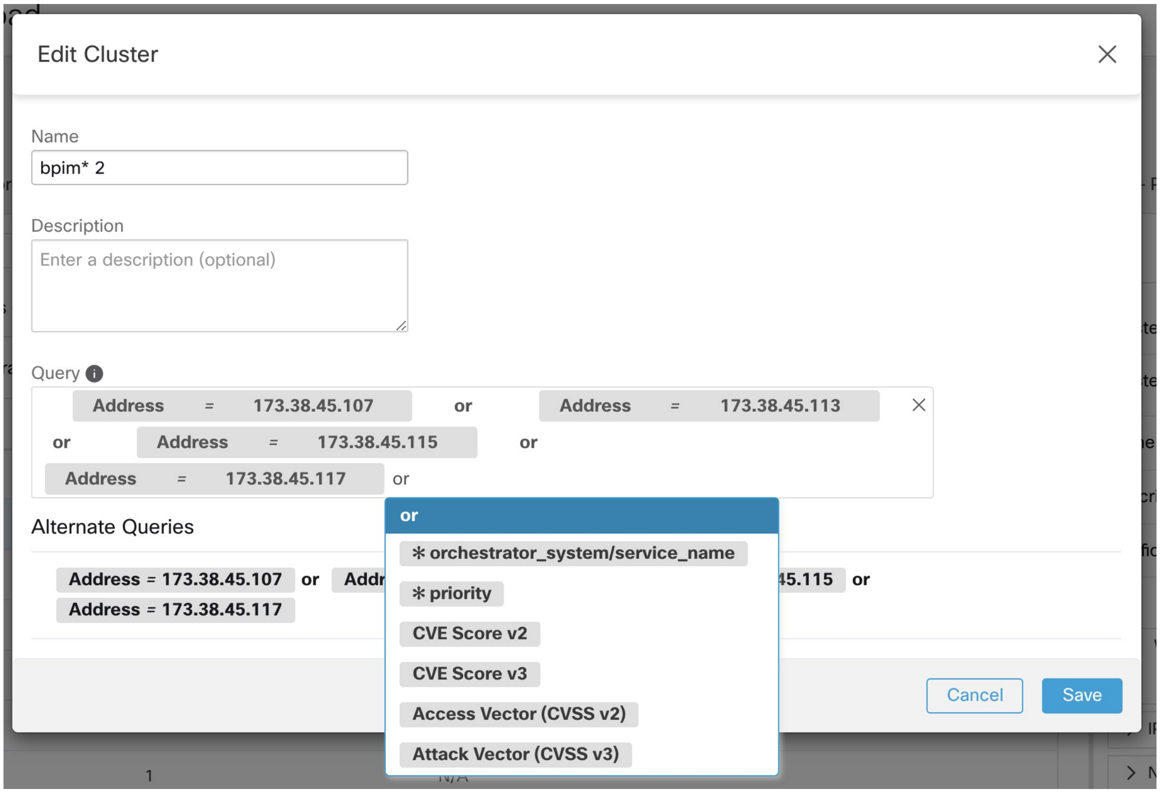
Making Changes to Clusters

Automatic policy discovery creates one or more candidate queries for each cluster.

If clustering results do not completely match your expectations, you can improve the grouping by editing the query.

To browse and edit clusters: Click on the **clusters** box at the top of the page. To change a cluster (e.g. change the members of a cluster or select/change its query), select/edit the cluster's query, as shown below.

Figure 261: Edit Cluster



Edit Cluster

Name: bpim* 2

Description: Enter a description (optional)

Query: Address = 173.38.45.107 or Address = 173.38.45.113 or Address = 173.38.45.115 or Address = 173.38.45.117 or

Alternate Queries

Address = 173.38.45.107 or Addr… …45.115 or
Address = 173.38.45.117

You can add or remove explicit IP addresses, or pick another query from the list of alternatives provided and edit that query. A cluster's query can be any query filter expressed in terms of addresses, hostnames, and labels. If you define a query based on labels rather than explicit IP addresses, the cluster will be dynamic, and new, changed, or removed inventory that is properly labeled will automatically be included in or excluded from the cluster.

After query selection and possible editing is done, click save. Note that once the SAVE button is clicked, the cluster is automatically marked approved, the approved thumbs-up icon turns blue (whether or not a change was made). The approved icon can be toggled to change the approved status as desired. See details at Approving Clusters, on page 492.

Important When a cluster's membership is changed, it may be necessary to discover policies again to get an updated policy accurately reflecting the changes in flows among the changed clusters. This is because cluster memberships may have changed (such as new nodes added to a cluster). A similar situation can occur if the scope corresponding to the workspace is edited or in general when workspace membership changes. Similarly, cluster confidence scores may no longer be accurate with changes to cluster memberships. In all these cases, automatically discovering policies again is useful to get updated policies and cluster confidence scores (updated confidences on unapproved clusters).

If you edit cluster queries, it is possible that clusters associated with queries may overlap.

Convert a Cluster to an Inventory Filter

Convert a cluster to an inventory filter if:

- You do not want the cluster to be modified by future automatic policy discovery runs, as a more versatile alternative to approving the cluster.
- You want the cluster to be independent of the workspace and workspace version.
- You are creating or discovering policies in which the consumer and provider belong to different scopes, and you want to create policies specific to a subset of workloads in a scope, not just policies involving the entire scope.

  You must use inventory filters instead of clusters for this purpose if you create cross-scope policies using the advanced method described in When Consumer and Provider Are In Different Scopes: Policy Options, on page 500 and you want policies to be more granular than scope-to-scope.

Procedure

Step 1 Navigate to the workspace that contains the cluster to promote.

Step 2 Click **Manage Policies**.

Step 3 Click **Filters**.

Step 4 Click **Clusters**.

Step 5 Click the cluster you want to use in the cross-scope policy.

Step 6 In the panel on the right, in the **Cluster Actions** section, click ↣ (Promote to Inventory Filter.)

Step 7 Verify that the name, description, and query are as expected.

Step 8 Select **Restrict Query to Ownership Scope**.

(Inventory filters can cross scope boundaries, but you do not want this behavior for this purpose; you want this filter to include only workloads in this scope.)

Step 9 If you want the application defined by this inventory filter to be the provider in policies generated during automatic policy discovery, select **Provides a service external of its scope**.

If this application is a consumer rather than a provider, or if you will use this inventory filter only for manually created policies, you don't need to enable this option.

Step 10 Click **Promote Cluster**.

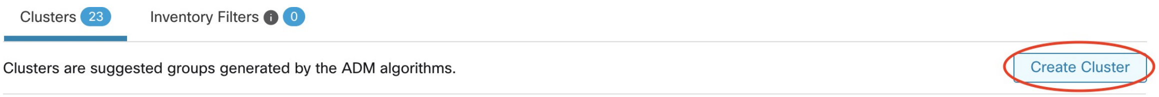
Step 11 Verify that the cluster has moved to the **Inventory Filters** tab.

You may need to refresh the page to see this change.

Creating or Deleting Clusters

Click the **Create Cluster** button on the clusters page to create a new empty cluster. Alternatively, you can also create a cluster from the automatic policy discovery page by clicking on **Create Filter** button in Get Started sidebar and selecting Clusters in the modal.

Figure 262: Creating a new Cluster

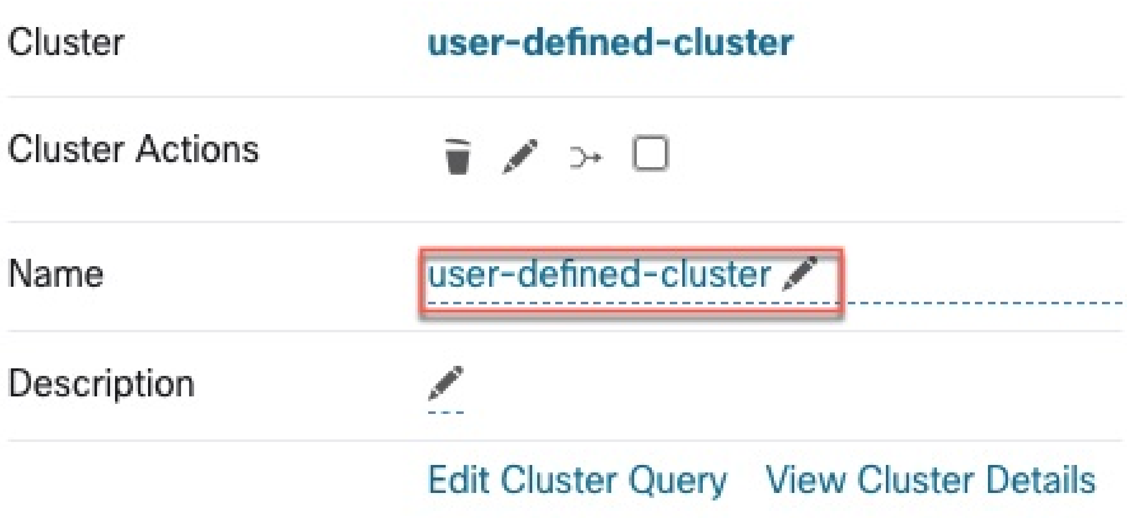


Clusters 23 Inventory Filters 0

Clusters are suggested groups generated by the ADM algorithms.

The new user defined cluster will show up on the side panel to be renamed, if necessary.

Figure 263: Renaming a Cluster



Cluster	user-defined-cluster
Cluster Actions	
Name	user-defined-cluster
Description	

An empty cluster may be deleted by selecting the cluster in any of the views so that the details appear on the side panel and clicking the trash button on the header of cluster detail view. See figure above.

Comparing Versions of Generated Clusters: Diff Views

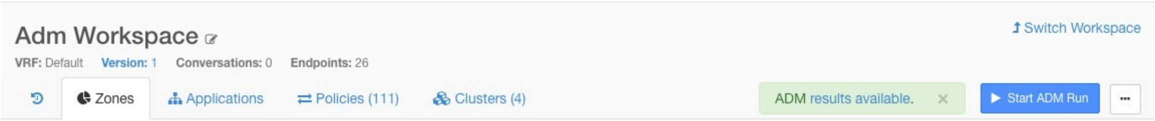
After you have automatically discovered policies at least twice for a workspace, you can compare the clusters generated in different discovery runs.

Procedure

Step 1 Navigate to the clusters diff view using one of the following paths:

- After successfully discovering policies, a message will appear indicating the success with a link that navigates to the diff view showing discovery results. Click the results link.

  Figure 264: Successful automatic policy discovery run

  Adm Workspace

  VRF: Default Version: 1 Conversations: 0 Endpoints: 26

- Compare revisions from the versions view:

  a. Follow the steps in View, Compare, and Manage Discovered Policy Versions, on page 462.

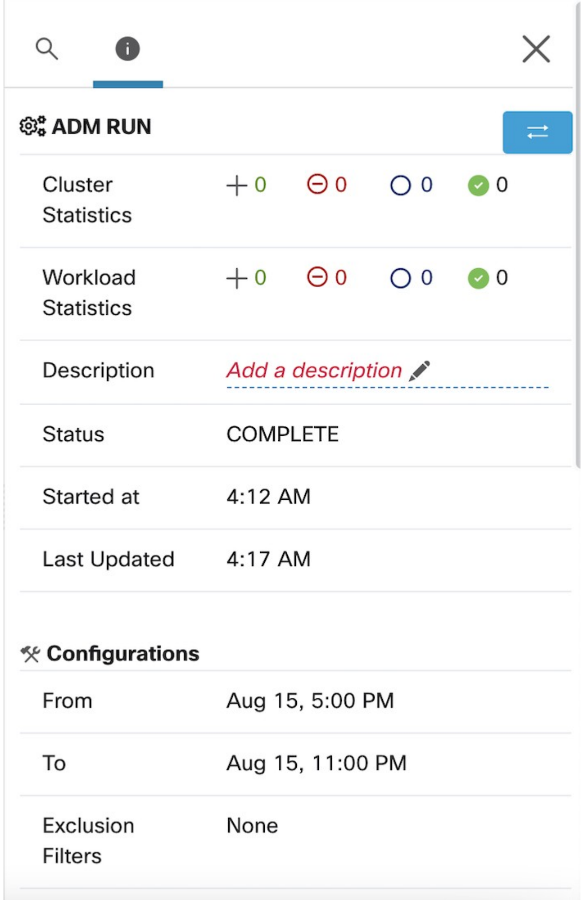
  b. After you click **Compare Revisions**, click **Clusters**.

- From the version details side panel:

  a. Follow the steps to view version details in View, Compare, and Manage Discovered Policy Versions, on page 462.

  b. From the side panel, when it is showing context information for an automatic policy discovery run, click the double-arrow button on the top right corner of the side panel:

Figure 265: Showing Context Information



ADM RUN

Cluster Statistics	+ 0	⊖ 0	○ 0	✓ 0
Workload Statistics	+ 0	⊖ 0	○ 0	✓ 0
Description	Add a description			
Status	COMPLETE			
Started at	4:12 AM			
Last Updated	4:17 AM			

Configurations

From	Aug 15, 5:00 PM
To	Aug 15, 11:00 PM
Exclusion Filters	None

Step 2 Choose the versions to compare.

Step 3 Review the comparison results:

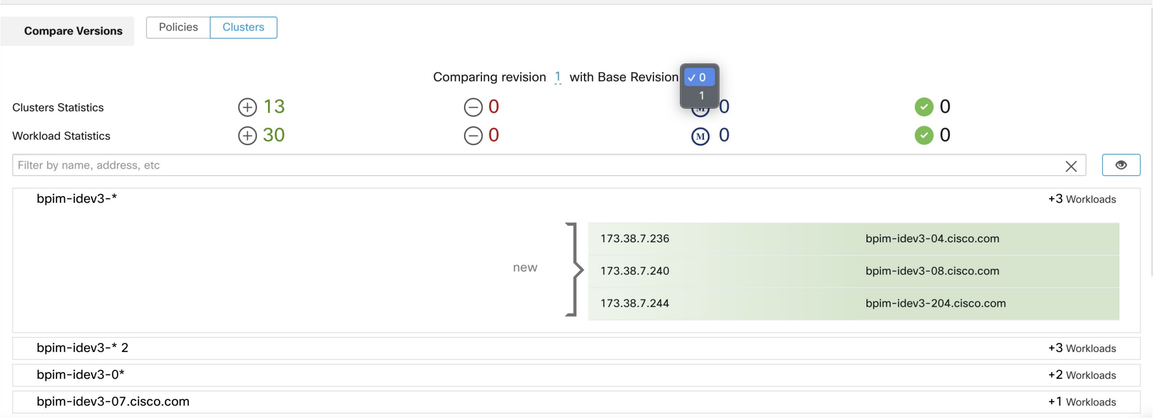
At the top level, the diff view for automatically discovered policies shows high level statistics about changes in clusters and workloads showing the number of added, deleted, modified, and unchanged clusters and workloads.

The rest of the view is organized as a list of clusters in the order of added, deleted, modified and unchanged, each color coded to reflect the status as well as the number of workloads added to or removed from the cluster.

You may search for a particular cluster or workload by name or IP address. To see how the contents of a cluster have changed, click any of the rows representing a cluster to expands that row.

Note By default, unchanged clusters are hidden. To display unchanged clusters, click the button with the eye icon.

Figure 266: Cluster Diff View



Comparing revision 1 with Base Revision ✓ 0 1

Clusters Statistics	⊕ 13	⊖ 0	Ⓜ 0	✓ 0
Workload Statistics	⊕ 30	⊖ 0	Ⓜ 0	✓ 0

Filter by name, address, etc

bpim-idev3-* +3 Workloads

new

173.38.7.236	bpim-idev3-04.cisco.com
173.38.7.240	bpim-idev3-08.cisco.com
173.38.7.244	bpim-idev3-204.cisco.com

bpim-idev3-* 2 +3 Workloads

bpim-idev3-0* +2 Workloads

bpim-idev3-07.cisco.com +1 Workloads

What to do next

To view a similar comparison for policies, see Comparison of Policy Versions: Policy Diff.

Preventing Cluster Modification During Automatic Policy Discovery Reruns

If you do not want automatic policy discovery (formerly known as ADM) to modify a cluster when you automatically discover policies for the workspace in future, approve the cluster.

For example, approve the cluster if you have edited the cluster query, and now you need to add new workloads to the scope and cluster them without affecting the existing policies. Approving the cluster freezes the cluster contents and attributes in the current state. Automatic policy discovery does not change approved clusters.

See Approving Clusters, on page 492.

Alternatively, you can promote the cluster to an inventory filter, which will never be modified by policy discovery. See Convert a Cluster to an Inventory Filter, on page 489.

Approving Clusters

Note See also Convert a Cluster to an Inventory Filter, on page 489, which may be a more appropriate option for your needs.

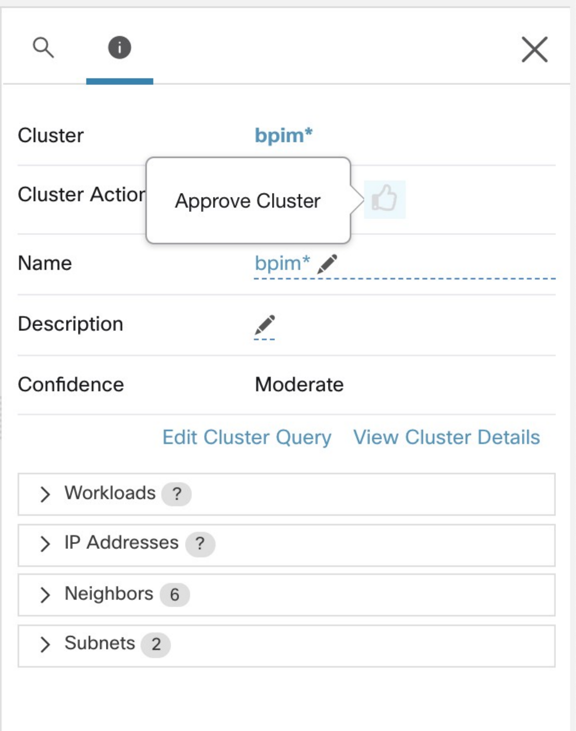
After you approve a cluster, subsequent automatic policy discovery does not change that cluster’s query. Memberships of approved clusters can change only if the members of the workspace change.

Workloads that are members of an approved cluster may be referred to as "approved workloads."

To approve a cluster:

Make sure the cluster of interest is shown on the side panel. You can accomplish this via searching for the cluster, or clicking on the desired cluster on the chart in any of the views. Then select the check box on the top-right corner of the cluster info on the side panel as illustrated below. After a cluster is approved, it indicates that it will remain unchanged by future automatic policy discovery.

Figure 267: Approving Clusters



Cluster bpim*

Cluster Action

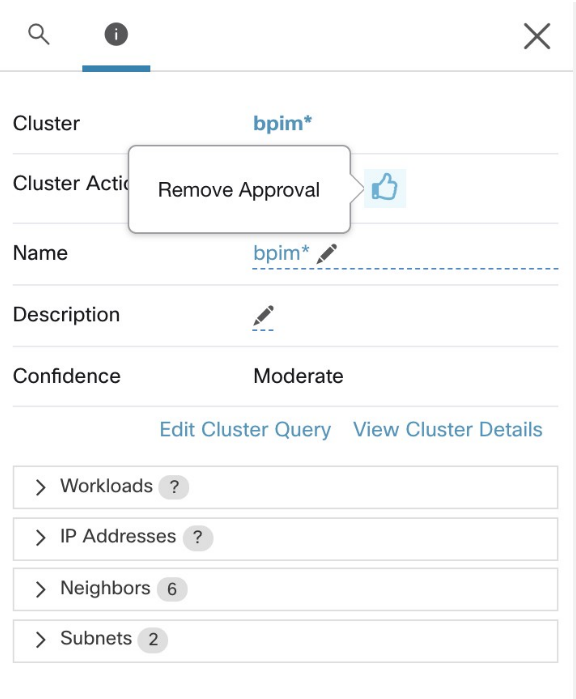
Name bpim*

Description

Confidence Moderate

To remove approval of a cluster, click the approval icon.

Figure 268: Removing Approval of a Cluster



Cluster bpim*

Cluster Acti

Name bpim*

Description

Confidence Moderate

Address Policy Complexities

Enforcement results are impacted by factors including:

- Rule type and rank:
    - Absolute vs Default policies
    - The catch-all setting for the workspace

  See Policy Rank: Absolute, Default, and Catch-All, on page 421.

- Order of policies within the workspace

  See Policy Priorities, on page 494.

- Policies inherited from parent or ancestor scopes, including the catch-all rule

  You will want to ensure that a higher-priority policy is not hitting traffic before the policy that you expect to hit that traffic.

  To see the impact of policies in ancestor scopes, run live policy analysis on all involved scopes. See Live Policy Analysis, on page 523.

  When you are ready to enforce the policies in a workspace, a wizard shows you which inherited policies impact workloads in the workspace. For information, see Policy Enforcement Wizard, on page 540.

- Cross-scope policy interactions

  (When consumer and provider are in different scopes, or one end of the conversation is in a different scope than the policy)

  See When Consumer and Provider Are In Different Scopes: Policy Options, on page 500.

- Situations in which the actual consumer or provider in a policy may differ from the default configured consumer and provider, for example in failover scenarios.

  See Effective Consumer or Effective Provider, on page 513.

Policy Priorities

Traffic handling is affected by:

- The priority of policies within the scope, and
- Policy Global Ordering and Conflict Resolution, on page 495

Policy priorities within a scope

Within a workspace, the order of the policies in the list reflects the relative priority of each policy, with the highest priority policy at the top of the list, and the lowest priority policy at the bottom of the list.

In each workspace, Absolute policies have priority over Default policies, and the Catch-All policy is the lowest priority policy in the workspace.

For details, see Policy Rank: Absolute, Default, and Catch-All, on page 421.

Policy Global Ordering and Conflict Resolution

Conflicts can arise between different policies defined under different scopes. More specifically, conflicts arise for workloads (inventory items) that belong to multiple scopes, such as parent/child, when those scopes have contradictory policies).

It is not feasible to resolve such conflicts manually due to the dynamic nature of scope membership; workloads can enter and leave scopes as their properties change. Therefore, the system imposes a global order, as described below, for all policies according to the scope under which they are defined. For each workload, the list of relevant policies (according to consumer/provider/scope) is identified and sorted by the global order. The decision to permit or drop a flow is made based on the *first* matching policy in the sorted list.

By understanding the global ordering scheme of security policies, network admins can define the correct scopes and their priorities to apply the overall desired policies on workloads. Within each scope, application owners maintain their ability to enforce fine-grained policies on their respective workloads.

A global network policy has the following characteristics:

- A set of scopes ordered by priority (highest priority first).
- Each scope's primary workspace has absolute policies, default policies and a catch-all action.
- Each group of absolute or default policies within each workspace is sorted according their local priorities (highest first).

The global order of policies is defined as follows:

- Groups of absolute policies from the primary workspaces of all scopes (arranged from highest to lowest priority).
- Groups of default policies from the primary workspaces all scopes (arranged from lowest to highest priority).
- Catch-all policies from all scopes (arranged from lowest to highest priority).

Note that the scope order applies to groups of policies in category 1 and 2, rather than individual policies. Within each group, individual policies with with lower policy priority numbers taking precedence.

For a specific workload, first the subset of scopes it belongs to is determined, then the above order is applied. The catch-all policy from the lowest priority (enforced) workspace to which this workload belongs is the applicable catch- all (but an absolute or default policy may override). For a given flow on that workload, the action of the highest matching policy is applied.

Note

- If a workspace has neither Absolute nor Default policies defined, the workspace is ignored. The workspace's catch-all policy will not be included in the global order.
- The order of Default policies in the global order is the reverse of the scope priorities. This lets you define broad policies for all scopes to secure the perimeter of all workspaces including those that do not have policy enforcement enabled. At the same time application owners who have enabled enforcement on their scopes have the ability to override these default policies.
- Overlapping scopes are not recommended; see Scope Overlap, on page 359 for details. However, if a workload has two or more interfaces, in overlapping or disjoint scopes, the catch-all policy of the lowest priority workspace with enforcement enabled will apply (among all the applicable catch-all policies).

We expand our previous three-scope example to illustrate this ordering scheme. Assume the three scopes are assigned the following priorities (See Use Workspaces to Manage Policies for instruction on how to change scope priorities):

1. Apps
2. Apps:HR
3. Apps:Commerce

The primary workspace of each of these scopes has absolute policies, default policies and a catch-all action. Each group of absolute or default policies within each workspace is sorted according their local priorities.

The global ordering of the policies will be as follows:

1. Apps Absolute policies
2. Apps:HR Absolute policies
3. Apps:Commerce Absolute policies
4. Apps:Commerce Default policies
5. Apps:HR Default policies
6. Apps Default policies
7. Apps:Commerce Catch-all
8. Apps:HR Catch-all
9. Apps Catch-all

A workload that belongs to the *Apps* scope will receive only the following policies in the given order:

1. Apps Absolute policies that match the workload
2. Apps Default policies
3. Apps Catch-all

A workload that belongs to the *Apps* and *Apps:Commerce* scopes will receive only the following policies in the given order:

1. Apps Absolute policies
2. Apps:Commerce Absolute policies
3. Apps:Commerce Default policies
4. Apps Default policies
5. Apps:Commerce Catch-all

A workload that belongs to the *Apps* and *Apps:HR* scopes will receive only the following policies in the given order:

1. Apps Absolute policies
2. Apps:HR Absolute policies
3. Apps:HR Default policies
4. Apps Default policies
5. Apps:HR Catch-all

Policy Order and Overlapping Scopes

Important The following scenario involves overlapping scopes. You should avoid having overlapping sibling scopes – workloads should not be members of multiple branches of the scope tree. For more information, see Scope Overlap, on page 359.

A workload that belongs to all three *Apps*, *Apps:HR* and *Apps:Commerce* scopes will receive the following policies in the given order:

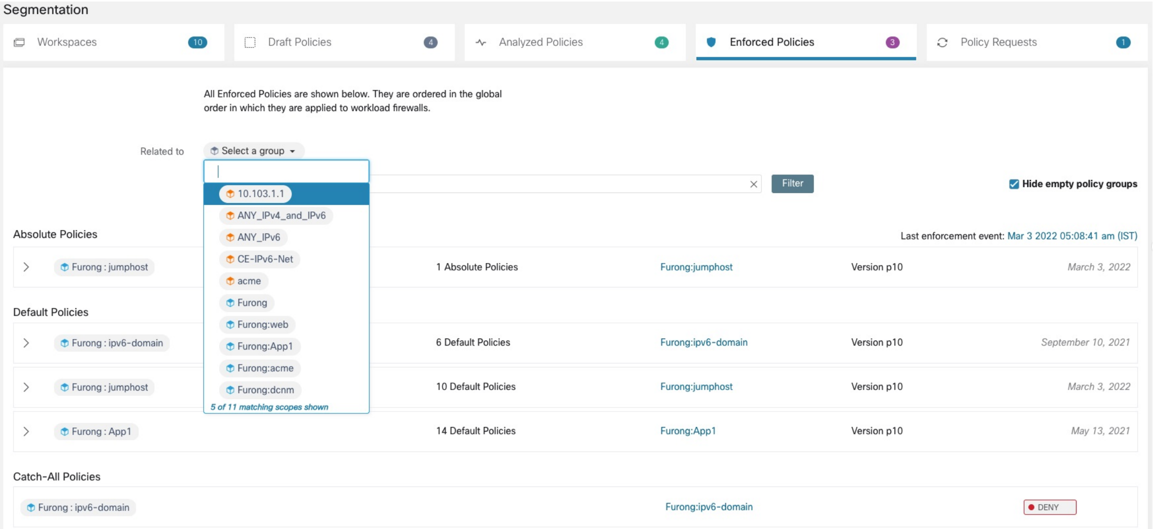
1. Apps Absolute policies
2. Apps:HR Absolute policies
3. Apps:Commerce Absolute policies
4. Apps:Commerce Default policies
5. Apps:HR Default policies
6. Apps Default policies
7. Apps:Commerce Catch-all

Note that the relative ordering of the *Apps:HR* and *Apps:Commerce* scopes only matters if the two scopes overlap (that is, there are workloads that belong to both sibling scopes.) This is because policies are always defined under a scope. A workload belonging to one scope only will not be affected by policies from the other scope, thus the order does not matter.

Validate the Order and Priority of Policies

To validate the order and priority of policies in parent/ancestor workspaces, click the **Analyzed Policies** or **Enforced Polices** tab at the top of the Defend > Segmentation page. These views provide a global view of the analyzed and enforced policies respectively.

Figure 269: Example: List of enforced policies in their policy priority order



All Enforced Policies are shown below. They are ordered in the global order in which they are applied to workload firewalls.

Last enforcement event: Mar 3 2022 05:08:41 am (IST)

Absolute Policies

Furong : jumphost	1 Absolute Policies	Furong:jumphost	Version p10	March 3, 2022

Default Policies

Furong : ipv6-domain	6 Default Policies	Furong:ipv6-domain	Version p10	September 10, 2021
Furong : jumphost	10 Default Policies	Furong:jumphost	Version p10	March 3, 2022
Furong : App1	14 Default Policies	Furong:App1	Version p10	May 13, 2021

Catch-All Policies

Furong : ipv6-domain	Furong:ipv6-domain	DENY

- To limit the list of policies to only those which include a particular scope or filter as a consumer or provider, select a scope or enter a filter.
- Available filters:

Filter Name	Definition
Port	Policy port to match, e.g. 80.
Protocol	Policy protocol to match, e.g. TCP.
Approved	Matches policies that have been marked as Approved Policies.
External?	Policies in which the consumer and provider are in different scopes.
Action	Policy action: Allow or Deny

(Advanced) Change Policy Priorities

⚠

Caution Scope policy priority order rarely needs to be changed. Since changing policy priorities can affect enforcement results on all workspaces, change with caution.

Access to this feature is limited to users with very high privilege roles such as site admin.

Before you begin

Before changing scope priority order:

- Understand policy sorting logic and how policy priorities on scopes translate to ordering of individual policy intents. See Policy Priorities, on page 494.
- Make changes in a secondary workspace until you are confident that your new order will be as expected.
- Plan your changes, considering the following guidelines:

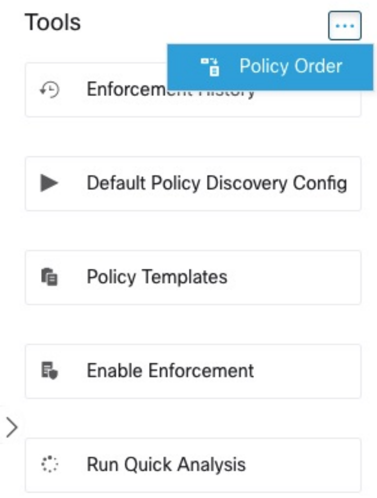
  When reordering, keep a parent-first ordering (parent scopes above child scopes) to take advantage of the hierarchical structure of your scope tree.

  (If you have overlapping sibling scopes, it may be necessary to reorder sibling scopes and their children. Overlapping sibling scopes are not recommended. Fix these by updating scope queries. See Scope Overlap, on page 359.)

Procedure

Step 1 To reorder policy priority, click the menu icon next to **Tools** and select **Policy Order**:

Figure 270: Navigating to Policy Priorities page

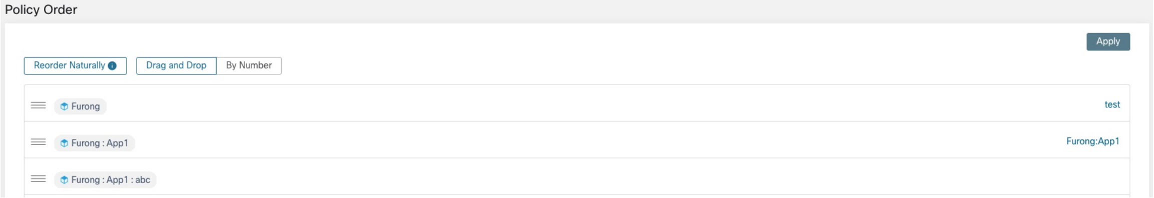


Once on the Policy Order page, you can see the list of all scopes and their corresponding primary workspaces according to the current policy priority.

Step 2 There are several ways to reorder the scopes:

- To reorder the entire list to place parent scopes above child scopes ("pre-order"): Click **Reorder Naturally**. This is the recommended order and any deviation from this should be done with care.
- To reorder the list manually:
  - Drag the rows up and down.
  - Click **By Number** to set a number for each scope to be used for sorting. This can be easier for large lists.

Figure 271: Setting Policy Priorities for Scopes



What to do next

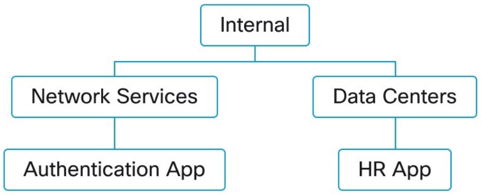
Run Quick Analysis to see the results of your changes.

When Consumer and Provider Are In Different Scopes: Policy Options

Example Scenario

The following situation is an example showing cross-scope traffic:

Your scope hierarchy includes a Network Services scope that includes an authentication application (the provider). An HR application, which is a member of a scope on a different branch of the scope hierarachy, is a consumer of the service provided by the authentication application.



Policy Options

Secure Workload offers several ways to address this situation:

Option	Instructions	Pros and Cons
Create these policies in a parent or ancestor scope that includes both consumer and provider as children or descendants	• Manually create one or more policies in the common-ancestor scope. (Optional) For more precise policies, group workloads using inventory filters. For examples and instructions, see Create an Inventory Filter, on page 379. • Automatically discover policies in the common-ancestor scope, for the entire branch of the scope tree.	These methods are the simplest way to address cross-scope policies. These methods require only one policy per consumer-provider pair. If you are considering using automatic policy discovery, see important additional considerations in Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435.
Use the advanced method for creating cross-scope policies	Automatically discover policies for each individual scope. See (Advanced) Create Cross-Scope Policies, on page 501. (This procedure applies to both manually created policies and discovered policies.)	This method requires two policies for each consumer-provider pair: A policy for the consumer and a policy for the provider. This method allows policy creation when consumer and provider policies are owned by different people. See additional considerations in Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435.

(Advanced) Create Cross-Scope Policies

This procedure describes the advanced method of creating cross-scope policies (policies in which consumer and provider are in different scopes.) It applies to both manually created policies and automatically discovered policies.

This method requires two policies for each consumer-provider pair, because both ends of the conversation must allow the conversation to happen:

- A policy in the consumer's scope must allow conversations with the provider,

  and

- A policy in the provider's scope must allow conversations with the consumer.

This procedure includes the steps that must be taken by the owner of each scope in order to create cross-scope policies. If your access privileges allow you to modify both scopes, you can perform all steps.

Before you begin

- Consider simpler options for handling cross-scope traffic. See When Consumer and Provider Are In Different Scopes: Policy Options, on page 500.
- Policies using this method must be created in the primary workspace of both consumer and provider.

  If the provider scope to be specified in the policy does not yet have a primary workspace, create it before creating cross-scope policies using this method.

- The policies must have ALLOW action in order for policy requests to be created.
- For some additional details related to these requirements, see Policy Requests, on page 502.
- (Optional) Consider options for automatic handling of cross-scope policy requests. See Automate Handling of Cross-Scope Policy Requests, on page 507.
- (Optional) If you want cross-scope policies to apply only to the workloads in a cluster within the consumer or provider scope, and not to the entire scope, see Convert a Cluster to an Inventory Filter, on page 489. Clusters cannot be used in cross-scope policies created using this procedure.

  If you are discovering policies automatically, see also External Dependencies, on page 444 and Fine-Tune External Dependencies for a Workspace, on page 445.

Procedure

Step 1 In the consumer's primary workspace, create the desired policy, either manually or using automatic policy discovery.

For each cross-scope policy created, a policy request will automatically be created for the provider.

To view the policy requests, see Viewing, Accepting, and Rejecting Policy Requests, on page 503.

Note: If an existing policy in the provider application's workspace matches this traffic, a new policy is not needed and a request is not created. This situation is indicated as described in Resolved Policy Requests, on page 511.

Step 2 You (or the owner of the provider application) must respond to each policy request:

See Viewing, Accepting, and Rejecting Policy Requests, on page 503.

Accepting a policy request automatically creates the required policy in the primary workspace of the provider, allowing traffic between the two applications.

If you do not want to allow traffic from the requesting application, reject the request.

Step 3 (Optional) If you are automatically discovering policies, you may want to Fine-Tune External Dependencies for a Workspace, on page 445.

Step 4 Review and analyze both primary workspaces.

What to do next

When you are ready to enforce these policies, you must enforce both primary workspaces.

Policy Requests

Policy requests are generated when you create cross-scope policies using the method described in (Advanced) Create Cross-Scope Policies, on page 501. Each time a policy is created in a consumer scope's primary workspace when the provider is a member of a different scope, if the policy does not yet exist in the primary workspace associated with the provider's scope, a policy request is generated.

This policy request alerts the owner of the provider application to allow dependent applications to access necessary services.

See options for viewing and responding to policy requests at Viewing, Accepting, and Rejecting Policy Requests, on page 503 and Automate Handling of Cross-Scope Policy Requests, on page 507.

Additional details about policy requests

- The provided services page (on which policy requests appear) is only available to primary workspaces. This is to ensure that isolated experiments on secondary workspaces do not create notifications on other primary workspaces.
- If an external scope (when the provider specified in the policy belongs to a different scope than the consumer) does not have a primary workspace, no requests are sent (for example, this could be the case for the root scope, or any scope defined for workloads outside the organization). If an external scope has not published any policy, policy analysis and enforcement are carried out on the consumer end only.
- Clusters are not supported when the provider is in a different scope than the consumer. If the policy's consumer is a cluster, the policy request will be made as if the policy request were from the consumer application's scope. Multiple policies consuming the same service from a provider could be grouped together.
- Policy requests are generated only for providers, not for consumers. If a consumer workspace is analyzing or enforcing policies, it has to explicitly include policies that allow all its legitimate consuming flows, either through automatic policy discovery or by explicitly manually crafting policies (no policy requests from external provider workspaces are generated to it).

Viewing, Accepting, and Rejecting Policy Requests

When creating cross scope policies using the method described in (Advanced) Create Cross-Scope Policies, on page 501, a policy is required in the primary workspace of the provider's scope in addition to the policy in the consumer's scope. When a cross-scope policy is created in the primary workspace of the consumer's scope, a policy request is automatically created in the primary workspace of the provider's scope.

Use the information in this topic to accept the request (to create the required policy in the provider scope) or reject the request (in which case the cross-scope policy will not take effect.)

To view, accept, or reject policy requests:

To	Do This
View all policy requests	**1.** Choose **Defend** > **Segmentation**. **2.** Click **Policy Requests** at the top of the page. **3.** Click a consumer scope to see policy requests from that scope.

To	Do This
View policy requests for a particular scope	To view pending policy requests for a provider scope: 1. Choose **Defend > Segmentation**. 2. Click the primary workspace of the applicable scope. 3. Click **Manage Policies**. 4. Click **Provided Services**. If the tab does not display a number, there are no policy requests pending for this workspace. 5. Click **Policy Requests**. 6. Click a consumer scope to see policy requests from that scope. Or To view a policy request from the consumer scope: In the Policies tab of the primary workspace of the consumer scope, click the value in the **Protocols and Ports** column, then look at the panel that opens on the right side of the page. In the **Protocols and Ports** section, click a yellow dot to see pending policy requests.
Manually accept a request and automatically create the required policy in the Provider scope	From either of the locations above, click **Accept** next to the policy request.
Manually reject a request	From either of the locations above, click **Reject** next to the policy request.

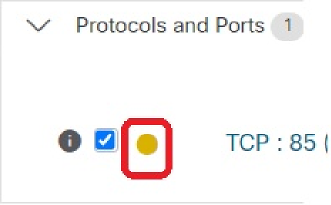
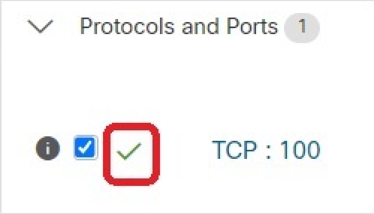
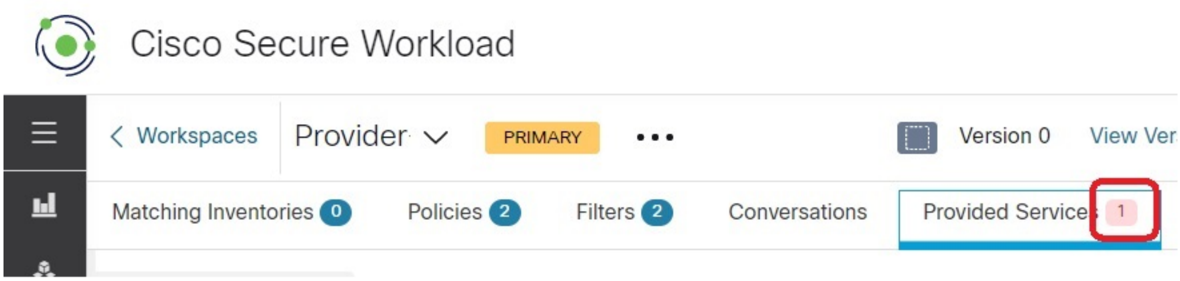
To	Do This
View policy request status from the consumer workspace	On the Policies page of the primary consumer workspace, click the policy, then click the port/protocol value. Status is shown in the panel that opens on the right. A pending request is shown with a yellow dot:  When the request is accepted, the dot changes to a green check mark:  Click the indicator for details.
View policy request status from the provider's workspace	View request status in the **Provided Services** tab described above.
Allow policy discovery to create the required policy for the provider	Automatically discover policies in the provider scope's primary workspace, using a time range that ensures that the corresponding flows are seen, then publish the policy.
See also options for automating handling of policy requests	Automate Handling of Cross-Scope Policy Requests, on page 507

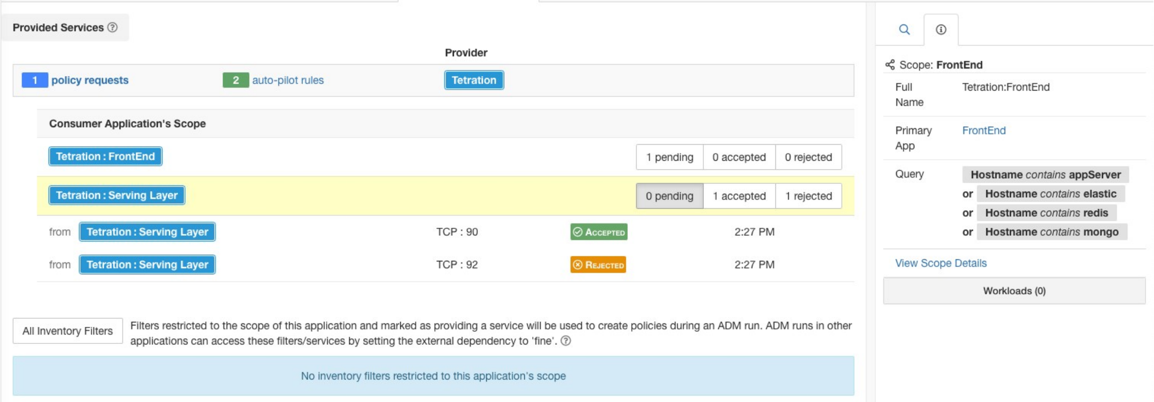
Figure 272: Pending policy requests in the provider's workspace



Accepting Policy Requests: Details

Accepting a policy request on a service is equivalent to creating a policy from the requested filter as the consumer to the service as the provider. Additionally, upon accepting a policy request, the original policy from the consumer application's workspace (in the example, FrontEnd App and Serving Layer) will be marked as accepted (see figures below)

Figure 273: Accepting/Rejecting policy requests



Tetration : FrontEnd		1 pending	0 accepted	0 rejected
Tetration : Serving Layer		0 pending	1 accepted	1 rejected
from Tetration : Serving Layer	TCP : 90	ACCEPTED	2:27 PM	
from Tetration : Serving Layer	TCP : 92	REJECTED	2:27 PM	

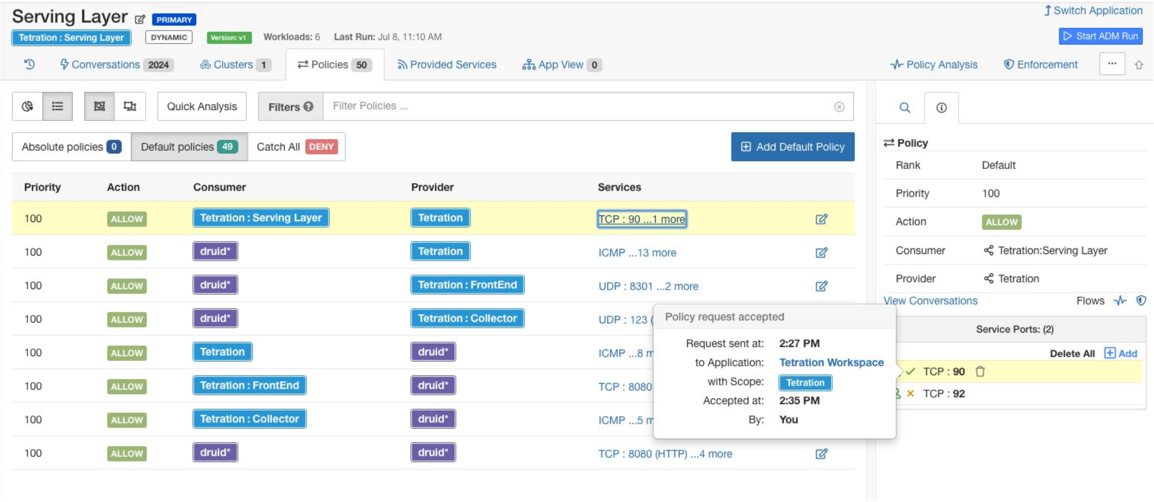
Filters restricted to the scope of this application and marked as providing a service will be used to create policies during an ADM run. ADM runs in other applications can access these filters/services by setting the external dependency to 'fine'.

No inventory filters restricted to this application's scope

Scope: FrontEnd

Full Name	Tetration:FrontEnd
Primary App	FrontEnd
Query	Hostname *contains* appServer or Hostname *contains* elastic or Hostname *contains* redis or Hostname *contains* mongo

Figure 274: Policy status shown as Accepted



Priority	Action	Consumer	Provider	Services
100	ALLOW	Tetration : Serving Layer	Tetration	TCP : 90 ...1 more
100	ALLOW	druid*	Tetration	ICMP ...13 more
100	ALLOW	druid*	Tetration : FrontEnd	UDP : 8301 ...2 more
100	ALLOW	druid*	Tetration : Collector	UDP : 123 (
100	ALLOW	Tetration	druid*	ICMP ...8 m
100	ALLOW	Tetration : FrontEnd	druid*	TCP : 8080
100	ALLOW	Tetration : Collector	druid*	ICMP ...5 m
100	ALLOW	druid*	druid*	TCP : 8080 (HTTP) ...4 more

Policy request accepted

Request sent at:	2:27 PM
to Application:	Tetration Workspace
with Scope:	Tetration
Accepted at:	2:35 PM
By:	You

Policy

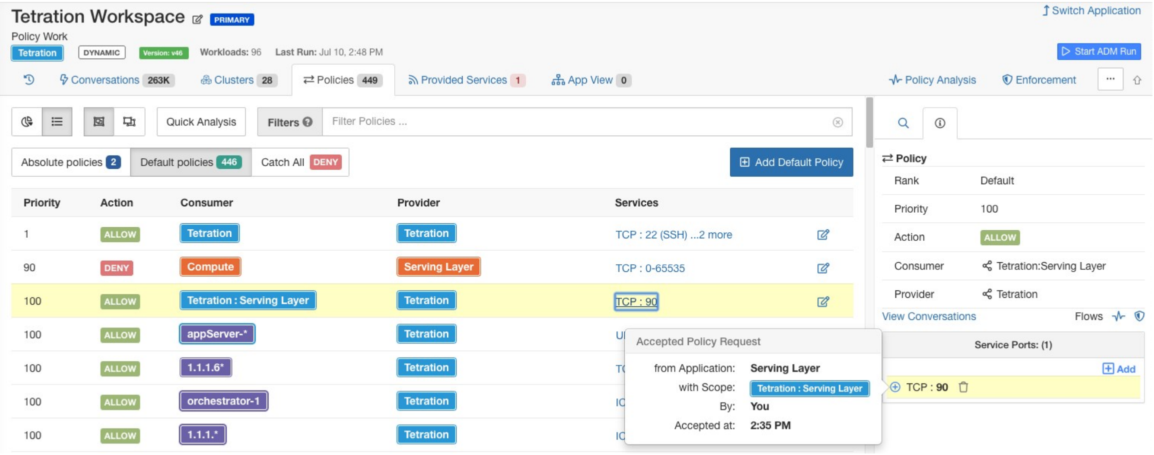
Rank	Default
Priority	100
Action	ALLOW
Consumer	Tetration:Serving Layer
Provider	Tetration

✓ TCP : 90
✗ TCP : 92

The new policy created on the provider application's workspace (in this example, the workspace is named Tetration) is marked with a **plus** icon indicating that this policy was created due to an external policy request.

Note If the original policy on the consumer side is deleted after the policy request is accepted, the policy on provider side will not be deleted. However, the tooltip next to the policy shows the original policy as deleted with the timestamp of the event:

Figure 275: Provider side policy, created by accepting a policy request



Tetration Workspace PRIMARY

Policy Work

Tetration | DYNAMIC | Version: v46 | Workloads: 96 | Last Run: Jul 10, 2:48 PM

Priority	Action	Consumer	Provider	Services
1	ALLOW	Tetration	Tetration	TCP : 22 (SSH) ...2 more
90	DENY	Compute	Serving Layer	TCP : 0-65535
100	ALLOW	Tetration : Serving Layer	Tetration	TCP : 90
100	ALLOW	appServer-*	Tetration	U
100	ALLOW	1.1.1.6*	Tetration	T
100	ALLOW	orchestrator-1	Tetration	IC
100	ALLOW	1.1.1.*	Tetration	IC

Accepted Policy Request

from Application: Serving Layer
with Scope: Tetration : Serving Layer
By: You
Accepted at: 2:35 PM

Policy

Rank	Default
Priority	100
Action	ALLOW
Consumer	Tetration:Serving Layer
Provider	Tetration

View Conversations   Flows

Service Ports: (1)

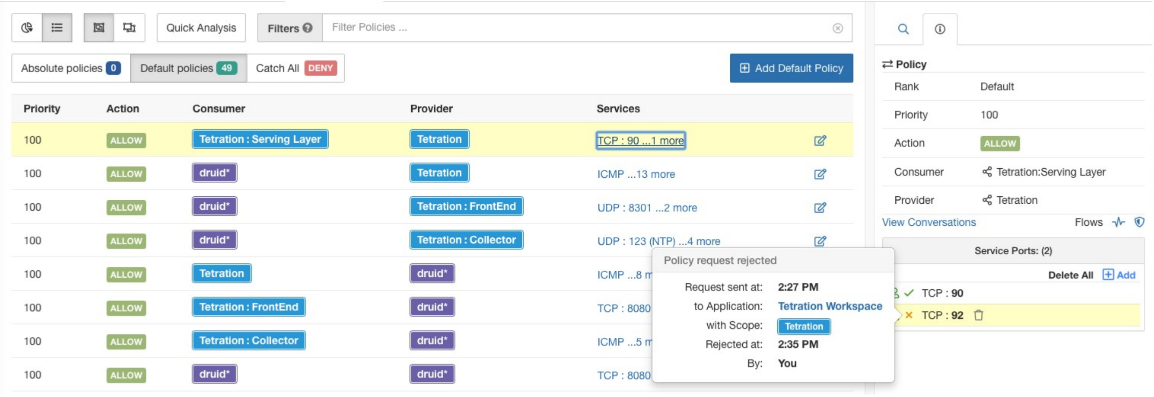
Add

TCP : 90

Rejecting Policy Requests: Details

Rejecting a policy request does not create or update any policies. The original policy from the consumer application's workspace (in the example, Serving Layer App) will be marked as rejected, but the policy remains in effect, i.e., outbound traffic still will be allowed. The tooltip next to the reject policy has information about the provider application, the user that rejected the policy request as well as the time of the rejection.

Figure 276: Policy status shown as Rejected



Priority	Action	Consumer	Provider	Services
100	ALLOW	Tetration : Serving Layer	Tetration	TCP : 90 ...1 more
100	ALLOW	druid*	Tetration	ICMP ...13 more
100	ALLOW	druid*	Tetration : FrontEnd	UDP : 8301 ...2 more
100	ALLOW	druid*	Tetration : Collector	UDP : 123 (NTP) ...4 more
100	ALLOW	Tetration	druid*	ICMP ...8 m
100	ALLOW	Tetration : FrontEnd	druid*	TCP : 8080
100	ALLOW	Tetration : Collector	druid*	ICMP ...5 m
100	ALLOW	druid*	druid*	TCP : 8080

Policy request rejected

Request sent at: 2:27 PM
to Application: Tetration Workspace
with Scope: Tetration
Rejected at: 2:35 PM
By: You

Policy

Rank	Default
Priority	100
Action	ALLOW
Consumer	Tetration:Serving Layer
Provider	Tetration

View Conversations   Flows

Service Ports: (2)

Delete All   Add

✓ TCP : 90
× TCP : 92

Automate Handling of Cross-Scope Policy Requests

Policy requests are generated when you create cross-scope policies using the method described in (Advanced) Create Cross-Scope Policies, on page 501.

There are several options to reduce the number of policy requests that are generated when creating cross-scope policies:

Table 25: Options for Automatically Handling Policy Requests

To	Do This
Specify handling of policy requests between specific consumer-provider pairs	See Auto-pilot Rules, on page 508. You must have the required privileges.
Automatically create all required policies for providers for all cross-scope policies created during policy discovery in a particular workspace	When you start an automatic policy discovery run, enable the **Auto accept outgoing policy connectors** option in the Advanced Configurations section. This option is available to root scope owners and site admins only. For details, see: Advanced Configurations for Automatic Policy Discovery, on page 447 and Auto Accept Policy Connectors, on page 510
Specify default handling for all policy requests from all workspaces	On the Default Policy Discovery Config page, enable the **Auto accept outgoing policy connectors** option in the Advanced Configurations section. This option is available to root scope owners and site admins only. For details, see: Default Policy Discovery Config, on page 457 and Advanced Configurations for Automatic Policy Discovery, on page 447 and Auto Accept Policy Connectors, on page 510

Auto-pilot Rules

This feature is applicable only if you create cross-scope policies using the method described in (Advanced) Create Cross-Scope Policies, on page 501.

Infrastructure applications that provide services to many other applications in a datacenter may receive a large number of policy requests from other applications.

You can reduce the volume of policy requests by creating auto-pilot rules to automatically accept or reject future matching policy requests.

Note Auto-pilot rules do not apply to existing policy requests. They affect only future policy requests.

Automatically accept or reject policy requests using Auto-Pilot Rules

Configure auto-pilot rules to automatically accept or reject policy requests between a specified consumer-provider pair, on specified ports. Auto-pilot rules can be broad (scope-to-scope), or apply only to a subset of workloads within each scope (as configured by inventory filters. You can use an inventory filter for the consumer, for the provider, or for each.)

1. If you want your auto-pilot rule to apply to a subset of workloads within a scope rather than to the entire scope:

Create an inventory filter in the relevant scope(s) to group the workloads. Be sure the **Restrict Query to Ownership Scope** option is selected in each inventory filter, to ensure that the filter only includes workloads that are members of the scope.

2. Choose **Defend** > **Segmentation**.
3. Click the primary workspace of the consumer scope for which you want to automatically accept or reject policy requests related to a specific provider.
4. Click **Manage Policies**.
5. Click **Provided Services**.
6. If you are creating this rule for an inventory filter, perform the following steps for the desired inventory filter (inventory filters are identified by an orange icon.)

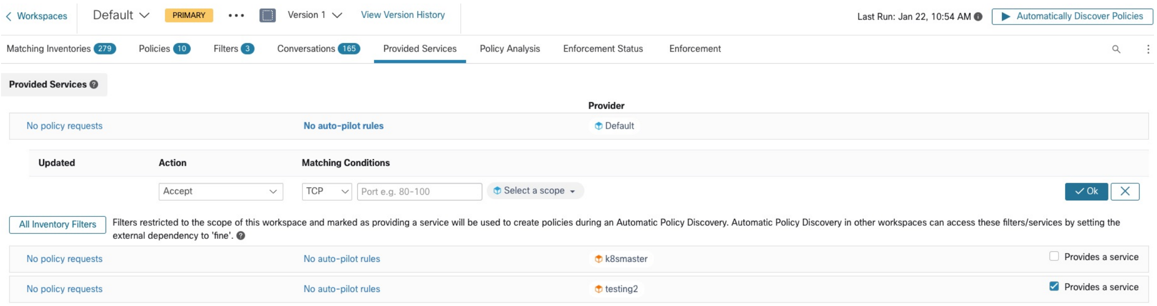
   Otherwise perform these steps for the scope (scopes are identified by a blue icon.)

   Make sure you are clicking in the correct place.
7. Click **No Auto-Pilot Rules** or **auto-pilot rules**, whichever is displayed.
8. Click **New Auto-Pilot Rule**.
9. Configure the auto-pilot rule. Select the scope or inventory filter that represents the provider.
10. Click **OK**.

Example Auto-Pilot Rule

In the example below, we create a new auto-pilot rule to reject TCP policy requests in port range 1-200 from any consumer contained in Tetration:Adhoc to the provider service Tetration

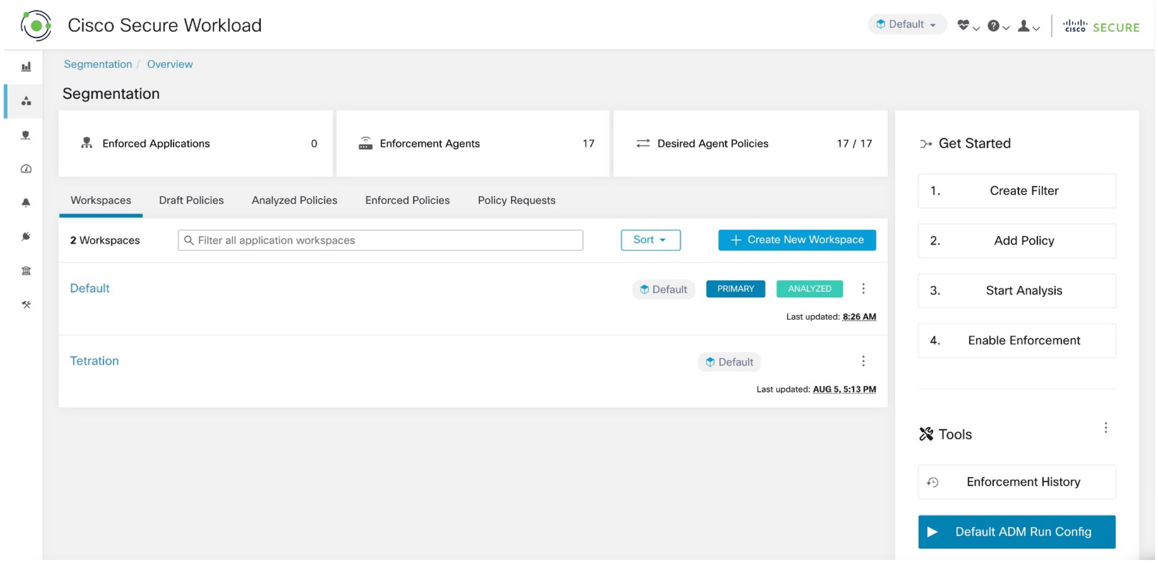
Figure 277: Creating/Updating Auto-pilot rules



Filters restricted to the scope of this workspace and marked as providing a service will be used to create policies during an Automatic Policy Discovery. Automatic Policy Discovery in other workspaces can access these filters/services by setting the external dependency to 'fine'.

Then we create a new policy in the workspace for the *FrontEnd App* on TCP port 23. Since the policy is a match for the auto-pilot rule, it will be automatically rejected. The status and reason for policy rejection is indicated on the tooltip next to the rejected policy.

Figure 278: Policy automatically getting rejected by Auto-pilot rule



View a count of policies recently created by auto-pilot rules

To view the number of policies created in a workspace by auto-pilot rules since live policy analysis was last initiated (or re-initiated) for the workspace:

Navigate to the Provided Services page for the relevant primary workspace and look for the count of “Auto Created” policies.

Auto Accept Policy Connectors

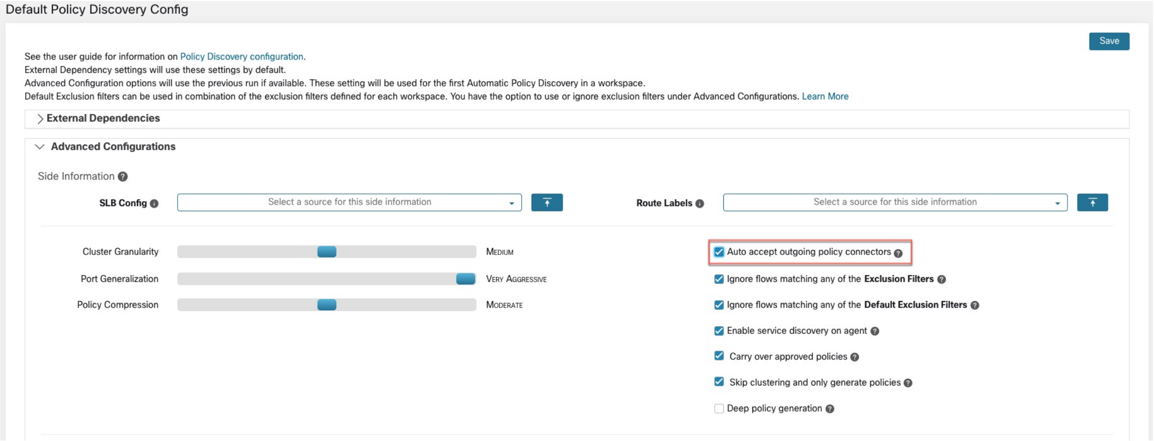
You can set this option as the default policy discovery configuration, or set it in the automatic policy discovery advanced options for each workspace.

The **Auto accept outgoing policy connectors** option on the automatic policy discovery configuration page allows you to automatically accept any policy requests created as part of automatic policy discovery.

If this option is enabled in Default automatic policy discovery config, policy requests created manually or by importing a workspace will be automatically accepted as well.

Note This option is only available for root scope owners or Site Admins.

Figure 279: The Auto accept outgoing policy connectors option



Default Policy Discovery Config

Save

See the user guide for information on Policy Discovery configuration.
External Dependency settings will use these settings by default.
Advanced Configuration options will use the previous run if available. These setting will be used for the first Automatic Policy Discovery in a workspace.
Default Exclusion filters can be used in combination of the exclusion filters defined for each workspace. You have the option to use or ignore exclusion filters under Advanced Configurations. Learn More

External Dependencies

Advanced Configurations

Side Information

SLB Config: Select a source for this side information

Route Labels: Select a source for this side information

Cluster Granularity: Medium

Port Generalization: Very Aggressive

Policy Compression: Moderate

☑ Auto accept outgoing policy connectors

☑ Ignore flows matching any of the **Exclusion Filters**

☑ Ignore flows matching any of the **Default Exclusion Filters**

☑ Enable service discovery on agent

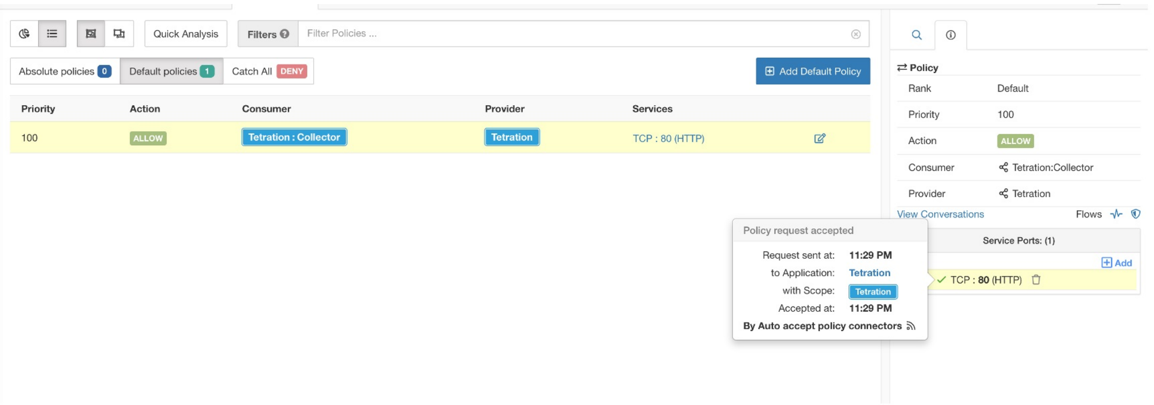
☑ Carry over approved policies

☑ Skip clustering and only generate policies

☐ Deep policy generation

After this option is set, any policy request created in any workspace the root scope or in the applicable workspace will be automatically accepted.

Figure 280: Policy is automatically accepted by Auto accept policy connectors



Quick Analysis | Filters | Filter Policies ...

Absolute policies 0 | Default policies 1 | Catch All DENY

Add Default Policy

Priority	Action	Consumer	Provider	Services
100	ALLOW	Tetration : Collector	Tetration	TCP : 80 (HTTP)

Policy

Rank	Default
Priority	100
Action	ALLOW
Consumer	Tetration:Collector
Provider	Tetration

View Conversations | Flows

Service Ports: (1)

Add

✓ TCP : 80 (HTTP)

Policy request accepted

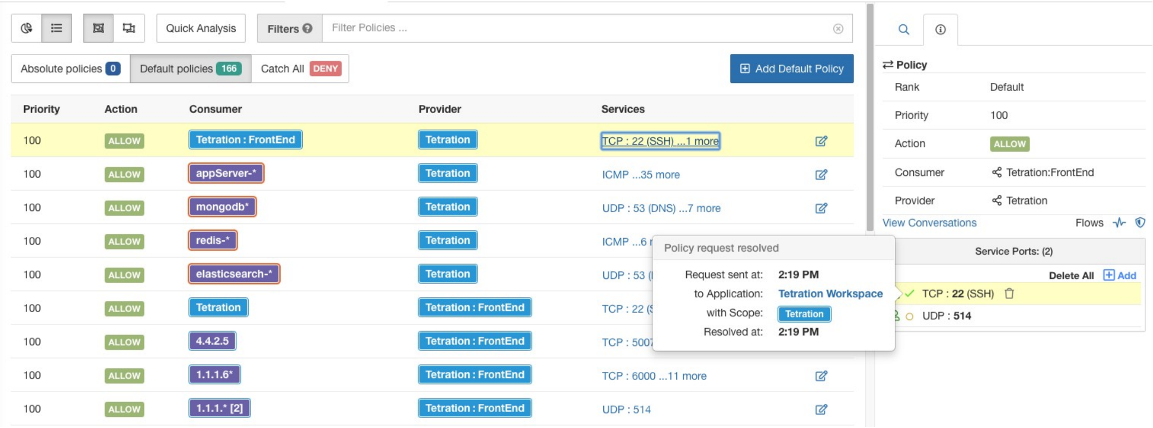
Request sent at:	11:29 PM
to Application:	Tetration
with Scope:	Tetration
Accepted at:	11:29 PM

By Auto accept policy connectors

Resolved Policy Requests

If all conditions for creating a policy request are met, but there is already an existing matching policy on the provider application’s workspace, the policy created on the consumer application’s workspace will be marked as resolved indicating that the provider application’s workspace is already allowing the traffic through the requested port.

Figure 281: Policy status shown as Resolved



Priority	Action	Consumer	Provider	Services
100	ALLOW	Tetration : FrontEnd	Tetration	TCP : 22 (SSH) ...1 more
100	ALLOW	appServer-*	Tetration	ICMP ...35 more
100	ALLOW	mongodb*	Tetration	UDP : 53 (DNS) ...7 more
100	ALLOW	redis-*	Tetration	ICMP ...6 r
100	ALLOW	elasticsearch-*	Tetration	UDP : 53 (
100	ALLOW	Tetration	Tetration : FrontEnd	TCP : 22 (S
100	ALLOW	4.4.2.5	Tetration : FrontEnd	TCP : 5007
100	ALLOW	1.1.1.6*	Tetration : FrontEnd	TCP : 6000 ...11 more
100	ALLOW	1.1.1.* [2]	Tetration : FrontEnd	UDP : 514

Policy request resolved

Request sent at: 2:19 PM
to Application: Tetration Workspace
with Scope: Tetration
Resolved at: 2:19 PM

Policy

Rank	Default
Priority	100
Action	ALLOW
Consumer	Tetration:FrontEnd
Provider	Tetration

View Conversations Flows

Service Ports: (2)

Delete All Add

✓ TCP : 22 (SSH)
○ UDP : 514

Provided Services

This page is used only for creating policies in which the consumer and provider are in different scopes, and only if you are using the method described in (Advanced) Create Cross-Scope Policies, on page 501.

For more information about options on this page, see:

- Policy Requests, on page 502
- Auto-pilot Rules, on page 508
- Create an Inventory Filter, on page 379 and External Dependencies, on page 444 (for information about the **Provides a service** option)

To access this page, navigate to a primary workspace, then click **Manage Policies**, then click **Provided Services**.

Troubleshoot Cross-Scope Policies

If cross-scope policies were created using the method described in (Advanced) Create Cross-Scope Policies, on page 501, the primary workspaces for the consumer and provider workloads must each have a policy that allows the traffic. Ensure that the required policies exist in both workspaces.

No notification is given if one of the policies is deleted or modified.

If the policy pair was generated during policy discovery, see information about approving policies to protect them from subsequent discovery runs. See Approve Policies, on page 459.

Verify that other requirements are still being met, as listed in (Advanced) Create Cross-Scope Policies, on page 501.

Both consumer and provider workspaces that have the required policies must be enforced.

Useful tools for cross-scope policies

- Use the **External?** filter option to find policies in which the provider is in a different scope from the scope in which you discovered policies.
- The policy visual view has an option to display external policies. See Policy Visual Representation, on page 519.

If you are using Default Policy Discovery Config

Make sure you have clicked **Save** on the **Default Policy Discovery Config** page after making changes to make default external dependency configurations available to individual workspaces.

Effective Consumer or Effective Provider

The consumer and provider specified in a policy determine:

- The set of workloads with Secure Workload agents that receive the policy.
- The set of IP addresses that are affected by the installed firewall rules.

By default, these are the same.

However, you may need to specify a group of IP addresses in the firewall rules that is different from the IP addresses of the workloads that receive the policy. (See an example below.)

To address this need, you can configure effective consumer and/or effective provider.

Default behavior for consumer and provider

By default, when a Secure Workload agent receives a policy, the firewall rules are specific to that workload. This is best illustrated with the following example:

Consider an ALLOW policy with provider filter specifying 1.1.1.0/24 subnet. When this policy is programmed on a workload with IP address 1.1.1.2, the firewall rules look like the following:

- For incoming traffic firewall rules allow traffic destined to 1.1.1.2 specifically and not to the whole subnet 1.1.1.0/24.
- For outgoing traffic firewall rules allow traffic sourced from 1.1.1.2 specifically and not from the whole subnet 1.1.1.0/24 (to prevent spoofing).

As a corollary, any agent workloads belonging to the workspace that do not have IP address within 1.1.1.0/24 subnet will not receive the above firewall rules.

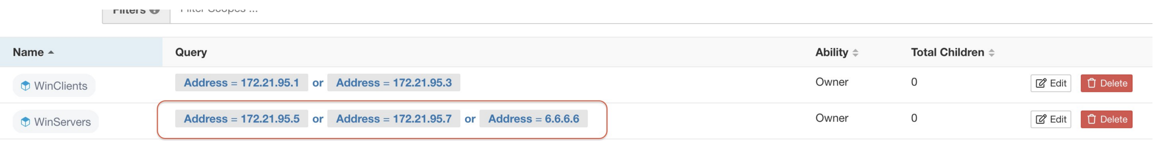
Example: Effective Consumer or Effective Provider

In this example, suppose you are configuring policies for a fleet of workloads behind a virtual IP (VIP), similar to keepalive or windows failover clustering solutions. You will use effective consumer and /or effective provider to ensure that traffic is not disrupted during a failover event.

Consider a fleet of workloads with IP addresses (*172.21.95.5* and *172.21.95.7*) that provide a service sitting behind a VIP - *6.6.6.6*. This VIP is a floating VIP and only one workload owns the VIP at any point in time. The goal is to program firewall rules on all the workloads in the fleet to allow traffic to *6.6.6.6*.

In this setup, we have a scope and a corresponding workspace that contain a cluster of workloads that represents the fleet (*172.21.95.5* and *172.21.95.7*) as well as the VIP (*6.6.6.6*).

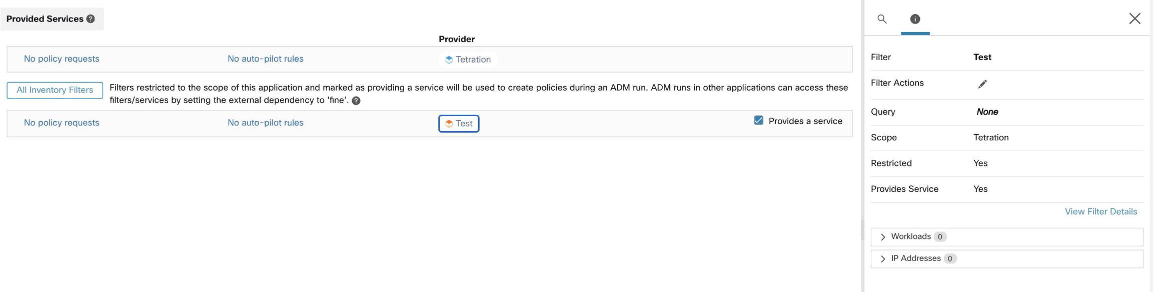
Figure 282: Scopes including VIP and cluster of workloads



Name	Query	Ability	Total Children		
WinClients	Address = 172.21.95.1 or Address = 172.21.95.3	Owner	0	Edit	Delete
WinServers	Address = 172.21.95.5 or Address = 172.21.95.7 or Address = 6.6.6.6	Owner	0	Edit	Delete

The VIP is exposed in this workspace as a provided service as shown below:

Figure 283: VIP exposed as a provided service



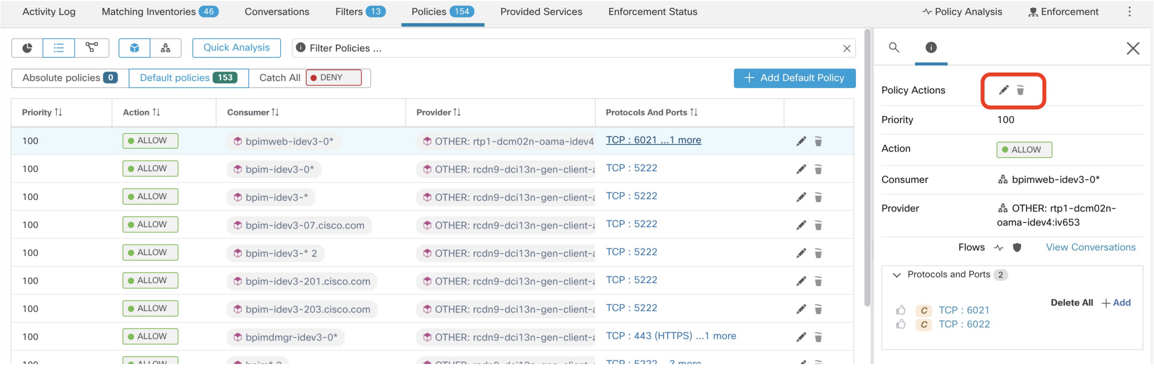
		Provider	
No policy requests	No auto-pilot rules	Tetration	
No policy requests	No auto-pilot rules	Test	☑ Provides a service

Filters restricted to the scope of this application and marked as providing a service will be used to create policies during an ADM run. ADM runs in other applications can access these filters/services by setting the external dependency to 'fine'.

Filter	**Test**
Filter Actions	
Query	***None***
Scope	Tetration
Restricted	Yes
Provides Service	Yes

If we were to add a policy from the clients of this service to the service VIP, then (by default) firewall rules allowing traffic to the VIP will only be programmed on the workload that owns the VIP. However, in case of a failover event, it may take some time for the new workload that subsequently owns the service VIP to get the right firewall rules and traffic may be disrupted for a brief while.

Figure 284: Policy allowing traffic from clients to service VIP



Priority	Action	Consumer	Provider	Protocols And Ports
100	ALLOW	bpimweb-idev3-0*	OTHER: rtp1-dcm02n-oama-idev4	TCP : 6021 ...1 more
100	ALLOW	bpim-idev3-0*	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222
100	ALLOW	bpim-idev3-*	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222
100	ALLOW	bpim-idev3-07.cisco.com	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222
100	ALLOW	bpim-idev3-* 2	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222
100	ALLOW	bpim-idev3-201.cisco.com	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222
100	ALLOW	bpim-idev3-203.cisco.com	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222
100	ALLOW	bpimdmgr-idev3-0*	OTHER: rcdn9-dci13n-gen-client-a	TCP : 443 (HTTPS) ...1 more
100	ALLOW	bpim* 2	OTHER: rcdn9-dci13n-gen-client-a	TCP : 5222 ...3 more

Policy Actions	
Priority	100
Action	● ALLOW
Consumer	bpimweb-idev3-0*
Provider	OTHER: rtp1-dcm02n-oama-idev4:iv653

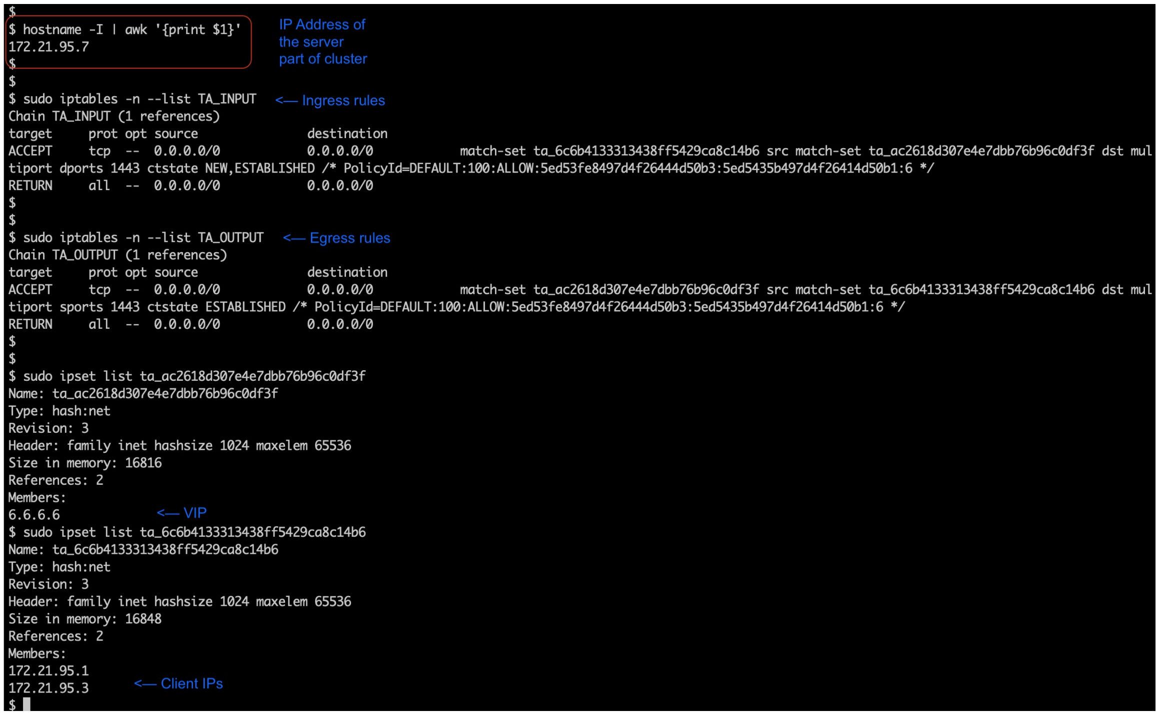
Protocols and Ports 2

- C TCP : 6021
- C TCP : 6022

To address this issue, we configure the Effective Provider (using the procedure below.) Specifically, we set Effective Provider to include the group of workloads where firewall rules allowing traffic to the service VIP need to be programmed – it does not matter if any of these workloads own the VIP or not.

When Effective Provider is set, we can see on the workloads that firewall rules allowing traffic to 6.6.6.6 are programmed even when a workload does not own the VIP. When all workloads backing the service are programmed with these rules, traffic will not be disrupted during a failover event because the new primary workload (that owns the VIP) will have the necessary firewall rules programmed.

Figure 285: Firewall rules on the host allowing traffic to service VIP



```
$
$ hostname -I | awk '{print $1}'
172.21.95.7
$
$
$ sudo iptables -n --list TA_INPUT
Chain TA_INPUT (1 references)
target     prot opt source               destination
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0            match-set ta_6c6b4133313438ff5429ca8c14b6 src match-set ta_ac2618d307e4e7dbb76b96c0df3f dst mul
tiport dports 1443 ctstate NEW,ESTABLISHED /* PolicyId=DEFAULT:100:ALLOW:5ed53fe8497d4f26444d50b3:5ed5435b497d4f26414d50b1:6 */
RETURN     all  --  0.0.0.0/0            0.0.0.0/0
$
$
$ sudo iptables -n --list TA_OUTPUT
Chain TA_OUTPUT (1 references)
target     prot opt source               destination
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0            match-set ta_ac2618d307e4e7dbb76b96c0df3f src match-set ta_6c6b4133313438ff5429ca8c14b6 dst mul
tiport sports 1443 ctstate ESTABLISHED /* PolicyId=DEFAULT:100:ALLOW:5ed53fe8497d4f26444d50b3:5ed5435b497d4f26414d50b1:6 */
RETURN     all  --  0.0.0.0/0            0.0.0.0/0
$
$
$ sudo ipset list ta_ac2618d307e4e7dbb76b96c0df3f
Name: ta_ac2618d307e4e7dbb76b96c0df3f
Type: hash:net
Revision: 3
Header: family inet hashsize 1024 maxelem 65536
Size in memory: 16816
References: 2
Members:
6.6.6.6
$ sudo ipset list ta_6c6b4133313438ff5429ca8c14b6
Name: ta_6c6b4133313438ff5429ca8c14b6
Type: hash:net
Revision: 3
Header: family inet hashsize 1024 maxelem 65536
Size in memory: 16848
References: 2
Members:
172.21.95.1
172.21.95.3
$
```

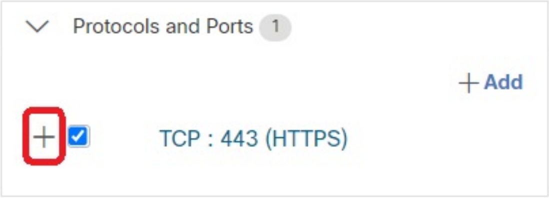
How to Configure Effective Consumer or Effective Provider

1. Click the policy to edit.
2. Click the Edit button at the top right side of the policy to go to advanced policy options.
3. Click **Effective Consumer** or **Effective Provider**.
4. Specify the desired addresses.
5. You may need to specify addresses for both effective consumer and effective provider.

About Deleting Policies

Important Before you delete a policy, check to be sure it is not one of a pair of policies required when consumer and provider are in different scopes.

To determine this: Click the link for the policy in the Protocols and Ports column. In the panel that opens on the right side of the page, look at the Protocols and Ports section. Policies created by accepting a cross-scope policy request are indicated by a plus sign beside the port and protocol:



Protocols and Ports 1

+ Add

+ ☑ TCP : 443 (HTTPS)

Click the plus sign to see the creator of the cross-scope policy and a link to the corresponding consumer policy.

Note Policies suggested by automatic policy discovery that have not been approved may not be present after a subsequent policy discovery run, if the traffic flows that produced them are not seen during the subsequent run. To preserve suggested policies, see Approve Policies, on page 459.

Review and Analyze Policies

It is essential that you ensure that your policies will have the intended effects (and not have any unintended effects) before you enforce them.

Review Automatically Discovered Policies

Review policy discovery results on the Policies page of the workspace in which you discovered policies.

Start your review here

We recommend that you start by checking to see if policies address each of the following areas, in this suggested order:

- Critical, common ports
- Internet-facing traffic
- Traffic between different applications (These flows may involve workloads in different scopes)
- Traffic within the same application (These flows are likely to involve workloads in the same scope)

Helpful tools for reviewing policies

- To make this effort more manageable, filter and sort the policies so you can review related policies as a group.
  - Click table headings to sort the columns, for example by consumer, provider, or port/protocol.
  - Use the filter at the top of the policies list to view specific subsets.

    To see a list of properties that you can filter on, click the (i) button in the Filter Policies box.
- Look at the graphical representation of the generated policies:

  Click the Policy Visual View button ().

  For more information, see Policy Visual Representation, on page 519.
- To search or filter the rows based on ports, click the **Ungrouped** button.
- By default, the policies are grouped by consumer/provider/action. To return to this view, click the **Grouped** button.
- Use the **External?** filter option to find policies in which the provider is in a different scope from the scope in which you discovered policies.

  Create policies for this traffic using one of the methods described in When Consumer and Provider Are In Different Scopes: Policy Options, on page 500.
- Look at the confidence level of the generated policies. See Address Low-Confidence Policies, on page 518.
- Look at the Workload Profile for detailed information about a workload. Click the IP address, then click **View Workload Profile** in the pane on the right.
- To view the traffic flows that were used to produce a particular policy, click the value in the **Protocols and Ports** column for that policy, then click **View Conversations** in the side panel that opens.

  See Conversations, on page 556 for more information.

  If needed, you can drill down further by clicking **Flow Search** to view the flows for a conversation.

Other things to do and check

- Identify unknown IP addresses (such as failover or other floating IPs) and tag them with labels so you know what they are.

  You may find helpful details on the Inventory Profile page. Click the IP address, then click **View Inventory Profile** in the pane on the right.
- Look for anything that is obviously not desirable or does not make sense.
- Group workloads using inventory filters so a single policy can address multiple workloads. See Create an Inventory Filter, on page 379.
- Investigate and contact other network administrators as needed to understand the need for the policies you see.
- See the topics under Address Policy Complexities, on page 494, which can involve manual and approved policies as well as automatically discovered policies.

- In general, it is recommended that the maximum number of policies in a scope is not larger than about 500. If you have many more than this, see if you can consolidate similar policies or consider splitting the scope.
- As you review, approve any policies that you know are correct as-is to preserve them in future discovery runs.

Address Low-Confidence Policies

After automatic policy discovery, confidence ratings indicate the accuracy and appropriateness of each discovered policy for each service (port and protocol) specified in the policy.

To identify low-confidence discovered policies:

1. Navigate to the applicable scope and workspace and click **Manage Policies**.
2. Click the **Policies** tab.
3. Click the **Ungrouped Policy List View** button.
4. Click the **Confidence** column heading to sort the list of policies by confidence level.
5. Click the value in the **Protocols and Ports** column to open a panel on the right side of the window.
6. In the **Protocols and Ports** section, the color of each **C** indicates the confidence for each service (port and protocol) specified in the policy.

   To interpret the confidence level, hover over the **C**.
7. Look for low-confidence indicators for any services in the list.
8. If applicable, delete or edit unwanted policies, or add additional policies.

To view the confidence levels for a particular policy:

1. In the Policies tab, click the value in the **Protocols and Ports** column for that policy.

   The Policy Side View panel opens at the right side of the window.
2. In the **Protocols and Ports** section, the color of each **C** indicates the confidence for each service (port and protocol) specified in the policy.

   To interpret the confidence level, hover over the **C**.

Flow Direction and Policy Confidence

The accuracy of discovered policies depends on correct identification of the flow direction. If flow direction is incorrectly identified, the confidence rating of automatic policy discovery results may be reduced. For information about determination of flow direction for the conversation(s) analyzed for the creation of the policy, see Client-Server Classification.

Troubleshoot Automatic Policy Discovery Results

If automatic policy discovery results are not what you expect, check the following:

Extend the selected time range to include more data

Extend the time window to include more data and to capture events that happen infrequently. For example, if an application generates a complex quarterly report using data drawn from several provider applications, be sure to include a time range that includes that traffic.

Avoid data gathered before certain changes

If the scope definition has changed, or data gathered before a certain time has become invalid for some other reason, be sure your time range does NOT include data before that point.

Exclude misleading traffic flows

Exclusion filters may need to be configured or modified.

There are multiple places exclusion filters can be configured, and multiple places they can be enabled or disabled. Check each location:

- Check the exclusion filters configured for the workspace.
- Check the default exclusion filters configured at the bottom of the Default Policy Discovery Config page.
- Check which exclusion filters are enabled in the Advanced Configurations section in the workspace's settings for automatic policy discovery.
- Check which exclusion filters are enabled in Advanced Configurations section on the Default Policy Discovery Config page.
- If you are using Default Exclusion Filters, make sure you have clicked **Save** on the **Default Policy Discovery Config** page to make those configurations available to individual workspaces.

For details, see Exclusion Filters, on page 441 and subtopics.

Troubleshoot Policies in which Consumer and Provider Are in Different Scopes

See Troubleshoot Cross-Scope Policies, on page 512.

Check Status of Approved Policies

See Troubleshoot Approved Policies, on page 460.

Policy Visual Representation

Policy visual representation provides a graphical view of the policies.

To navigate to the policy visual representation page: On the Policies page, click the graph icon (⑂) to the right of the list icon.

Policy View Elements

The visual elements on the policy view are:

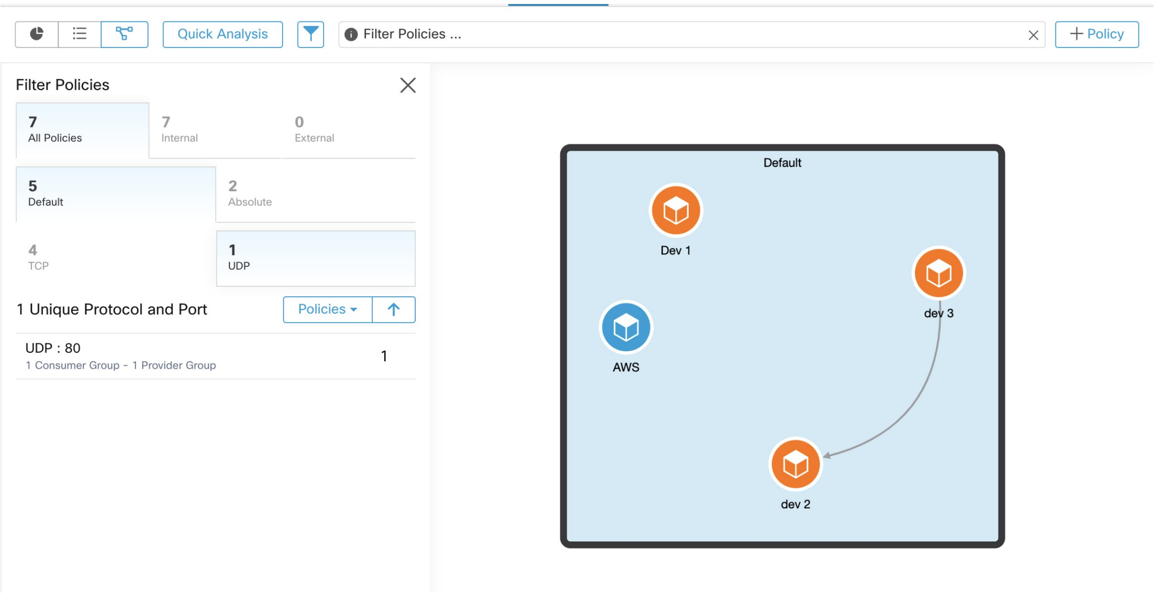
This Element	Represents This
A blue, orange, or purple icon	A node (the consumer or provider of a policy)

This Element	Represents This
Blue icon	A scope
Orange icon	An inventory filter
Purple icon	A cluster
Line connecting two icons	One or more policies.

Policy View Options

To	Do This
View the list of workloads included in a consumer or provider node	Double-click the node's icon.
View policy specifics such as services (ports), action (Allow/Deny) and protocol between a consumer and provider	Double-click the line connecting them. Details appear in the pane on the right.
View the policies entering and leaving a node	Click the icon.
View only the policies between workloads within the scope	Click the **Internal** button.
View only the policies in which the provider is in a different scope from the consumer	Click the **External** button.
Use advanced filtering options	Click the (i) button to the left of the filter text input box to see the options, then enter filter criteria.

Figure 286: Filtering policies in graphical view



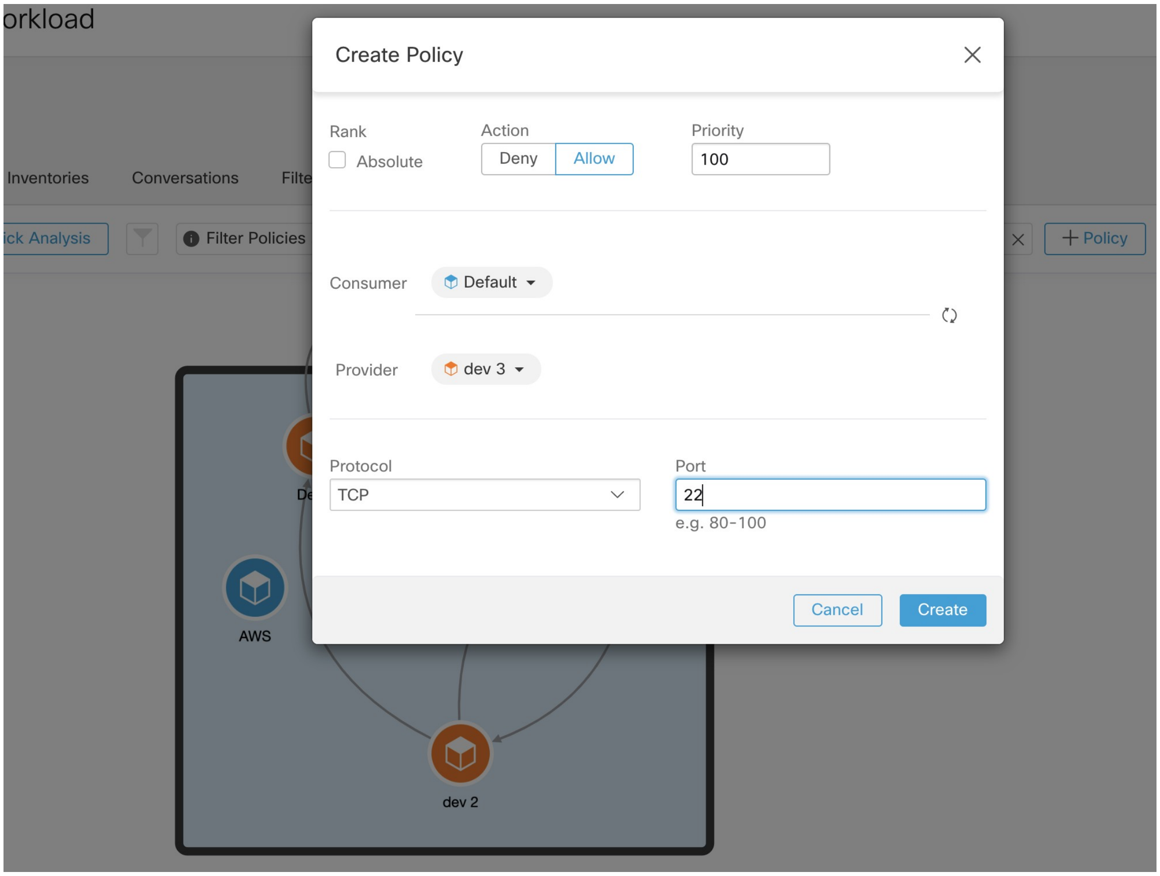
To download a high resolution image of the graphical view of the policies:

1. In the lower-right corner of the graph, click the ellipsis icon, and then click **Export Image**.
2. Select the required resolution and image type.
3. Click **Download**.

Add a Policy (Policy View Page)

To create a policy, hover over the consumer until you see a “+” sign and then hold and drag the policy onto the provider. To create an Absolute policy, toggle the Absolute checkbox in the modal. Otherwise, the policy is created as a Default policy. Policies can also be managed by clicking a line and selecting a policy from the pop-up list. Policies will be displayed in the sidebar.

Figure 287: Policy creation in graphical view



Create Policy

Rank
□ Absolute

Action
Deny | Allow

Priority
100

Consumer: Default

Provider: dev 3

Protocol
TCP

Port
22
e.g. 80-100

Quick Analysis

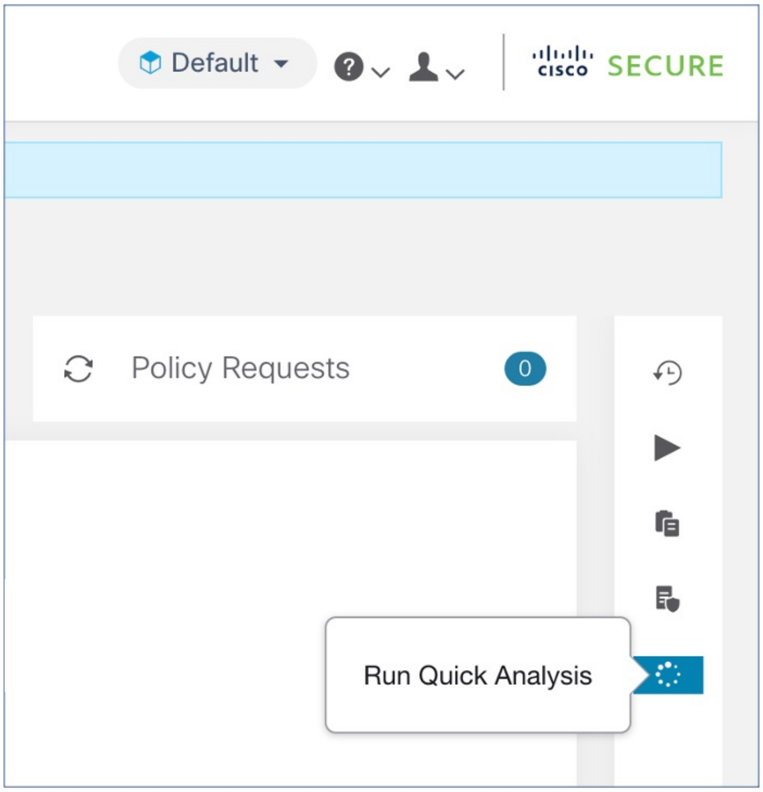
Quick analysis enables testing a hypothetical flow against all the policies in the current workspace as well as all other relevant policies from other workspaces. Quick analysis facilitates debugging and experimentation with different security policies, without the need to run live policy analysis for the workspace.

Restriction

- You can run Quick Analysis only on primary workspaces.
- Quick Analysis is not currently supported on flows from Kubernetes services.

Click on the **Run Quick Analysis** tab on the right navigation pane to view the dialog.

Figure 288: Quick Analysis Tab



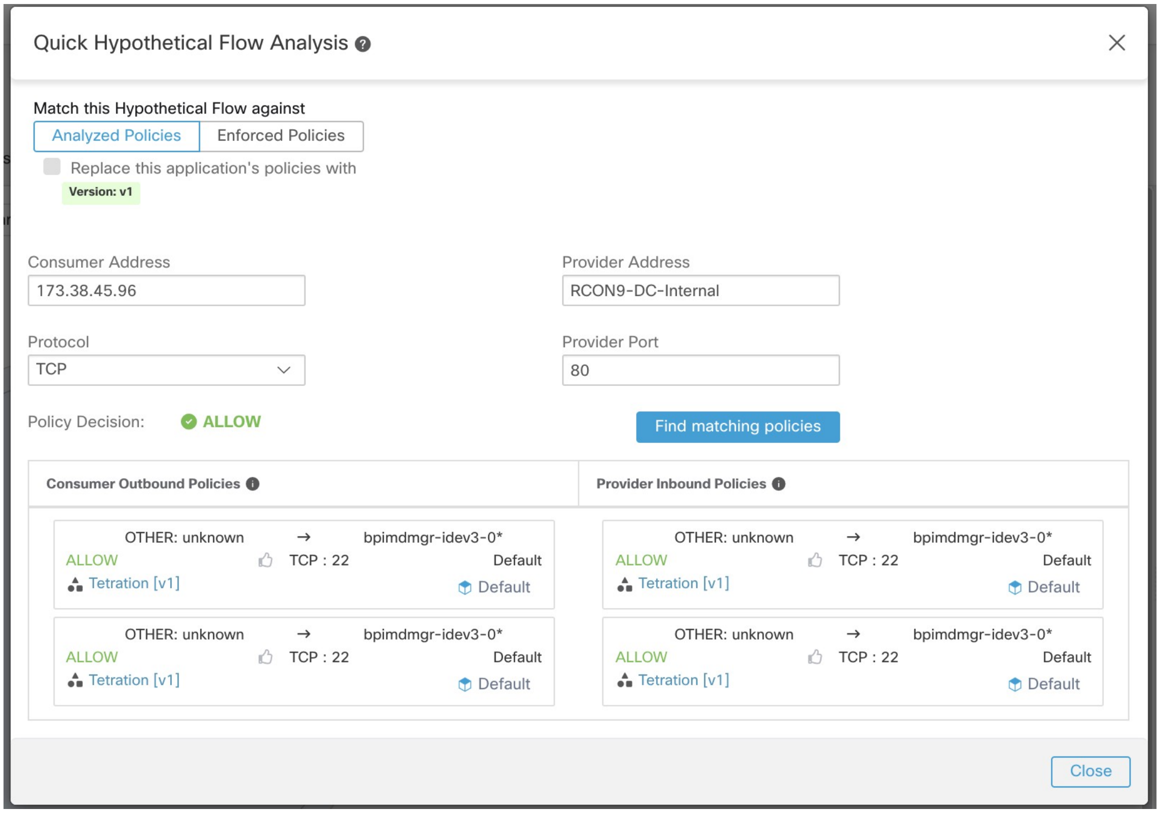
Enter the Consumer (client) IP, Provider (server) IP, port and protocol for the hypothetical flow, then click on **Find Matching Policies** button.

A policy decision will be shown indicating whether the hypothetical flow would be allowed or denied given the policy definitions in the latest version of the workspace and all other policies from relevant workspaces that are already pushed for live policy analysis.

At the bottom of the dialog, we show the matching outbound and inbound policies policies separately, and in their globally sorted order. It is only the very first row on either side that has any effect. For a connection to successfully get established, we need both the top outbound rule on consumer and the top inbound rule on the provider side to be ALLOW rules.

Showing all other matching policies in their order, provides a valuable debugging tool to help sort out issues in policy definitions when a certain policy seems to not be taking any effect. You can add, update, or delete policies from the workspace, and repeat the analysis immediately without the need to run live policy analysis on the workspaces.

Figure 289: Quick Policy Analysis



Quick Hypothetical Flow Analysis

Match this Hypothetical Flow against

Analyzed Policies | Enforced Policies

□ Replace this application's policies with Version: v1

Consumer Address: 173.38.45.96

Provider Address: RCON9-DC-Internal

Protocol: TCP

Provider Port: 80

Policy Decision: ✓ ALLOW

Consumer Outbound Policies	Provider Inbound Policies
OTHER: unknown → bpimdmgr-idev3-0* ALLOW TCP : 22 Default Tetration [v1] Default	OTHER: unknown → bpimdmgr-idev3-0* ALLOW TCP : 22 Default Tetration [v1] Default
OTHER: unknown → bpimdmgr-idev3-0* ALLOW TCP : 22 Default Tetration [v1] Default	OTHER: unknown → bpimdmgr-idev3-0* ALLOW TCP : 22 Default Tetration [v1] Default

Live Policy Analysis

After you have reviewed and approved the set of network security policies generated by automatic policy discovery, and before you enforce the policies, you should use live policy analysis to observe how the policies would affect actual traffic on your network.

Some questions that live policy analysis can help you answer:

- What would be the impact on this scope's application(s) if the policies in this workspace are enforced now?
- Could we have prevented a previously known security attack/risk by enforcing the new set of policies?

  See Run Policy Experiments to Test Current Policies Against Past Traffic, on page 530.
- Are our policies working the way we expect them to?

You should run policy analysis on any workspace that has policies. Because workloads in any particular scope can be affected by policies in other scopes, you should not run policy analysis only for a single scope before enforcing policy for that scope. Consider analyzing policies for all scopes that may affect traffic in a particular scope.

For example:

- Policies defined in scopes above this scope in the tree may apply to workloads in this scope.

- If workloads in this scope communicate with workloads in a different scope, policies in that scope may affect these communications. When policy analysis is started in that scope (or latest policies are analyzed after a policy change there), this can affect this scope's policy analysis results.

You should perform policy analysis any time you revise policies, to ensure that changes don't break applications.

Running live policy analysis on a workspace is sometimes referred to as "publishing" a workspace.

Start Live Policy Analysis

Once you have reviewed the policies generated in a workspace by automatic policy discovery, and you believe that they are as you want them, you can start policy analysis.

Before you begin

Important Live analysis includes the effects of policies in other workspaces that are also running live analysis. If you have enabled enforcement on any workspace, but analysis is not running on that workspace or the enforced version of the policies is not the same as the analyzed version of the policies, your live analysis results for this workspace may not be accurate.

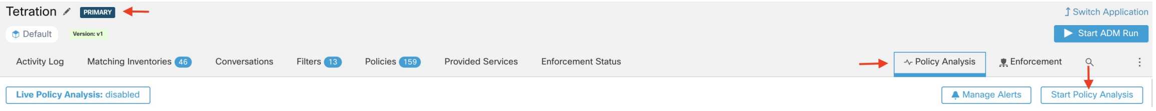
Procedure

Step 1 Toggle the workspace to **Primary** by clicking ••• to the right of "Secondary" next to the workspace name in the header.

Step 2 Navigate to the **Policy Analysis** tab.

Step 3 Click **Start Policy Analysis** on the right.

Figure 290: Enable Policy Analysis



What to do next

- Because policies in other scopes can apply to workloads in this scope, consider simultaneously analyzing policies in other scopes that could affect analysis results in this scope. See Example: Impact of Policies Analyzed in Other Scopes, on page 526.

- If you want to be notified when escaped flows are detected, click **Manage Alerts**.

- Use the tools on the page to filter the data. To see the available filter criteria, click the (i) button in the filter box.

- If you add or change policies after initiating policy analysis, you must re-start analysis in order to include the changes in the analysis. See After Changing Policies, Analyze Latest Policies, on page 531.

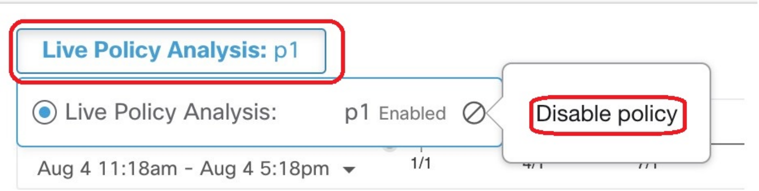
Stop Live Policy Analysis

In general, you should let policy analysis continue to run, even after you enforce policies, since the policies in this workspace may affect policy analysis results in other workspaces you are analyzing.

To stop live policy analysis:

Click the **Live Policy Analysis: P<number>** button, then click **Disable policy**:

Figure 291: Disable Live Policy Analysis

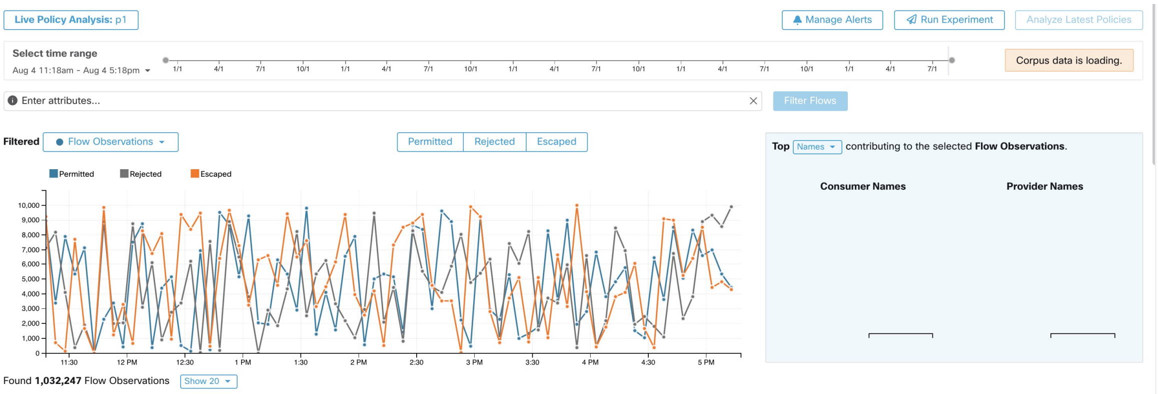


Policy Analysis Results: Understand the Basics

During policy analysis, all flows traveling into, out of, and within the scope associated with the workspace are assigned one of the following results:

- **Permitted**: Flow was allowed by the network, and also by the analyzed policies.
- **Escaped**: Flow was allowed by the network, but should have been dropped according to the analyzed policies.
- **Rejected**: Flow was dropped by the network, and also by the analyzed policies.

Figure 292: Policy Analysis Page



Some things to look at to get oriented:

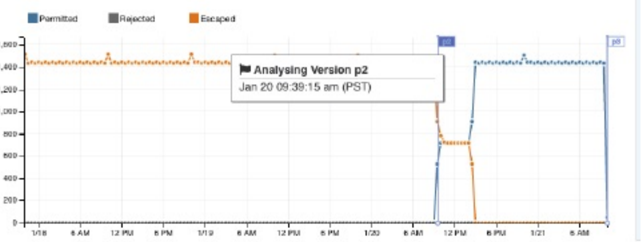
- You may filter the flow information presented in this page via a faceted filter bar. Clicking the **Filter Flows** button updates all the charts accordingly.
- Hovering on the chart shows the percentage of the aggregate observed flows at that timestamp.
- Clicking on a timestamp reveals a list of all filtered flows in a table below for further analysis.
- You can limit the interactions to one of the three result types by selecting/deselecting the the types at the top of the time series charts.

- The Top N chart on the right shows the top Hostnames, Addresses, Ports, etc. contributing to the data shown in the timeseries chart on the left.

  You can limit the timeseries chart to just escaped flows and select “Ports” in the Top N chart to see the top ports contributing to escaped flows.

Example: Impact of Policies Analyzed in Other Scopes

In the following example, there are permitted flows up to about 12pm. At that time, policy analysis was started in a workspace associated with a different scope, affecting traffic with workloads in this scope and causing flows to be marked as escaped. (You know that this change did not result from policy changes newly analyzed in this workspace, because this would have created a label flag.)



Analysis without Policies

The flows into, out of, and within the scope associated with the workspace may be affected by policies in other workspaces that are being analyzed. If live policy analysis is not enabled on this workspace, the flows will be marked with those of the other workspaces in the system that do have live policy analysis enabled.

Note If no workspaces are running live policy analysis, the timeseries chart will be empty.

Policy Analysis Details

Flow Disposition

In policy live analysis, to decide on whether a flow is **Permitted**, **Escaped**, or **Rejected**, we have to first determine the **Disposition** of the flow from the network perspective. Each flow will receive an **ALLOWED**, **DROPPED** or **PENDING** disposition, based on the signals and observations given by Secure Workload agents. There are a number of scenarios based on the agent configurations along the path of the flow and the flow types.

First, regardless of flow types, if any agent along the path of a flow reports that the flow is DROPPED, the flow will receive a DROPPED disposition.

When there is no DROP reported by any agents along the path of the flow, we consider the case of bidirectional flows and unidirectional flows separately. When bidirectional flows are observed, we look at flows in pairs (forward and reverse) based on their source, destination ports and protocol, and timings. The same cannot be done for unidirectional flows.

For bidirectional flows, if there are agents installed and data plane enabled on both ends, a forward flow will receive an ALLOWED disposition if both the source and the destination agent report that the flow is observed. Otherwise, the forward flow will get a PENDING disposition. If an agent is installed on either the source or the destination workload, but not both, then the forward flow will received an ALLOWED disposition if and only if the agent observes subsequent reverse flow within a **60**second window. Otherwise a PENDING status will be assigned to the forward flow. The disposition of the reverse part of the bidirectional flow follows the same logic except that now the source and the destination are reversed. For example, if only one side has an agent, whether a reverse flow disposition is PENDING or ALLOWED depends on the observation and timing of its subsequent forward flow based on the same logic.

Note that we assume firewalls implement silent drop. If a reject message is sent on the *same* flow (e.g. rejecting a TCP SYN with RST + ACK), a reverse flow will be detected, and the previous forward flow will be marked as ALLOWED. However if the reject message is sent on a *different* flow (e.g. rejecting a TCP SYN with an ICMP message), the forward flow will remain as PENDING.

For a unidirectional flow, the flow will be considered DROPPED if it is reported as DROPPED by any agent as in the case of bidirectional flows. However, since there is no matching reverse flow, the flow will have PENDING disposition status if both agents observe the flow.

Violation Types

The flow dispositions are checked against the policies being analyzed to determine the final violation types.

A flow’s violation type will be

- **Permitted**, if its disposition is ALLOWED or PENDING, and its deciding policy action is ALLOW,
- **Escaped**, if its disposition is ALLOWED, and its deciding policy action is DENY,
- **Rejected**, if its disposition is DROPPED or PENDING, and its deciding policy action is DENY,

A DROPPED status is assigned only to flows whose relevant agents explicitly report their DROPPED status. When there is no explicit report of dropping for agents, the flow receives PENDING status.

When disposition is PENDING:

- and policy action is DENY, then violation type is set to Rejected.
- and policy action is ALLOW, then violation type is set to Permitted.

For a bidirectional flow, if the policy violation types of forward and reverse part of the flow agree, only a single type is shown in the policy analysis or enforcement analysis page. Otherwise, forward and reverse are shown separately, such as PERMITTED:REJECTED.

Example scenarios:

- Packets are dropped at the source-side enforcement
  - In this case, the source side Secure Workload egress agent will report that the flow is DROPPED.
- Packets leave the source.
  - If there is only an agent on the source side, the flow will be reported as ALLOWED by the egress agent if a reverse packet is also oberved by the agent within 60 seconds.
  - If there is a visibility-only agent on both the source and the destination side, the flow will be given a DROPPED disposition status, if and only if the ingress agent reports that the flow is DROPPED. Otherwise, the flow will be reported as ALLOWED.
  - Flow packets are received at the destination, but no reverse traffic.

    If there is no destination side agent, the flow will receive a PENDING status. Otherwise, it will be assigned ALLOWED status.

Suggested Steps for Investigating Flows

When drilling into specific flows when examining policy results, the following suggestions and filters may be helpful:

1. Focus on *ESCAPED FLOWS* initially:

   Escaped flows require special attention as their actual flow dispositions differ from the intended actions based on the currently analyzed policies. Investigate to ensure that enforcing these policies does not block needed flows and adversely impact your applications.

   Click the violation type, such as **Escaped**.

   (Later, you can look at rejected and permitted flows as needed.)

   Escaped flows can occur for many reasons, including but not limited to:

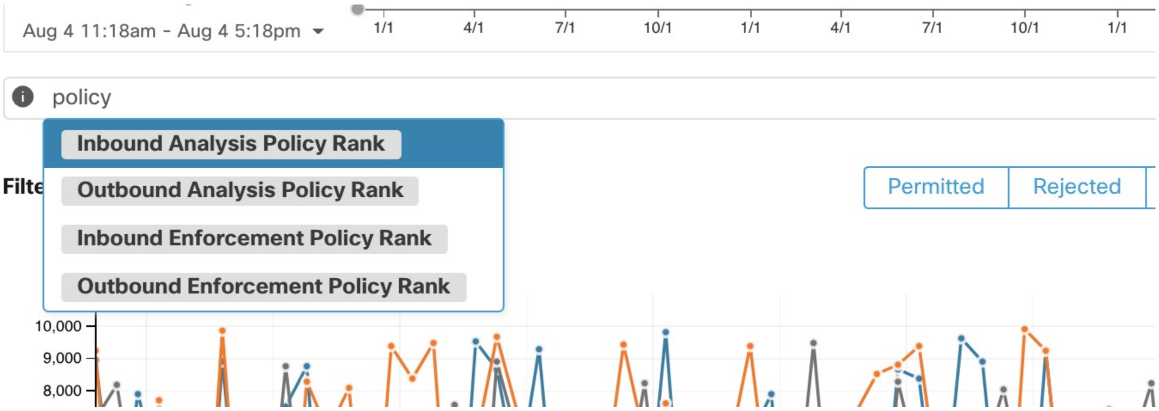
   - Another policy higher in the priority order is taking effect
   - The traffic is taking a different path than the route that your policies address, or
   - The policy that you expect the traffic to hit is in a workspace that is not being analyzed (if you are looking at escaped flows on the Policy Analysis page) or enforced (if you are looking at escaped flows on the Enforcement page), for example in an ancestor scope or even in a secondary workspace in the same scope.

2. Identify flows that matched the catch-all policy (inbound and outbound) :

   It is important to understand what flows are matched to catch-all policies, especially in an allow-list policy model. If these flows are legitimate but do not have explicit allow policies configured for them, you may want to add appropriate explicit policies in the corresponding inbound or outbound scopes. On the other hand, if they are suspicious flows, you want to quickly identify them and further investigate their details.

   To focus on these flows, apply filters based on the *catch-all* value of **inbound_policy_rank** or **outbound_policy_rank**, depending whether you are looking at the inbound, outbound or both sides, shown below.

   Figure 293: Policy Analysis filtering options for Rank

   Aug 4 11:18am - Aug 4 5:18pm

   policy

   Inbound Analysis Policy Rank
   Outbound Analysis Policy Rank
   Inbound Enforcement Policy Rank
   Outbound Enforcement Policy Rank

3. Filter out TCP flows with RST: *Fwd flags does not contain RST, Rev flags does not contain RST*

   Some escaped TCP flows have RST flags set. These flows are reset by either their consumers or providers. They are essentially unestablished connections without data exchange, but may be reported as ALLOWED because the agents see their handshaking packets. Since they do not have established connections to begin with, they will not be affected when currently analyzed polices are enforced. Filtering out TCP flows that have the RST flag on either side allows you to focus on more meaningful and important escaped flows whose established connection will be blocked by the currently analyzed policies.

4. If most traffic is using IPv4, focus only on IPv4 flows:

   Filter using *address type = IPv4, address type != IPv6*. It is also helpful to filter out *link-local* address.

5. Priorize which flows to focus on in the next diagnostic step by identifying the most frequent hostnames, ports, addresses, scopes, etc. involved in the escaped traffic:

   Select *Hostname, Ports* or *Addresses* from the TopN feature pane. You can usually combine these with other filters to drill down to a particular type of traffic when diagnosing policies.

6. Search flow data for the hostnames, ports, protocols, etc. identified in the previous step

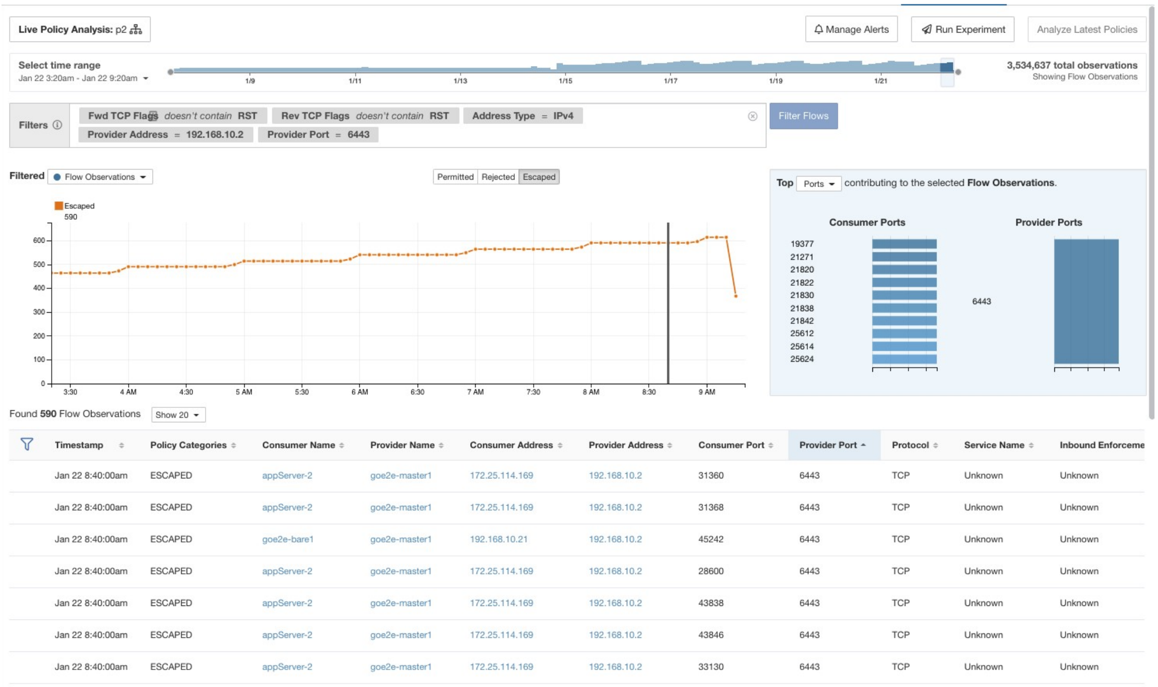
   Once you have an idea about the top candidates based on the targeted flows' hostnames, port and etc., you can choose to drill down into the flows by either applying drill-down filters directly from values given in the top N query window, or by manually entering relevant filters into the flow search filters bar. For example, *Consumer Hostname contains {something}, Provider Hostname contains {something}, Provider Port = {some port number}, Protocol = TCP Protocol != ICMP*

7. Check individual flows and quick analysis:

   Finally, you can focus on a specific flow to examine its policy result by clicking the table row corresponding to the flow. Pay attention to the policies matched to the flow and the scopes of both the consumer and the provider addresses. If the policy action does not match your intended action, you need to create appropriate policies in workspaces associated with the consumer’s and/or the provider’s scopes to change the policy action.

   The figure below shows an example workflow of narrowing down escaped flows using some of the filtering described above. The search input also supports “,” and “-” for Port, Consumer Address and Provider Address, by translating “-” into range queries.

Figure 294: Policy analysis diagnosis example



Filters: **Fwd TCP Flags** *doesn't contain* **RST** | **Rev TCP Flags** *doesn't contain* **RST** | **Address Type = IPv4** | **Provider Address = 192.168.10.2** | **Provider Port = 6443**

Found **590** Flow Observations

Timestamp	Policy Categories	Consumer Name	Provider Name	Consumer Address	Provider Address	Consumer Port	Provider Port	Protocol	Service Name	Inbound Enforceme
Jan 22 8:40:00am	ESCAPED	appServer-2	goe2e-master1	172.25.114.169	192.168.10.2	31360	6443	TCP	Unknown	Unknown
Jan 22 8:40:00am	ESCAPED	appServer-2	goe2e-master1	172.25.114.169	192.168.10.2	31368	6443	TCP	Unknown	Unknown
Jan 22 8:40:00am	ESCAPED	goe2e-bare1	goe2e-master1	192.168.10.21	192.168.10.2	45242	6443	TCP	Unknown	Unknown
Jan 22 8:40:00am	ESCAPED	appServer-2	goe2e-master1	172.25.114.169	192.168.10.2	28600	6443	TCP	Unknown	Unknown
Jan 22 8:40:00am	ESCAPED	appServer-2	goe2e-master1	172.25.114.169	192.168.10.2	43838	6443	TCP	Unknown	Unknown
Jan 22 8:40:00am	ESCAPED	appServer-2	goe2e-master1	172.25.114.169	192.168.10.2	43846	6443	TCP	Unknown	Unknown
Jan 22 8:40:00am	ESCAPED	appServer-2	goe2e-master1	172.25.114.169	192.168.10.2	33130	6443	TCP	Unknown	Unknown

Run Policy Experiments to Test Current Policies Against Past Traffic

If a known attack or other significant short-term traffic pattern occurred in the past, and you want to see how your current policies (or another versioned policy set) would have handled that traffic, you can use the Run Experiments feature.

Before you begin

Tip As an alternative to this procedure, you can run automatic policy discovery again, including the relevant time range, and see what different policies are suggested.

Procedure

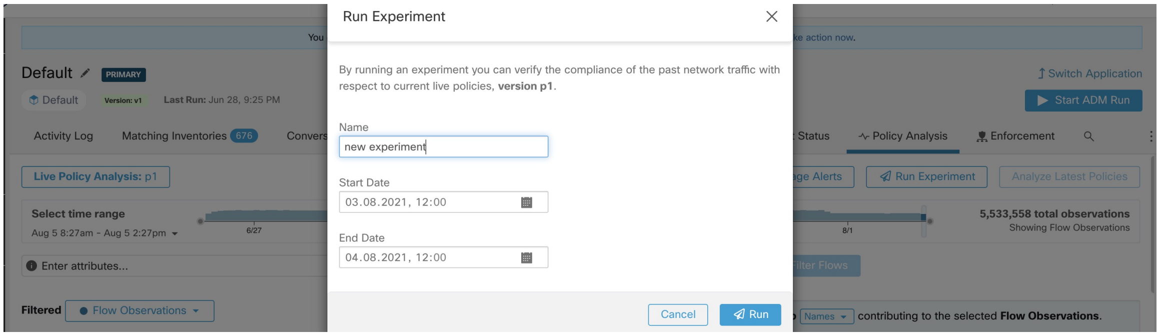
Step 1 Navigate to the Policy Analysis page of your selected workspace.

Step 2 From the top of the page, select the policy version to test.

Step 3 Click the **Run Experiment**button in the right corner of the page.

Step 4 In the new dialog select a name and a duration for the policy experiment.

Figure 295: Run Experiment Form



Run Experiment

By running an experiment you can verify the compliance of the past network traffic with respect to current live policies, **version p1**.

Name: new experiment

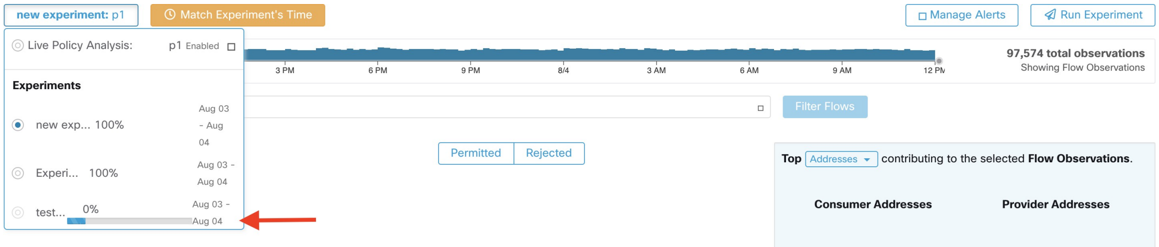
Start Date: 03.08.2021, 12:00

End Date: 04.08.2021, 12:00

This will start a new policy analysis job which goes back in time and re-analyzes all the flows in the selected duration against the selected versioned policy.

This job may take a few minutes, depending on the selected duration. The progress is shown in the policy selector menu. Once the results are ready to be presented, you should be able to select the policy experiment like any other versioned policy and the time series charts showing different flow categories will be updated accordingly.

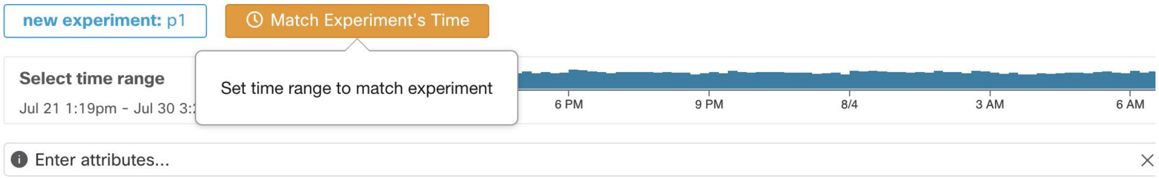
Figure 296: View Experiment Status



new experiment: p1
Match Experiment's Time
Live Policy Analysis: p1 Enabled
Experiments
new exp... 100% Aug 03 - Aug 04
Experi... 100% Aug 03 - Aug 04
test... 0% Aug 03 - Aug 04
3 PM
6 PM
9 PM
8/4
3 AM
6 AM
9 AM
12 PM
Manage Alerts
Run Experiment
97,574 total observations
Showing Flow Observations
Filter Flows
Permitted
Rejected
Top Addresses contributing to the selected Flow Observations.
Consumer Addresses
Provider Addresses

Note If you cannot see any flows when selecting a policy experiment, it might be due to time range mismatch, e.g., the current time range of the charts is the past 1 hour, but the experiment duration is 6 hours in the past. In order to reset the time range to the duration of the experiment, click on the clock icon next to the policy selector.

Figure 297: Match time range



After Changing Policies, Analyze Latest Policies

Policy analysis does not automatically reflect policy changes in the workspace. When you are ready to analyze the current set of policies after making changes, click **Analyze Latest Policies** so policy analysis reflects the changes.

If the policies in the workspace have not changed since policy analysis was last initiated, or if policy analysis is not currently enabled, the Analyze Latest Policies button is not available. If the button is clickable, there are policy changes that have not yet been included in analysis.

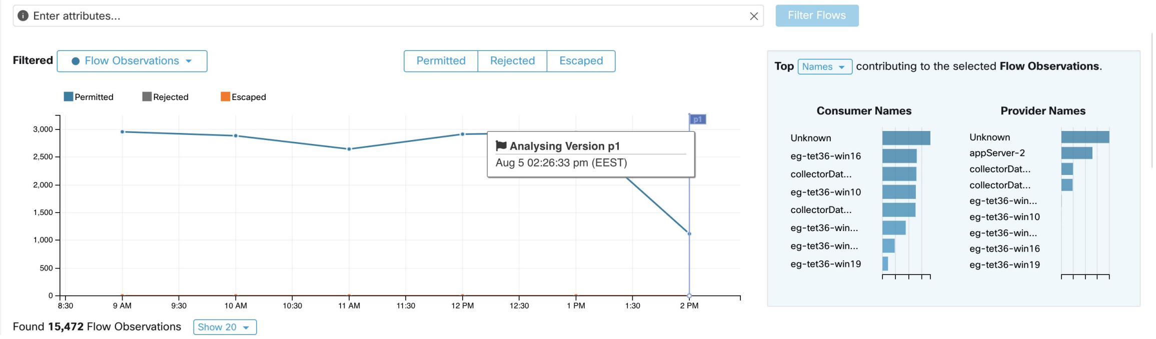
See also View, Compare, and Manage Analyzed Policy Versions, on page 532.

Policy Label Flags

On the policy analysis timeseries chart, policy label flags mark the point at which analysis was initiated and at each point analysis was re-initiated to reflect the latest policy and cluster changes.

Click a flag to view the version of the policies associated with that flag:

Figure 298: Policy label flag in timeseries chart



Clicking a policy label flag opens the corresponding version of the Policies page and displays the policies analyzed by that policy analysis version.

View, Compare, and Manage Analyzed Policy Versions

Each time you analyze or re-analyze policies in a workspace after making changes, a new analysis version (p*) is created.

For details about versioning, see About Policy Versions (v* and p*), on page 550.

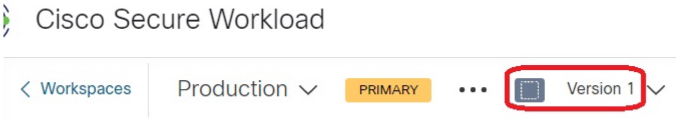
Procedure

Step 1 Click **Defend** > **Segmentation**.

Step 2 Navigate to the relevant scope and primary workspace.

Step 3 Click **Manage Policies**.

Step 4 The currently displayed version of the policies is shown at the top of the page:



The displayed version may be a policy discovery version, an analyzed policy version, or an enforced version.

Step 5 You can:

To display a different version of the policies:	Click the current version and choose a different version. For descriptions of the versions, see About Policy Versions (v* and p*), on page 550. **Important!** If you choose a v* version, see View, Compare, and Manage Discovered Policy Versions, on page 462 instead of this topic, including the important caveat at the end of the topic.
To view details about the analyzed versions:	**a.** Click **View Version History** at the top of the page beside the current version. **b.** Click the **Published Versions** tab to see the versions of analyzed and enforced policies. **c.** To view log entries for a version, click the link in the version. Pale green rows represent analysis activity. Bright green rows represent enforcement activity.
To compare two versions to see what has changed:	**a.** Click **Compare Revisions**. **b.** Choose the versions to compare. You can compare the latest draft version, analyzed and enforced versions. **c.** For result details, see Comparison of Policy Versions: Policy Diff, on page 552.
To delete an unwanted version:	Click ⋮ for the version and choose **Delete**. Published policy versions (p* versions) can be deleted as long as the version is not being actively analyzed or enforced.
To export a version:	Click ⋮ for the version and choose **Export...**. See also Export a Workspace, on page 467.

What to do next

When you are done working with versions, change the version at the top of the workspace page to the latest discovered policy version (v*).

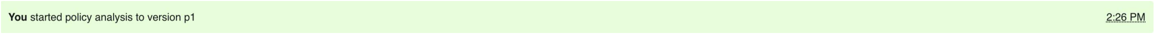
This avoids unintentional deletion of discovered policy versions and allows you to manually create policies in the workspace.

Activity Logs of Policy Analysis

All workspace users may view activity logs associated with changes done on the policy analysis page in the workspace history (see Activity Logs and Version History).

- Enable policy analysis

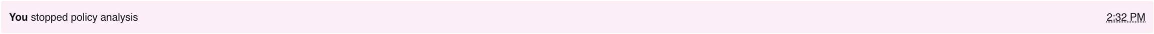
Figure 299: Enable policy analysis



You started policy analysis to version p1 2:26 PM

- Disable policy analysis

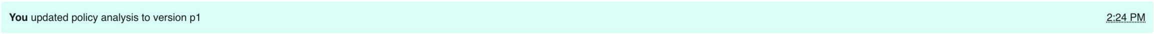
Figure 300: Disable policy analysis



You stopped policy analysis 2:32 PM

- Update policy analysis

Figure 301: Update policy analysis



You updated policy analysis to version p1 2:24 PM

Enforce Policies

Secure Workload can enforce policies using:

- Software Agents, on page 9 installed on individual workloads:
  - Linux
  - Windows
  - Kubernetes/OpenShift

  For technical details about how agents work on each platform, see Policy Enforcement with Agents, on page 39 and Enforcement on Containers, on page 542.
- Cloud connectors:
  - AWS through AWS Connector, on page 239
  - Azure through Azure Connector, on page 252
- Integrate load balancers through an external orchestrator:
  - F5 BIG-IP, on page 163
  - Citrix Netscaler, on page 169
- Integration with Cisco Secure Firewall Management Center, on page 333
- Streaming to third-party orchestrators for enforcement in third-party infrastructure

Caution When you enforce policies, the system inserts new firewall rules on affected hosts and deletes any existing rules on the relevant hosts.

Check Agent Health and Readiness to Enforce

Some of these checks can be done before or after enforcing policy.

Permissions may be required to modify agent or connector capability; see the requirements and prerequisites in the relevant chapters.

You do not need to perform these checks for any workloads on which you do not intend to enforce policies.

Verify That:	More Information
Agents are installed on all workloads in the scope that are associated with the enforced workspace	Click **Defend** > **Segmentation** and navigate to the relevant scope and workspace. Click **Matching Inventories**, then click **IP Addresses**. IP addresses on this tab generally do not have agents that are installed, and agents generally must be installed to enforce policy. Exceptions: Enforcement occurs for the following types of inventory that appears on the IP Addresses tab: • Cloud-based inventory on which policy is enforced using a cloud connector. (Installing agents on individual workloads is optional.) • Kubernetes addresses appear in the IP Addresses list if agents are installed on individual workload pods; Kubernetes inventory with installed agents appears on the Pods tab.
The installed agent version is current and supported	For an overview of installed agent versions, click **Manage** > **Agents**, then click **Distribution** and look at the **Agent Software Version Distribution** chart. For details, click **Manage** > **Agents**, then click **Agents List**.
Installed agents have enforcement capability	Click **Manage** > **Agents**, then click **Convert to Enforcement Agent**. In the **Filter** box, enter `Agent Type = Deep Visibility` Convert any agents that must enforce policy.
Enforcement is enabled for all agents	(This requirement is distinct from ensuring that agents have enforcement capability and from enabling enforcement in the workspace.) **Important!** Depending on your deployment, this may need to be done before or after you enforce the workspace. See that the Verify Enforcement is Enabled for Agents section.
Enforcement is enabled for nonagent enforcement mechanisms	**Important!!!** Do not enable enforcement on cloud connectors without agents until AFTER you enforce policy on the workspace. External orchestrators that support enforcement must also be enabled before they can enforce.

Verify That:	More Information
The **Preserve Rules** setting in the Agent Config Profile is appropriate for the workload platform	• For Kubernetes/OpenShift, see Enforcement on Containers section. • For other platforms, see information for each platform in Software Agents section. Tip: Search this document for "Preserve Rules" to find useful information.
(After the workspace is enforced) All agents have received the applicable policies for the workload	See the Verify Enforced Policies are being pushed to Agents section.
Agents are healthy	In addition to the sources above, the following locations have information about agent health: • Click **Manage** > **Agents**, then click **Monitor**. Look at the information under **Enforcement Agents**. For details, see theAgent Monitoring section. • Click **Manage** > **Agents**, then click **Distribution**. Choose the agent type from the top of the page. For information about this page, see the Agent Status and Statistics. • Click **Organize** > **Scopes and Inventory**, filter to find a specific workload of interest, and click the IP address. The **Workload Profile** page opens in a separate browser window including an Agent Health panel. For details, see Workload Profile section.

Enable Policy Enforcement

⚠

Caution Enforcing policies delete existing firewall rules and write new firewall rules on every workload in the scope that is affected by this workspace.

If you have not properly verified that your policies are working correctly, enforcing policies can change the way that your applications work and disrupt business operations.

Before you begin

- Initially, when you enforce policies, consider setting the catch-all to Allow. Then, monitor traffic to see what matches the catch-all rule. When no necessary traffic is matching the catch-all rule, you can set the catch-all to Deny.
- If you enforce workspaces in multiple scopes at once, you can enforce only analyzed workspaces. If you enforce a single workspace using the second method that is described in the procedure below, analyzing the policies in the workspace before you enforce them is recommended but not required.

See Live Policy Analysis and subtopics.

- The wizard for enforcing a single scope is more detailed than the wizard that offers the option to enforce multiple scopes simultaneously. If you require the features in Policy Enforcement Wizard, on page 540, use the second method that is described in the procedure below.
- **IMPORTANT!** Verify that the policies are correct.

  Policy results in any workspace may be affected by enforced policies in other scopes. Before policy enforcement is enabled on a workspace, the Policy Enforcement page shows how flows are affected by enforced policies in the workspaces associated with other scopes. For example, a broad "Production hosts should not talk with Non-Production hosts" policy in the enforced workspace of a parent scope may impact traffic on workloads belonging to an application in a child scope.

  If no new information is being shown in the Enforcement charts, make sure that the correct time range is selected.

  For information about the information you see on the Enforcement page, see Live Policy Analysis and subtopics. (The same information for Live Analysis also applies to the Policy Enforcement page.)

  If live analysis results differ from results on the Enforcement page, make sure the scopes, policy versions, and time range being analyzed are the same as the scopes, policy versions, and time range being used to generate results on the Enforcement page.

- Understand how agents enforce policies on each platform. See:
  - For Windows and Linux workloads, see Policy Enforcement with Agents, on page 39 and subtopics.
  - For Kubernetes and OpenShift, see

    Enforcement on Containers, on page 542.
  - For load balancers, see

    Policy enforcement for Citrix Netscaler, on page 171 and

    Policy enforcement for F5 BIG-IP, on page 165.
  - For cloud-based workloads configured using cloud connectors, see:
    - Best Practices When Enforcing Segmentation Policy for AWS Inventory, on page 248 and linked topics.
    - Best Practices When Enforcing Segmentation Policy for Azure Inventory, on page 259 and linked topics.

- You must have the required permissions to enforce policies:

  You must have the Enforce ability or higher for the scope. Users with other abilities on the scope can still view this page but will not be able to enforce (or disable) new policies. For more information, see Roles.

- Verify that all relevant installed agents and other enforcement endpoints such as cloud connectors are ready to enforce policy.

  For a list of agent health and readiness checks, see Check Agent Health and Readiness to Enforce, on page 535. (Some of these checks must wait until after enforcement; for example, you should enable enforcement on cloud connectors AFTER you have enabled enforcement in the workspace, NOT before.

For installed agents, you will typically enable enforcement in the agent config before you enforce the workspace.)

Procedure

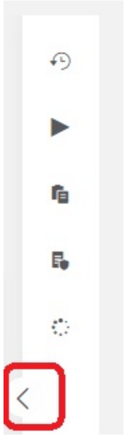
Step 1 Choose **Defend** > **Segmentation**.

Step 2 You can enforce policies for one scope or for multiple scopes at the same time:

To enforce policy for multiple scopes at the same time:

(Only workspaces that have been analyzed can be enforced using this process.)

a) Click the caret on the right side of the page to display the Tools pane:



b) Click **Enable Enforcement**.

c) Click **Next** to start the wizard.

d) Select one workspace to enforce.

(The option to enforce workspaces for additional scopes is on the last page of the wizard.)

e) Click **Next**.

f) Choose the version of that workspace to enforce, then click **Next**.

g) To simultaneously enforce policies for another scope, click **+ Add Another Workspace** and complete the steps.

Repeat as needed for additional scopes.

h) Click **Accept and Enforce**.

To enforce policies for a single scope:

a) Navigate to the primary workspace for the scope for which you want to enforce policy.

b) Click **Manage Policies**.

c) Click **Enforcement**.

d) Click **Enforce Policies**.

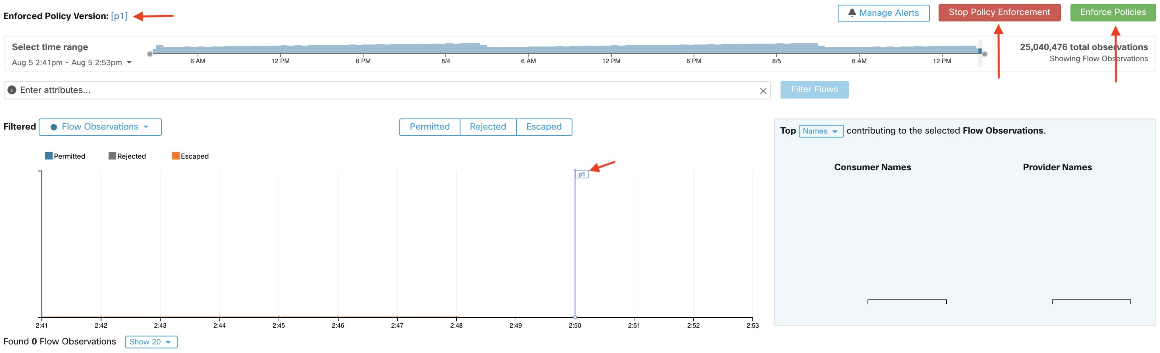
e) Step through the wizard.

For wizard details, see Policy Enforcement Wizard, on page 540.

Step 3 After you click **Accept and Enforce** on the final page of the wizard, new firewall rules will be pushed to the assets that are affected by policies in this workspace.

A Label Flag is created at the time of enforcement:

Figure 302: The Policy Enforcement Page with Enforcement Enabled



You may need to refresh the page to see the flag.

What to do next

- If you enforced policy for a single workspace, consider whether workspaces for other scopes must also be enforced to achieve the expected enforcement outcomes.

  For example, workspaces for ancestor scopes or scopes that include workloads that are involved in cross-scope policies may also need to be enforced.

- Enforcement will not occur until enforcement is enabled for the agents, cloud connectors, and/or external orchestrators that enforce the policies:

  - For workloads with installed agents, enforce policy in the agent config for the relevant scopes and inventory filters. See Software Agent Config, on page 63 and subtopics.

  - For cloud-based workloads configured using cloud connectors, see:

    - Best Practices When Enforcing Segmentation Policy for AWS Inventory, on page 248 and linked topics.

    - Best Practices When Enforcing Segmentation Policy for Azure Inventory, on page 259 and linked topics.

  - For Kubernetes and OpenShift, see:

    - Enforcement on Containers, on page 542

    - Software Agent Config, on page 63

  - For load balancers, see:

    - Policy enforcement for F5 BIG-IP, on page 165

      Policy enforcement for F5 ingress controller, on page 166

    - Policy enforcement for Citrix Netscaler, on page 171

- Check to be sure enforcement is working as expected. See Verify That Enforcement Is Working as Expected, on page 543.
- Configure alerts so you are notified of any issues, for example if flows are rejected after enforcement is enabled.

Policy Enforcement Wizard

When you enforce policies for a single workspace from the Enforcement page of the workspace, the policy enforcement wizard lets you:

- Review policies before they are implemented on the workloads.

  This includes policies that are inherited from ancestor scopes.
- Download policy changes for review.
- Compare policy versions.
- Choose which analyzed version of the workspace to enforce.
- Roll back policies to a previous version.

Steps in the policy enforcement wizard:

1. Select Policy Updates

   You can select which version of policies to be enforced on the workloads.

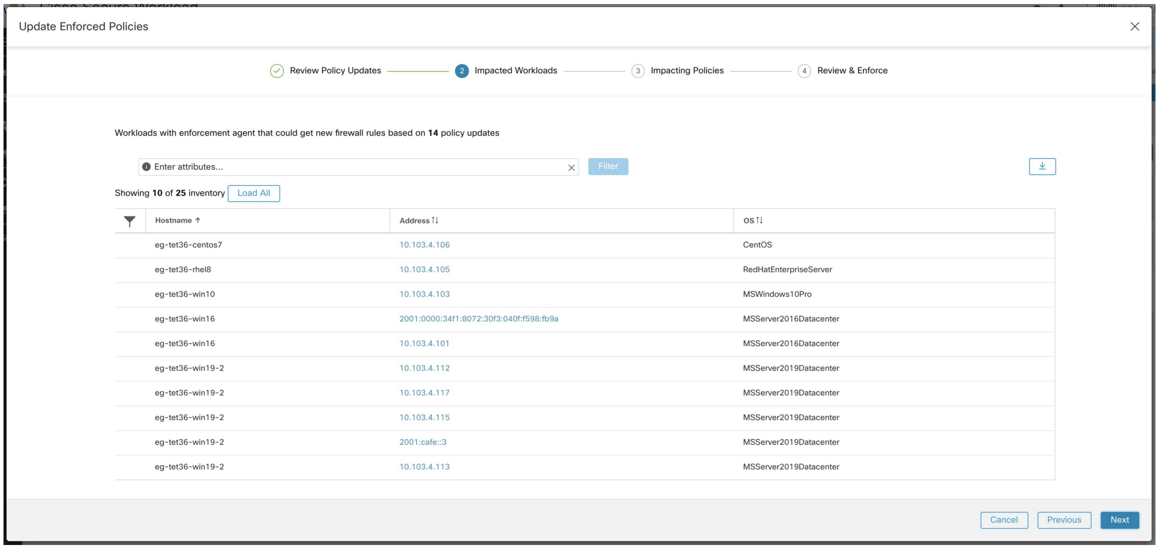
   The difference between the currently enforced policies and policies in the selected version is displayed.

   Similarly to the Comparison of Policy Versions: Policy Diff, you can filter and review the policy changes and download them as CSV.
2. Impacted Workloads

   This step shows the workloads that will be affected by the new firewall rules generated from the selected policy changes. The result comes from searching all the workloads that have enforcement agents within the union of the consumers/providers of the selected policy changes.

   The number of potentially impacted workloads cannot exceed the total number of workloads in the scope. However, the actual impacted workloads might be smaller due to other factors such as agent config intents.

Figure 303: List of Impacted Workloads



Workloads with enforcement agent that could get new firewall rules based on **14** policy updates

Showing **10** of **25** inventory

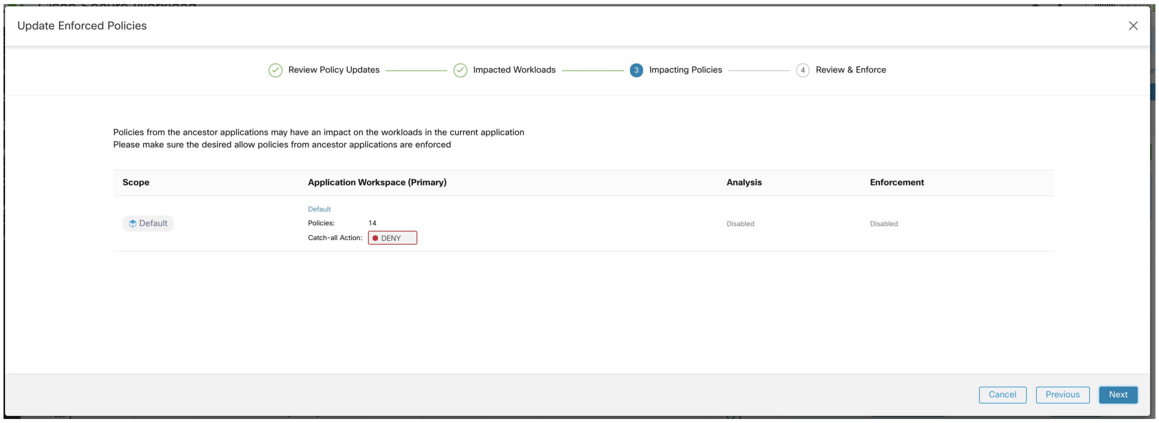
Hostname ↑	Address ↑↓	OS ↑↓
eg-tet36-centos7	10.103.4.106	CentOS
eg-tet36-rhel8	10.103.4.105	RedHatEnterpriseServer
eg-tet36-win10	10.103.4.103	MSWindows10Pro
eg-tet36-win16	2001:0000:34f1:8072:30f3:040f:f598:fb9a	MSServer2016Datacenter
eg-tet36-win16	10.103.4.101	MSServer2016Datacenter
eg-tet36-win19-2	10.103.4.112	MSServer2019Datacenter
eg-tet36-win19-2	10.103.4.117	MSServer2019Datacenter
eg-tet36-win19-2	10.103.4.115	MSServer2019Datacenter
eg-tet36-win19-2	2001:cafe::3	MSServer2019Datacenter
eg-tet36-win19-2	10.103.4.113	MSServer2019Datacenter

For more details on viewing, filtering, and downloading inventory items, see Inventory, on page 339.

3. Impacting Policies

   Policies from the ancestor workspaces may impact workloads in the current workspace. Therefore, you should make sure the desired allow policies from ancestor workspaces are enforced.

   Figure 304: List of ancestor workspaces and enforced versions



Policies from the ancestor applications may have an impact on the workloads in the current application
Please make sure the desired allow policies from ancestor applications are enforced

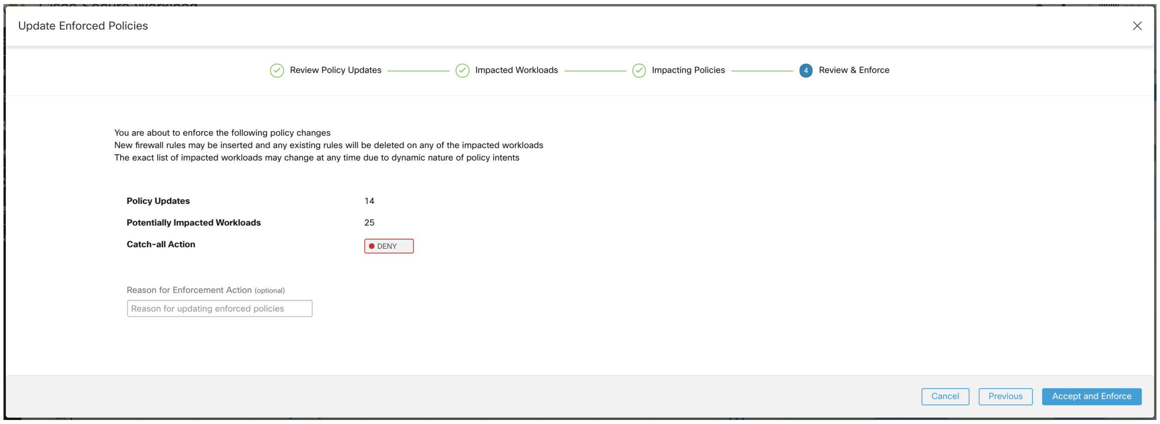
Scope	Application Workspace (Primary)	Analysis	Enforcement
Default	Default Policies: 14 Catch-all Action: ● DENY	Disabled	Disabled

4. Review & Accept

   This final step summarizes the policy changes to be enforced, the number of potentially impacted workloads, and the catch-all action that will be enforced. When you click **Accept and Enforce**, the policies in the workspace will be used to calculate the new firewall rules that will be configured on the relevant workloads.

   You have the option to provide a name, description, and reason for action for the newly enforced policies for future reference. In case of rollback, you can provide only the reason, as name and description for a past version cannot be changed.

Figure 305: Review the Summary and Enforce Policy Changes



Update Enforced Policies

You are about to enforce the following policy changes
New firewall rules may be inserted and any existing rules will be deleted on any of the impacted workloads
The exact list of impacted workloads may change at any time due to dynamic nature of policy intents

Policy Updates 14
Potentially Impacted Workloads 25
Catch-all Action ● DENY

Reason for Enforcement Action (optional)
Reason for updating enforced policies

Enforcement on Containers

For an overview of the steps that are required to set up segmentation on container-based workloads that are managed by Kubernetes and OpenShift, see Set Up Microsegmentation for Kubernetes-Based Workloads, on page 7.

Attention **Agents running on Kubernetes/OpenShift hosts must be configured to preserve existing rules.**

In order to prevent enforcement from interfering with iptables rules added by Kubernetes, the agent must be configured with a profile that has the **Preserve Rules** option enabled. See Create an Agent Configuration Profile

When enforcing policies on containers, Secure Workload allows Kubernetes/OpenShift service abstractions to be used as providers. Internally, the policies for service abstractions are transformed into rules for the provider pods and the nodes they are running on. This transformation depends on the type of the Kubernetes/OpenShift service, and it is dynamically updated whenever changes are received from the API server.

The following example illustrates the flexibility made possible by this feature. Consider the following policy which allows traffic from all hosts and pods with the label *environment* = *production* to a Kubernetes service of type *NodePort* with the name *db* which exposes TCP port 27017 on a set of pods.

Consumer	Provider	Protocol/Port	Action

environment = production
OR
orchestrator_environment = production
	orchestrator_system/service_name = db	TCP 27017	Allow

This policy would result in the following firewall rules:

- On hosts and pods that are labeled with *environment* = *production*, allow outgoing connections to all Kubernetes nodes of the cluster to which the service belongs. This rule uses the node port that is assigned to this service by Kubernetes.
- On pods with the label *environment* = *production*, allow outgoing connections to the ClusterIP assigned to this service by Kubernetes. This rule uses the port that is exposed by the service (TCP 27017).
- On Kubernetes nodes of the cluster to which the service belongs, allow outgoing connections to the provider pods. This rule uses the target port that is exposed by the service (TCP 27017).
- On pods providing the service db, all incoming connections from all kubernetes nodes and consumer hosts and pods. This rule uses the target port that is exposed by the service (TCP 27017).

Changes to the type of the service, ports, and set of provider pods will immediately be picked up by Secure Workload rule generator and used to update the generated firewall rules.

⚠

Caution **Policies including Kubernetes/OpenShift inventory must be designed carefully to avoid conflicting with the internal operation of the kubernetes cluster.**

Kubernetes/OpenShift items imported by Secure Workload include the pods and services constituting the kubernetes cluster (for example, pods in the kube-system namespace). This allows precise policies to be defined to secure the kubernetes cluster itself, but it also means that badly designed policies can affect the operation of the cluster.

Verify That Enforcement Is Working as Expected

Check Agents

See Check Agent Health and Readiness to Enforce, on page 535.

Check for Escaped and Rejected Flows

In the menu on the left side of the screen, click **Overview**.

On the **Security Dashboard** page, look at the **Segmentation Compliance Score**.

If this is less than 100, you may have escaped or rejected flows, either of which indicates a policy configuration issue.

For details, see Segmentation Compliance Score, on page 686.

For more information about investigating these situations, see Policy Analysis Results: Understand the Basics, on page 525 and subtopics. (The information in these topics applies to enforced policies shown on the Enforcement tab and to analyzed policies shown on the Policy Analysis tab.)

Add any missing policies, or modify existing policies, for example, by adding additional protocols/ports, to allow required legitimate traffic.

Then reanalyze before reenforcing.

View Enforced Policies for a Specific Workload (Concrete Policies)

Use this procedure to view all enforced policies for a specific workload (that is, the *concrete policies* for that workload). This view is useful because all policies in a workspace may not apply to every workload in the workspace, and because policies in multiple workspaces may apply to a particular workload (for example, inherited policies in parent or ancestor scopes).

Concrete policies are listed in priority order. For more information about the effects of priority, see the Policy Priorities section.

Before you begin

Note Concrete policies include only policies in enforced workspaces. If a workspace is not enforced, any policies that would apply to the workload if the workspace were enforced do not appear in the list.

Procedure

Step 1 You can navigate to the Concrete Policies page for a workload from the Inventory page or from the workspace:

To navigate from the Scopes and Inventory page:

a) Choose **Organize > Scopes and Inventory**.
b) Search for the IP address of the workload of interest and click it.

   The Workload Profile opens in a separate tab.

   In general, except for cloud-based workloads that are managed without agents, Kubernetes, and OpenShift workloads, if the IP address appears in the **IP Addresses** tab and not in the **Workloads** tab, this means that an agent is not installed on the workload, so policies cannot be enforced, and there is no concrete policies list.

To navigate from the Segmentation page:

a) Choose **Defend > Segmentation**.
b) Click the scope.
c) Click the Primary workspace.
d) Click **Manage Policies**.
e) Click the **Matching Inventories** tab.
f) Search for the IP address of the workload of interest and click it.
g) In the panel that opens on the right, click **View Workload Profile**.

   The Workload Profile opens in a separate tab.

Step 2 From the menu on the left side of the Workload Profile page, click **CONCRETE POLICIES**.

Step 3 Click a row to view details.

For more information, see the Concrete Policies tab.

Step 4 To see the amount of traffic that has hit each policy:

a) Click **Fetch All Stats**.
b) Click each policy of interest.

Step 5 To view information about Kubernetes or OpenShift workloads, click **CONTAINER POLICIES**.

What to do next

Choose **Monitor** > **Enforcement Status** for status of concrete policies, for example to see if any policies have been skipped. For details, see the Enforcement Status section.

Verify That Enforcement Is Enabled for Agents

Procedure

Step 1 Click **Defend** > **Enforcement Status**.

Step 2 To view only the enforcement status for a specific scope, toggle the **Filter by Scope** control and select a scope.

Step 3 Look at the **Agent Enforcement Enabled** chart.

If the chart shows that any agents are **Not Enforced**, continue with this procedure.

Otherwise, skip the rest of this procedure, as all agents are enabled for enforcement.

Step 4 Click the orange **Not Enforced** section of the chart to display the affected workloads in the table below the chart.

Step 5 Enable enforcement on these workloads by modifying the Agent Config profile.

See Create an Agent Configuration Profile, on page 66.

Verify That Enforced Policies Are Being Pushed to Agents

For enforcement to occur, policies specific to each workload must be successfully pushed to the agent installed on that workload. Status is also shown for policy enforcement that is managed by cloud connectors even if agents are not installed.

Before you begin

Enforce policies for at least one scope.

Procedure

Step 1 Click **Defend** > **Enforcement Status**.

Step 2 To view only the enforcement status for a specific scope, toggle the **Filter by Scope** control and select a scope.

Step 3 Look at the **Agent Concrete Policies** chart.

If the chart shows that any are **Skipped**, continue with this procedure.

Otherwise, skip the rest of this procedure.

Step 4 To display the list of workloads affected by this issue, click the red **Skipped** slice of the chart.

The affected workloads are listed in the table below the charts.

Step 5 To see the reasons for this issue:

For each workload in the search results, click the **(i)** button beside **Skipped** in the **Concrete Policies** column.

Error Message	More Information
Agent doesn't have Windows OS	At least one policy that is applicable only to Windows workloads includes consumers and/or providers that are not running Windows OS. Remove those workloads from those policies.
Maximum number of policies has been reached	See If There Are Too Many Policies for the Agent, on page 546.

What to do next

(Optional) Configure an alert so you are notified if this situation occurs in future. See Configure Alerts, on page 641.

If There Are Too Many Policies for the Agent

If the complete set of applicable concrete policies cannot be pushed to a particular agent, the latest version of the policies is not pushed.

Background: There is a limit to the number of policies supported on each agent. Limits also apply to policies enforced using cloud connectors. You may find the information in Limits, on page 945 helpful.

Before you begin

Use this procedure to resolve this problem if Verify That Enforced Policies Are Being Pushed to Agents, on page 545 indicates that the agent cannot accommodate the full set of enforced policies.

Procedure

Step 1 Navigate to the primary workspace for an affected scope.

Step 2 Modify the policies in the primary workspace:

Try to reduce the number of policies and reduce any long lists of IP addresses in consumer or provider.

For example, consolidate existing policies, and/or base policies on subnets rather than on huge lists of IP addresses.

For policies enforced using a cloud connector, you may also be able to increase any limits that are imposed by the platform. See the documentation for your cloud platform.

Step 3 After you have made changes, enforce the latest version of the workspace and check again for skipped policies.

Step 4 Repeat this procedure for any other scopes experiencing this issue.

Modify Enforced Policies

Enforce New and Revised Policies

If you must revise policies after enforcement, generally you will make the changes in the same primary workspace. Then, review your changes carefully, and analyze the workspace again to be sure it has the effect you expect. When you are confident that the changes will have the desired effect, click the **Enforce Latest Policies** button in the upper right of the page.

View, Compare, and Manage Enforced Policy Versions

Each time that you enforce or reenforce policies in a workspace after making changes, a new version (p*) is created.

For detailed information about versioning, see About Policy Versions (v* and p*), on page 550.

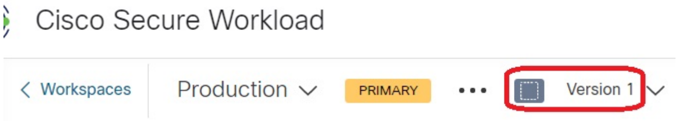
Procedure

Step 1 Click **Defend** > **Segmentation**.

Step 2 Navigate to the relevant scope and primary workspace.

Step 3 Click **Manage Policies**.

Step 4 The currently displayed version of the policies is shown at the top of the page:



The displayed version may be a policy discovery version, an analyzed policy version, or an enforced version.

Step 5 Do one of the following:

To display a different version of the policies:	Click the current version and choose a different version. For descriptions of the versions, see About Policy Versions (v* and p*), on page 550. **Important!** If you choose a v* version, see View, Compare, and Manage Discovered Policy Versions, on page 462 instead of this topic, including the important caveat at the end of the topic.

To view details about the analyzed versions:	**a.** Click **View Version History** at the top of the page beside the current version. **b.** Click the **Published Versions** tab to see the versions of analyzed and enforced policies. **c.** To view log entries for a version, click the link in the version. Pale green rows represent analysis activity. Bright green rows represent enforcement activity.
To compare two versions to see what has changed:	**a.** Click **Compare Revisions**. **b.** Choose the versions to compare. You can compare the latest draft version, analyzed and enforced versions. **c.** For result details, see Comparison of Policy Versions: Policy Diff, on page 552.
To delete an unwanted version:	Click ⋮ for the version and choose **Delete**. Published policy versions (p* versions) can be deleted as long as the version is not being actively analyzed or enforced.
To export a version:	Click ⋮ for the version and choose **Export...**. See also Export a Workspace, on page 467.

What to do next

When you are done working with versions, change the version at the top of the workspace page to the latest discovered policy version (v*).

This avoids unintentional deletion of discovered policy versions and allows you to manually create policies in the workspace.

Revert Enforced Policies to an Earlier Version

To roll back enforced policies to a previous version, follow one of the processes that are described in Enable Policy Enforcement, on page 536 and choose an earlier version to enforce.

Disable Policy Enforcement

- **To disable policy enforcement for multiple scopes simultaneously**:

  Follow the procedure for enforcing policy in multiple scopes simultaneously, as described in Enable Policy Enforcement, on page 536. On the Select Version page of the wizard, click **Select a version** and choose **Disable enforcement**.

- **To disable policy enforcement for a single scope**:

Navigate to the Policy Enforcement page for the scope's primary workspace and click the red **Stop Policy Enforcement** button. This writes new firewall rules to assets in the scope based on enforced policies in ancestor workspaces. A Label Flag with an 'x' will be created on the time series chart.

Pause Policy Updates

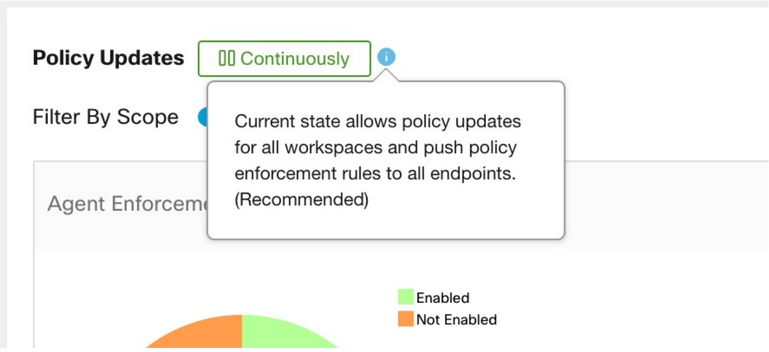
Caution This option pauses policy updates for ALL workloads in ALL scopes.

This feature requires site admin or customer support privileges.

To pause rule updates for all enforcement endpoints in all scopes:

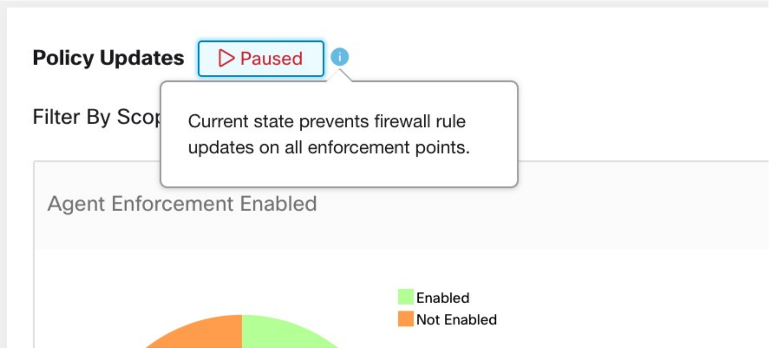
1. Choose **Defend** > **Enforcement Status**.
2. Click the status beside **Policy Updates**.
3. Read and accept the caution.

Figure 306: Firewall Rules are being Updated Continuously



Current state allows policy updates for all workspaces and push policy enforcement rules to all endpoints. (Recommended)

Figure 307: Firewall Rule Updates are Paused



Current state prevents firewall rule updates on all enforcement points.

Enforcement History

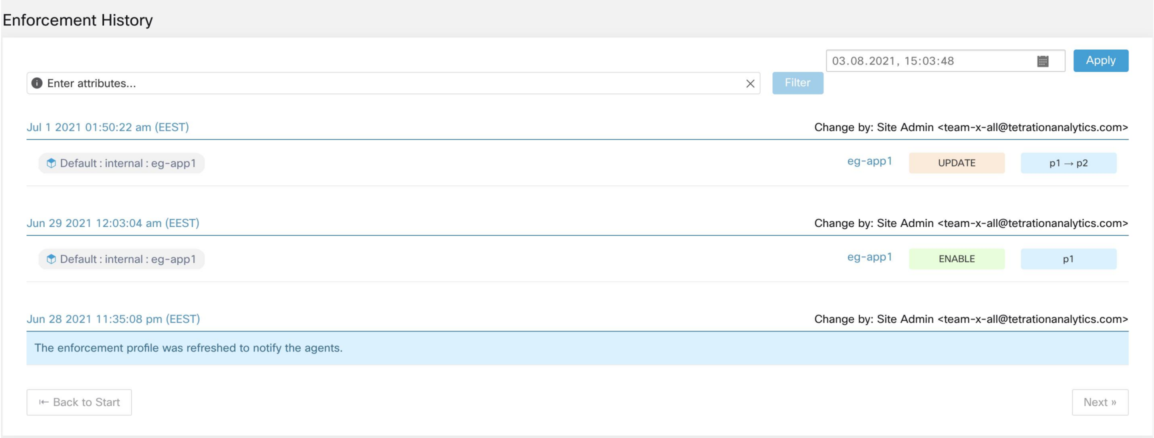
Enforcement History provides a list of changes to the list of enforced workspaces and their version.

To view the enforcement history:

1. Click the caret at the right side of the Segmentation page to expand the Tools menu.
2. Click **Enforcement History**.

   Each section describes an event and displays a summary of what has changed.
3. Click an event for details about all the policies that were enforced at that time.

Figure 308: Enforcement history view



Enforcement History

03.08.2021, 15:03:48 | Apply

Enter attributes... | Filter

Jul 1 2021 01:50:22 am (EEST) — Change by: Site Admin <team-x-all@tetrationanalytics.com>

Default : internal : eg-app1 — eg-app1 — UPDATE — p1 → p2

Jun 29 2021 12:03:04 am (EEST) — Change by: Site Admin <team-x-all@tetrationanalytics.com>

Default : internal : eg-app1 — eg-app1 — ENABLE — p1

Jun 28 2021 11:35:08 pm (EEST) — Change by: Site Admin <team-x-all@tetrationanalytics.com>

The enforcement profile was refreshed to notify the agents.

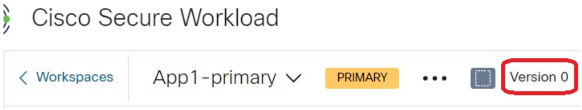
⇤ Back to Start | Next »

About Policy Versions (v* and p*)

Policy versions are sometimes called workspace versions.

Displayed Version

The version of the policies (and clusters) that you are currently working with is shown at the top of the workspace page:



Cisco Secure Workload

< Workspaces | App1-primary ∨ | PRIMARY | ••• | Version 0

- V* versions are generated by automatic policy discovery

  For details, see below
- P* versions are analyzed and/or enforced versions

  For details, see below

The following icons may appear beside the version number:

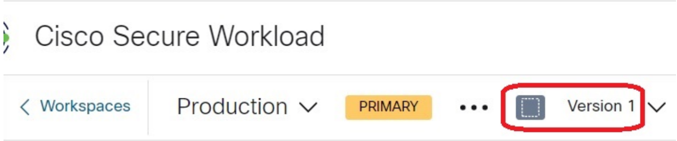
Table 26: Version Icons

∿	Indicates the version of the policies that is currently being analyzed

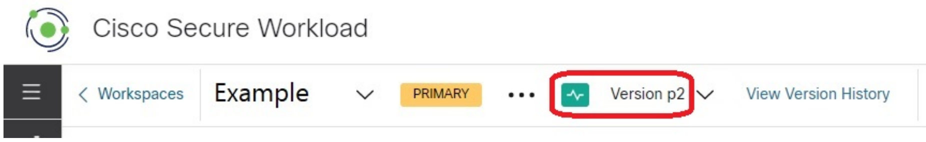
🛡	Indicates the version of the policies that is currently being enforced
⬚	Indicates the latest version of automatically discovered policies
(no icon)	Indicates that the version is not the latest version of its type

Examples:

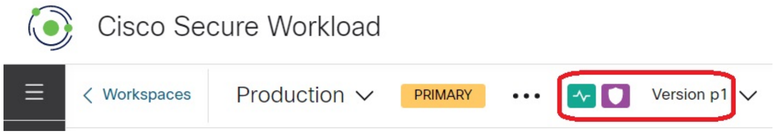
- Displayed version is the latest discovered version of the policies:



- Displayed version is the version of the policies that is currently being analyzed:



- Displayed version is the version of the policies currently being analyzed and enforced:



Policy Discovery Version (v*)

Each time you automatically discover policies for a workspace, the version (v*) increments.

The first time you automatically discover policies, version 1 is generated, and all modifications after that run, such as editing or approving clusters (but not a rerun), are also grouped under version 1. When you subsequently automatically discover policies, a new version is generated (unless discovery failed).

The v* version also increments if you import policies.

To work with v* versions, see View, Compare, and Manage Discovered Policy Versions, on page 462.

Published Policy Version (p*)

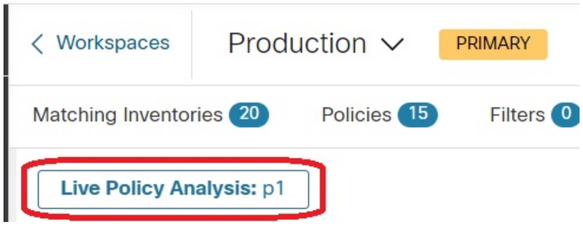
The term "published" policy version (p*) for a workspace can refer to either:

- The version of the policies that was analyzed, or
- The version of the policies that was enforced

These are two separate but parallel versions that depend on the context:

- Policy version for analysis:

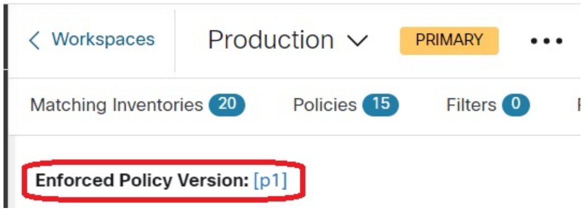
  Each time you analyze policies in a workspace, or click **Analyze Latest Policies** after making a change, the system takes a snapshot of all the clusters and policies that are defined in that workspace, and the "published" policy version (p*) number for analysis increments. The latest **Live Policy Analysis** version is shown at the top-left side of the page on the Policy Analysis tab of the primary workspace.



Live Policy Analysis: p1

- Policy version for enforcement:

  Each time you enable enforcement of the policies in a workspace, or enable enforcement again after making changes, the "published" policy version (p*) for enforcement becomes the number of the analyzed version that you choose in the enforcement wizard. So, if you enforce analyzed version 5, the enforced version is also version 5, even if it is, for example, the first time policy has been enforced for the workspace. The current **Enforced Policy Version** is shown at the top-left side of the page on the Enforcement tab of the primary workspace.



Enforced Policy Version: [p1]

Managing Published (p*) Versions

Published policy versions cannot be edited, only deleted entirely.

Note

Published policy versions (p*) are limited to 100 total. Once this limit is reached, you must delete old versions.

To manage and delete p* versions, see View, Compare, and Manage Analyzed Policy Versions, on page 532, or View, Compare, and Manage Enforced Policy Versions, on page 547.

You can also use the API to delete published versions.

Comparison of Policy Versions: Policy Diff

To compare policies, see any of the following topics: View, Compare, and Manage Discovered Policy Versions, on page 462, View, Compare, and Manage Analyzed Policy Versions, on page 532, or View, Compare, and Manage Enforced Policy Versions, on page 547

Policy changes will be displayed in three categories: Absolute, Default and Catch All. In the comparison table:

- Different services that belongs to the same policy are grouped together
- Filter policy changes by facet or by diff type
- Policy changes and services are paginated
- Download filtered policy changes as CSV

Table 27: Facet filter properties

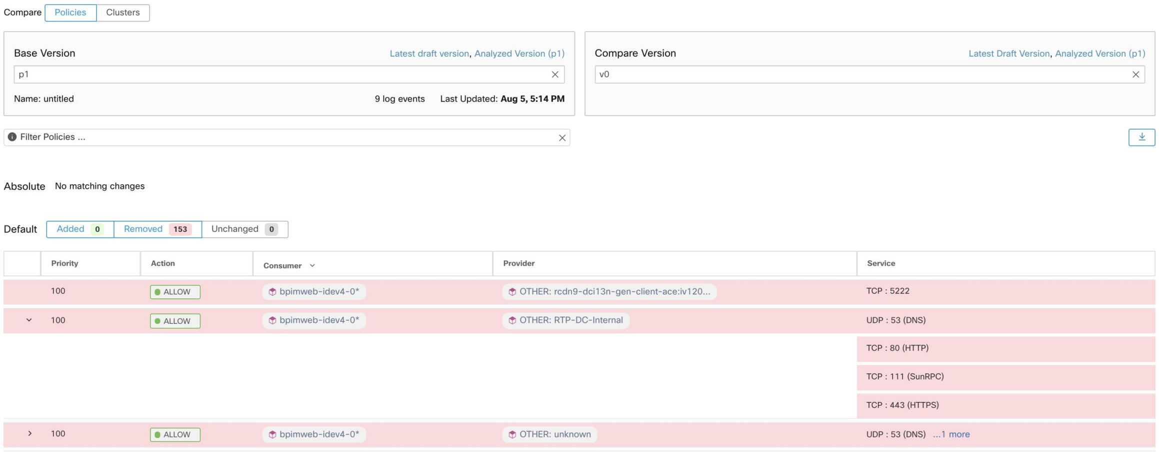
Property	Description
Priority	e.g. 100
Action	e.g. ALLOW, DENY
Consumer	e.g. Consumer Cluster
Provider	e.g. Provider Cluster
Port	e.g. 80
Protocol	e.g. TCP

Table 28: CSV output columns

Column	Description
Rank	The category of the policy. e.g. ABSOLUTE, DEFAULT, CATCH_ALL
Diff	The diff type of the change. e.g. ADDED, REMOVED, UNCHANGED
Priority	e.g. 100
Action	e.g. ALLOW, DENY
Consumer Name	The name of the consumer cluster.
Consumer ID	The ID of the consumer cluster.
Provider Name	The name of the provider cluster.
Provider ID	The ID of the provider cluster.
Protocol	e.g. TCP
Port	e.g. 80

In the figure below, policy versions p1 and v1 are compared.

Figure 309: Policy Diff View



Compare Policies | Clusters

Base Version — Latest draft version, Analyzed Version (p1)
p1
Name: untitled — 9 log events — Last Updated: **Aug 5, 5:14 PM**

Compare Version — Latest Draft Version, Analyzed Version (p1)
v0

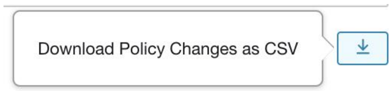
Filter Policies ...

Absolute No matching changes

Default Added 0 | Removed 153 | Unchanged 0

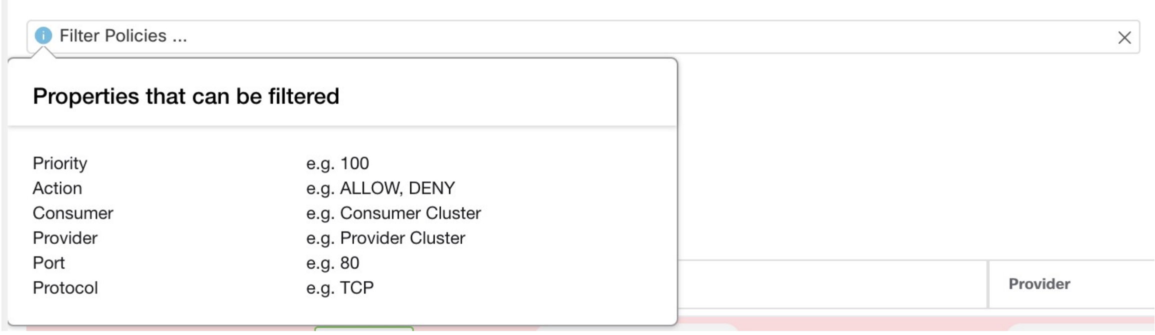
	Priority	Action	Consumer	Provider	Service
	100	ALLOW	bpimweb-idev4-0*	OTHER: rcdn9-dci13n-gen-client-ace:iv120...	TCP : 5222
⌄	100	ALLOW	bpimweb-idev4-0*	OTHER: RTP-DC-Internal	UDP : 53 (DNS) TCP : 80 (HTTP) TCP : 111 (SunRPC) TCP : 443 (HTTPS)
›	100	ALLOW	bpimweb-idev4-0*	OTHER: unknown	UDP : 53 (DNS) ...1 more

Figure 310: Policy Diff View Download Button



Download Policy Changes as CSV

Figure 311: Filtering Policy Diff View

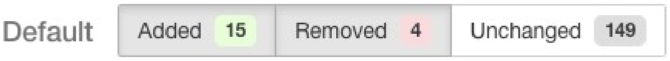


Filter Policies ...

Properties that can be filtered

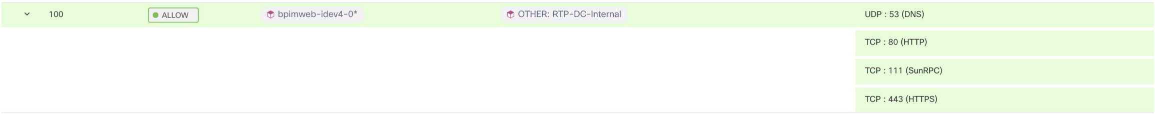
Priority	e.g. 100
Action	e.g. ALLOW, DENY
Consumer	e.g. Consumer Cluster
Provider	e.g. Provider Cluster
Port	e.g. 80
Protocol	e.g. TCP

Figure 312: Policy Diff View Diff Type Filter



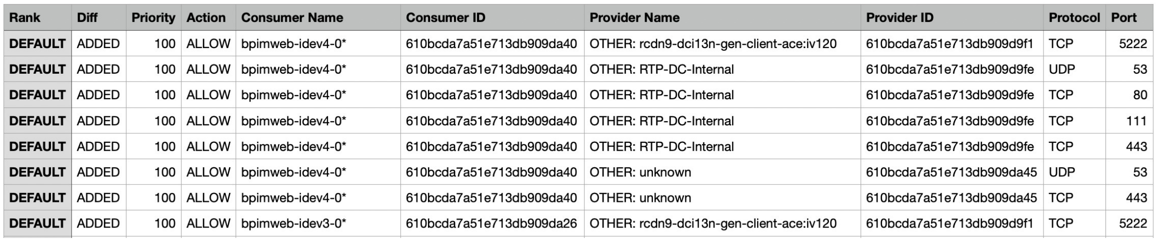
Default Added 15 | Removed 4 | Unchanged 149

Figure 313: Policy Diff View Grouping



⌄	100	ALLOW	bpimweb-idev4-0*	OTHER: RTP-DC-Internal	UDP : 53 (DNS) TCP : 80 (HTTP) TCP : 111 (SunRPC) TCP : 443 (HTTPS)

Figure 314: Policy Diff View CSV Output



Rank	Diff	Priority	Action	Consumer Name	Consumer ID	Provider Name	Provider ID	Protocol	Port
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: rcdn9-dci13n-gen-client-ace:iv120	610bcda7a51e713db909d9f1	TCP	5222
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: RTP-DC-Internal	610bcda7a51e713db909d9fe	UDP	53
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: RTP-DC-Internal	610bcda7a51e713db909d9fe	TCP	80
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: RTP-DC-Internal	610bcda7a51e713db909d9fe	TCP	111
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: RTP-DC-Internal	610bcda7a51e713db909d9fe	TCP	443
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: unknown	610bcda7a51e713db909da45	UDP	53
DEFAULT	ADDED	100	ALLOW	bpimweb-idev4-0*	610bcda7a51e713db909da40	OTHER: unknown	610bcda7a51e713db909da45	TCP	443
DEFAULT	ADDED	100	ALLOW	bpimweb-idev3-0*	610bcda7a51e713db909da26	OTHER: rcdn9-dci13n-gen-client-ace:iv120	610bcda7a51e713db909d9f1	TCP	5222

Tip See also Comparing Versions of Generated Clusters: Diff Views, on page 490.

Activity Logs and Version History

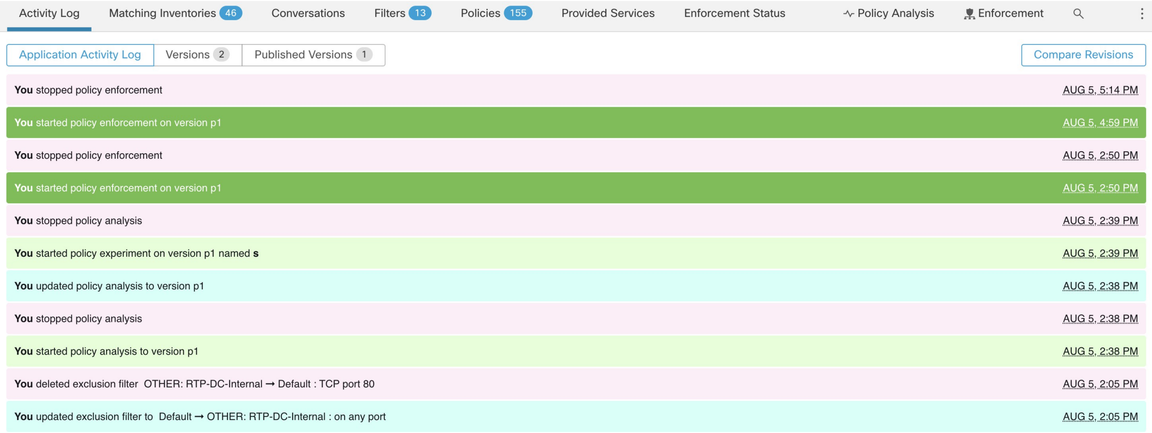
Activity logs record the history of modifications that are applied to a workspace by you. The events that are shown include adding, removing, and renaming workloads and clusters, moving workloads between clusters, uploading side information, submitting and aborting automatic policy discovery, and so on. The view shows which user has made each modification.

To view the modification history for a workspace, click any **Activity Log** link in the workspace.

For example:

1. Click **Defend** > **Segmentation**
2. Click the relevant scope and workspace.
3. Click the **View Activity Logs** link.
4. Click the **Workspace Activity Log** tab.

Figure 315: Log of Events Applicable to Version v1 of this Workspace



```
You stopped policy enforcement                                              AUG 5, 5:14 PM
You started policy enforcement on version p1                                AUG 5, 4:59 PM
You stopped policy enforcement                                              AUG 5, 2:50 PM
You started policy enforcement on version p1                                AUG 5, 2:50 PM
You stopped policy analysis                                                 AUG 5, 2:39 PM
You started policy experiment on version p1 named s                         AUG 5, 2:39 PM
You updated policy analysis to version p1                                   AUG 5, 2:38 PM
You stopped policy analysis                                                 AUG 5, 2:38 PM
You started policy analysis to version p1                                   AUG 5, 2:38 PM
You deleted exclusion filter  OTHER: RTP-DC-Internal → Default : TCP port 80   AUG 5, 2:05 PM
You updated exclusion filter to  Default → OTHER: RTP-DC-Internal : on any port AUG 5, 2:05 PM
```

For information about the version-related tabs and options on the page, see:

- About Policy Versions (v* and p*), on page 550
- View, Compare, and Manage Discovered Policy Versions, on page 462

- View, Compare, and Manage Analyzed Policy Versions, on page 532
- View, Compare, and Manage Enforced Policy Versions, on page 547

Automatic Deletion of Old Policy Versions

Every week, the following are automatically deleted: Workspace versions that have not been accessed for six months and policy experiments that have not been accessed in the last 30 days.

Conversations

A conversation is defined as a service provided by one host on a particular port and consumed by another host. Such a conversation is materialized from many flows over different times. Automatic policy discovery takes all such flows, ignores the ephemeral/client ports, and deduplicates them to generate the conversation graph. For any given conversation between host A and host B on server (provider) port N, there has been at least one flow observation from A to B on port N in the timeframe for which automatic policy discovery has been performed.

Use flow data to better understand what flows are associated with what process while evaluating clusters generated during automatic policy discovery.

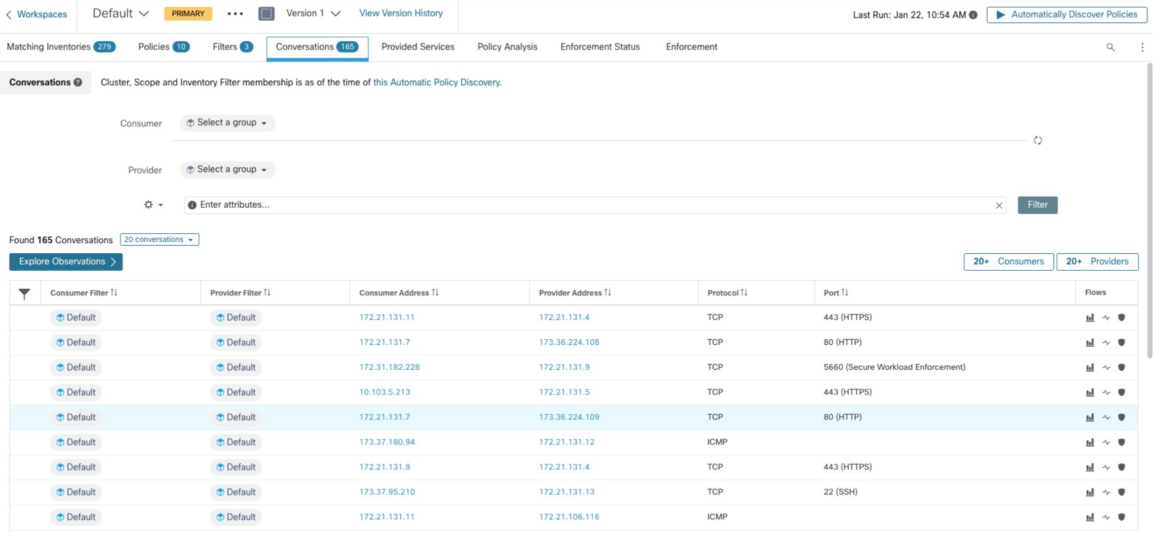
In addition, information that is collected by agents provides visibility of unused L4 ports. Unused ports are the ones for which no communication was seen for the interval selected for automatic policy discovery. This information can be used to open up policies for communication on those ports OR to close those applications binding to the unused ports, thereby reducing the attack surface of the workload.

Note that client-server classification affects the automatic policy discovery conversation view – it dictates which port is dropped (is deemed ephemeral) in the aggregation: See Client-Server Classification.

Conversations Table View

The Conversations Table view provides a simple way to view aggregated flows from the duration of automatic policy discovery where the consumer port is removed and there is only one record for all time. While policies go from filter to filter, conversations are from IP address to IP address.

Figure 316: Conversations Table View



Cluster, Scope and Inventory Filter membership is as of the time of this Automatic Policy Discovery.

Found 165 Conversations

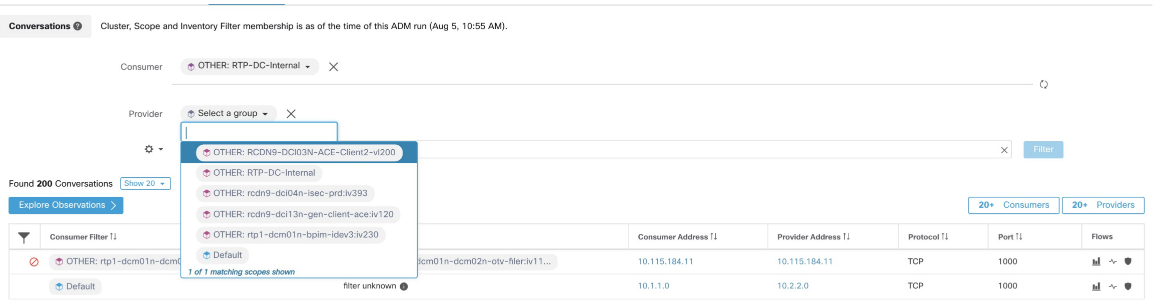
Consumer Filter	Provider Filter	Consumer Address	Provider Address	Protocol	Port	Flows
Default	Default	172.21.131.11	172.21.131.4	TCP	443 (HTTPS)	
Default	Default	172.21.131.7	173.36.224.108	TCP	80 (HTTP)	
Default	Default	172.31.182.228	172.21.131.9	TCP	5660 (Secure Workload Enforcement)	
Default	Default	10.103.5.213	172.21.131.5	TCP	443 (HTTPS)	
Default	Default	172.21.131.7	173.36.224.109	TCP	80 (HTTP)	
Default	Default	173.37.180.94	172.21.131.12	ICMP		
Default	Default	172.21.131.9	172.21.131.4	TCP	443 (HTTPS)	
Default	Default	173.37.95.210	172.21.131.13	TCP	22 (SSH)	
Default	Default	172.21.131.11	172.21.106.116	ICMP		

Choosing Consumer or Provider

Consumers and Providers can be selected by a typeahead dropdown selector which allows one to choose Inventory Filters, Scopes, and Clusters as shown in the example below. All conversations between the chosen Consumer and Provider are displayed. Note: to delete an existing filter, click on the ‘x’ icon (erasing the filter may not work).

By default, the Consumer and Provider match against all of the inventory filters an IP address is a member of during automatic policy discovery. For example, searching for the “root scope” will match all the conversations even though some IPs may be better matched by more specific scopes. To perform a more specific match, select “Restrict scope filtering to an IP’s best match” from the settings dropdown to the left of the faceted filter input.

Figure 317: Choosing Consumer or Provider


Conversations
Consumer
OTHER: RTP-DC-Internal
Provider
Select a group
OTHER: RCDN9-DCI03N-ACE-Client2-vl200
OTHER: RTP-DC-Internal
OTHER: rcdn9-dci04n-isec-prd:iv393
OTHER: rcdn9-dci13n-gen-client-ace:iv120
OTHER: rtp1-dcm01n-bpim-idev3:iv230
Default
1 of 1 matching scopes shown
Filter
Show 20
Explore Observations
20+ Consumers
20+ Providers

Cluster, Scope and Inventory Filter membership is as of the time of this ADM run (Aug 5, 10:55 AM).

Found 200 Conversations

Consumer Filter		Consumer Address	Provider Address	Protocol	Port	Flows
OTHER: rtp1-dcm01n-dcm0	dcm01n-dcm02n-otv-filer:iv11...	10.115.184.11	10.115.184.11	TCP	1000	
Default	filter unknown	10.1.1.0	10.2.2.0	TCP	1000	

Conversation Filters

Figure 318: Conversation Filters

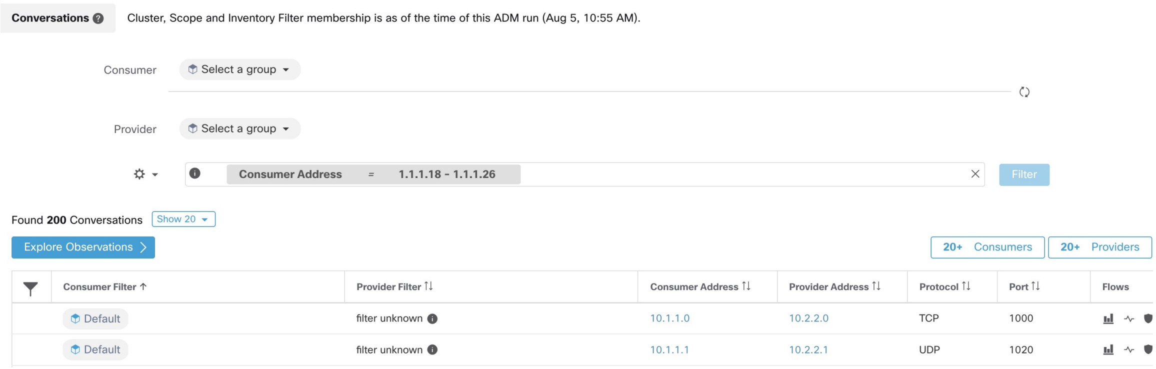
This is where you define filters to narrow-down the search results. All of the possible dimensions can be found by clicking on the (?) icon next to the word Filters. For any User Labels data, those columns will also be available for the appropriate intervals. This input also supports and, or, not, and parenthesis keywords, use these to express more complex filters. For example, a direction-agnostic filter between IP 1.1.1.1 and 2.2.2.2 can be written:

Consumer Address = 1.1.1.1 and Provider Address = 2.2.2.2 or Consumer Address = 2.2.2.2 and Provider Address = 1.1.1.1 And to additionally filter on Protocol = TCP:

(Consumer Address = 1.1.1.1 and Provider Address = 2.2.2.2 or Consumer Address = 2.2.2.2 and Provider Address = 1.1.1.1) and Protocol = TCP

The filter input also supports "," and "-" for Port, Consumer Address and Provider Address, by translating "-" into range queries. The following are examples of a valid filter:

Figure 319: Filter input supports range query for Consumer Address



Conversations

Cluster, Scope and Inventory Filter membership is as of the time of this ADM run (Aug 5, 10:55 AM).

Consumer: Select a group

Provider: Select a group

Consumer Address = 1.1.1.18 - 1.1.1.26

Found 200 Conversations Show 20

Consumer Filter ↑	Provider Filter ⇅	Consumer Address ⇅	Provider Address ⇅	Protocol ⇅	Port ⇅	Flows
Default	filter unknown	10.1.1.0	10.2.2.0	TCP	1000	
Default	filter unknown	10.1.1.1	10.2.2.1	UDP	1020	

Available filters:

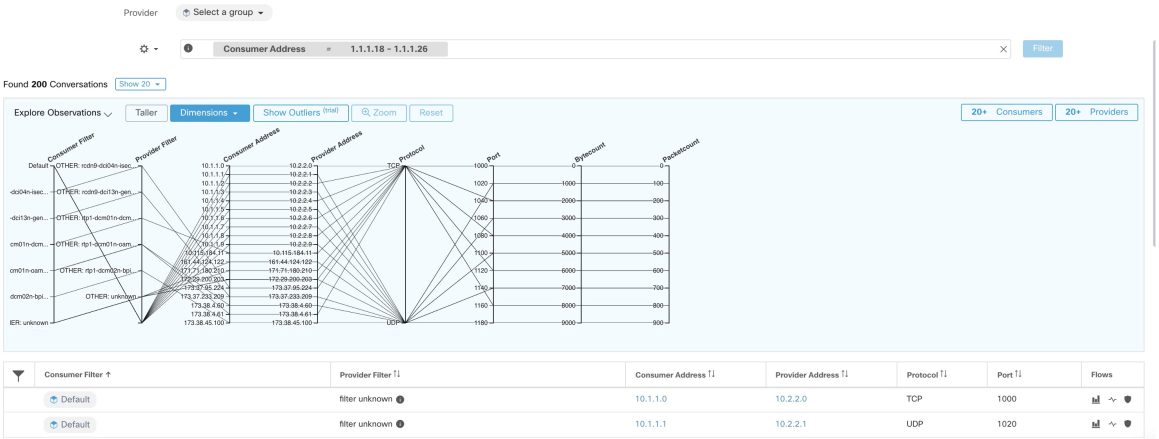
Filters	Description
Consumer Address	Enter a subnet or IP Address using CIDR notation (for example, 10.11.12.0/24). Matches conversation flow observations whose consumer address overlaps with provided IP Address or subnet.
Provider Address	Enter a subnet or IP Address using CIDR notation (for example, 10.11.12.0/24) Matches conversation flow observations whose provider address overlaps with provided ip address or subnet.
Port	Matches conversation flow observations whose port overlaps with provided port.
Protocol	Filter conversation flow observations by Protocol type (TCP, UDP, ICMP).
Address Type	Filter conversation flow observations by Address type (IPv4, IPv6, DHCPv4).
Confidence	Indicated the confidence in the direction of flow. Possible values: High, Very High, Moderate.
Excluded?	Match conversations that are excluded by an exclusion filter or approved policy.

Filters	Description
Excluded By	Match conversations excluded by a specific filter. Possible values: Exclustion Filter, Policy.

Explore Observations

Clicking on the Explore Observations button enables a chart view that allows quick exploration of the high-dimensional data via a "Parallel Coordinates" chart. A bit overwhelming at first, this chart can be useful when enabling only the dimensions you're interested in (by unchecking items in the Dimensions dropdown), and when rearranging the order of the dimensions. A single line in this chart represents a single observation, and where that line intersects with the various axes indicates the value of that observation for that dimension. This can become clearer when hovering over the list of observations below the chart to see the highlighted line representing that observation in the chart:

Figure 320: Explore Observations



Provider: Select a group

Consumer Address = 1.1.1.18 - 1.1.1.26

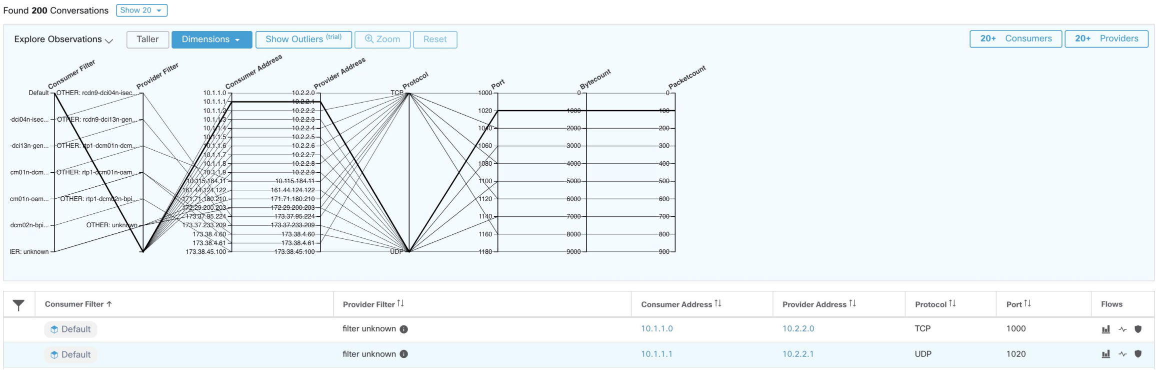
Found **200** Conversations

	Consumer Filter ↑	Provider Filter ⇅	Consumer Address ⇅	Provider Address ⇅	Protocol ⇅	Port ⇅	Flows
	Default	filter unknown	10.1.1.0	10.2.2.0	TCP	1000	
	Default	filter unknown	10.1.1.1	10.2.2.1	UDP	1020	

Conversation Observation Hovered

Due to the high-dimensional nature of the conversations data, this chart is wide by default, and requires scrolling right to see the entire chart. For this reason, it's useful to disable all but the dimensions you are interested in. Hover state in Explore Conversations is provided to map (hover) each conversation with the table list view.

Figure 321: Conversation Observation Hovered



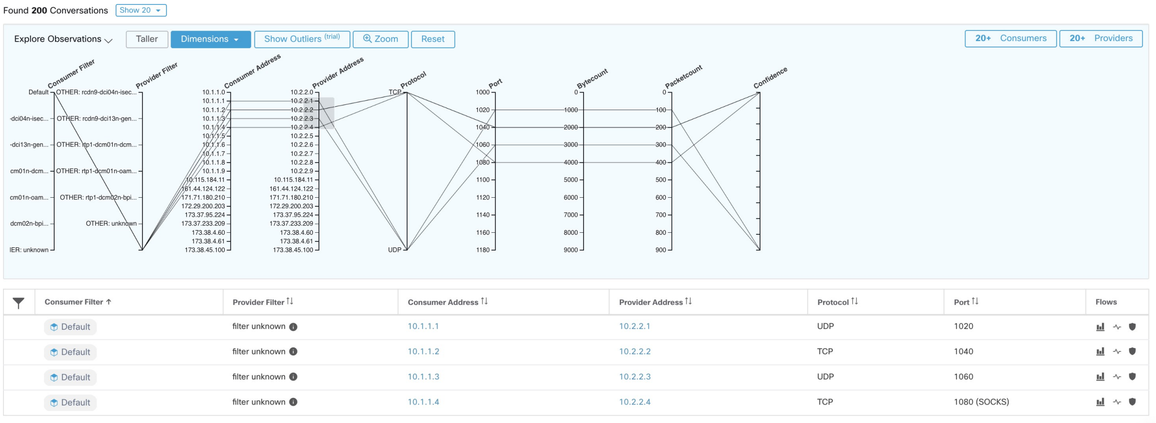
Found 200 Conversations

Consumer Filter ↑	Provider Filter ↑↓	Consumer Address ↑↓	Provider Address ↑↓	Protocol ↑↓	Port ↑↓	Flows
Default	filter unknown	10.1.1.0	10.2.2.0	TCP	1000	
Default	filter unknown	10.1.1.1	10.2.2.1	UDP	1020	

Filtering

Dragging the cursor along any of the axes creates a selection that will show only observations that match that selection. Click again on the axis to remove the selection at any time. Selections can be made on any number of axes at a time. The list of observations will update to show only the selected conversations.

Figure 322: Filtering



Found 200 Conversations

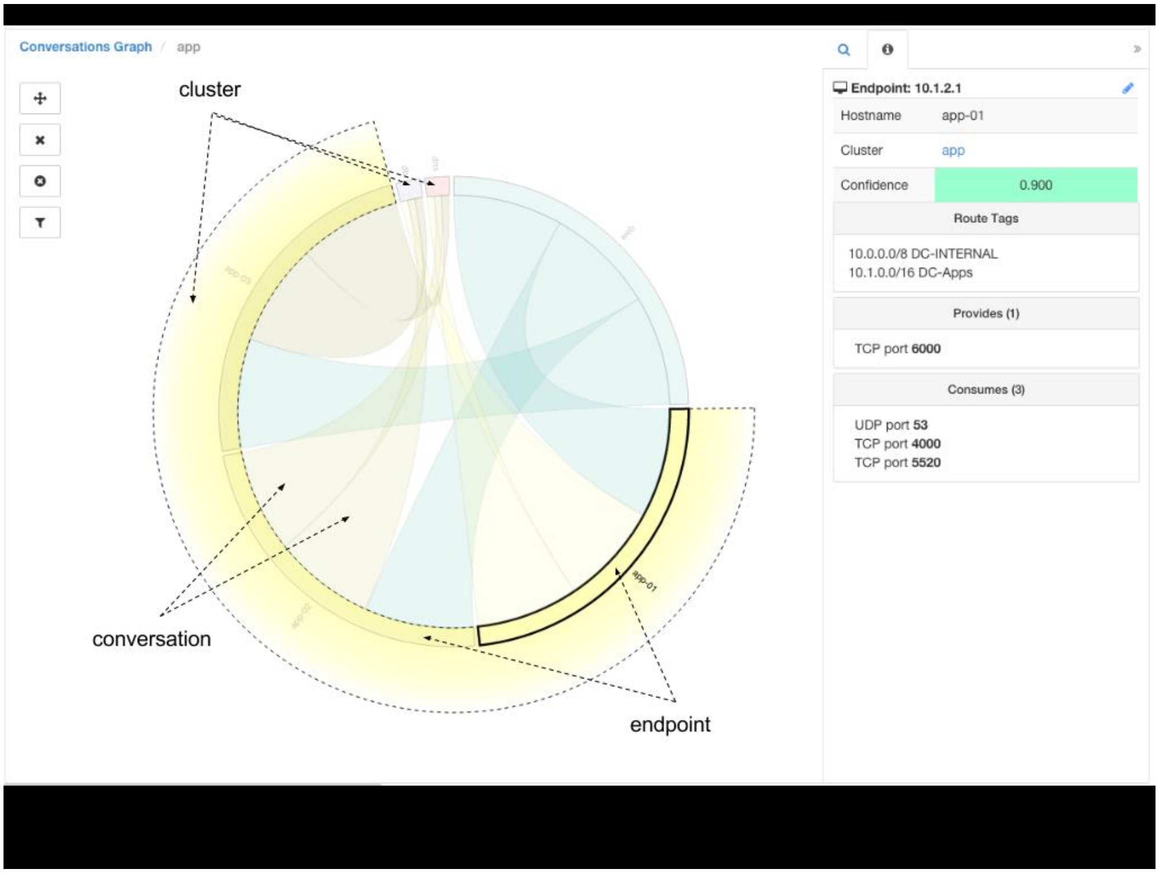
Consumer Filter ↑	Provider Filter ↑↓	Consumer Address ↑↓	Provider Address ↑↓	Protocol ↑↓	Port ↑↓	Flows
Default	filter unknown	10.1.1.1	10.2.2.1	UDP	1020	
Default	filter unknown	10.1.1.2	10.2.2.2	TCP	1040	
Default	filter unknown	10.1.1.3	10.2.2.3	UDP	1060	
Default	filter unknown	10.1.1.4	10.2.2.4	TCP	1080 (SOCKS)	

Conversations Chart View

Conversation chart view has a similar look and feel to the policy view page, except that instead of partitions/clusters/policies, it focuses on clusters/workloads/conversations. As illustrated in the figure below, the outer arcs at the high level represent clusters and can be expanded to show the member hosts/workloads as inner arcs. The chords represent the conversations or connections.

The controls and side panel on conversation view behave similarly to the policy view, except for the fact that the side panel information also shows detailed information about selected workloads such as consumed/provided services as well as link to parent cluster and process information, if available.

Figure 323: Conversations Chart View



Endpoint: 10.1.2.1

Hostname	app-01
Cluster	app
Confidence	0.900

Route Tags

10.0.0.0/8 DC-INTERNAL
10.1.0.0/16 DC-Apps

Provides (1)

TCP port **6000**

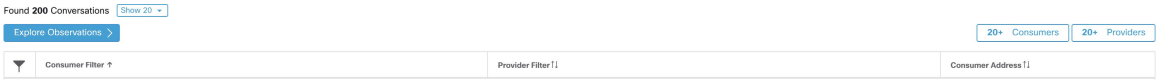
Consumes (3)

UDP port **53**
TCP port **4000**
TCP port **5520**

Top Consumers/Providers of Conversations

The number of top Consumers or Providers based on total conversations reflecting chosen filters can be seen from two buttons on top of the Conversations table. Click on each one to see a dialog containing a table with the Conversation Count column along with each Consumer/Provider’s Address, Hostname, and other User Annotated columns.

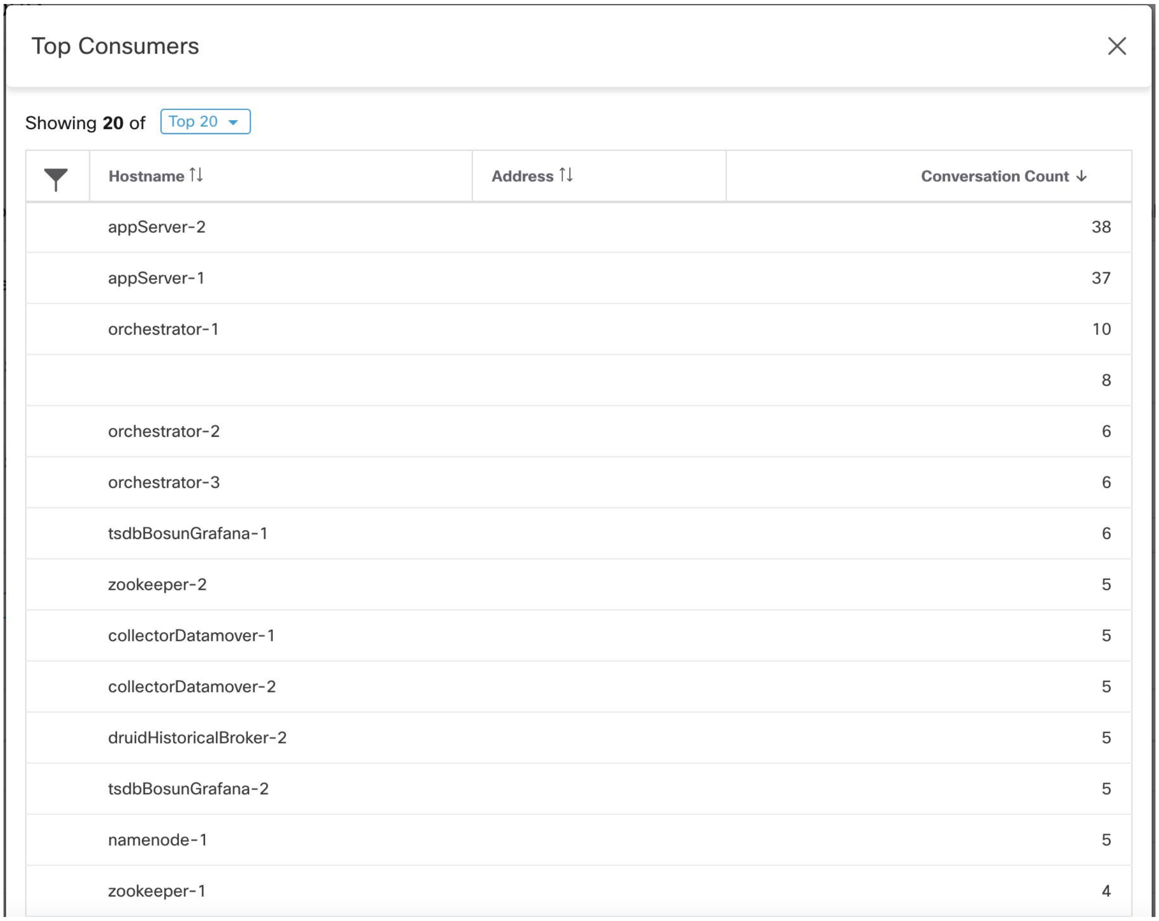
Figure 324: Above the Conversations Table



Found **200** Conversations

Consumer Filter ↑	Provider Filter ↑↓	Consumer Address ↑↓

Figure 325: Top Consumers Modal

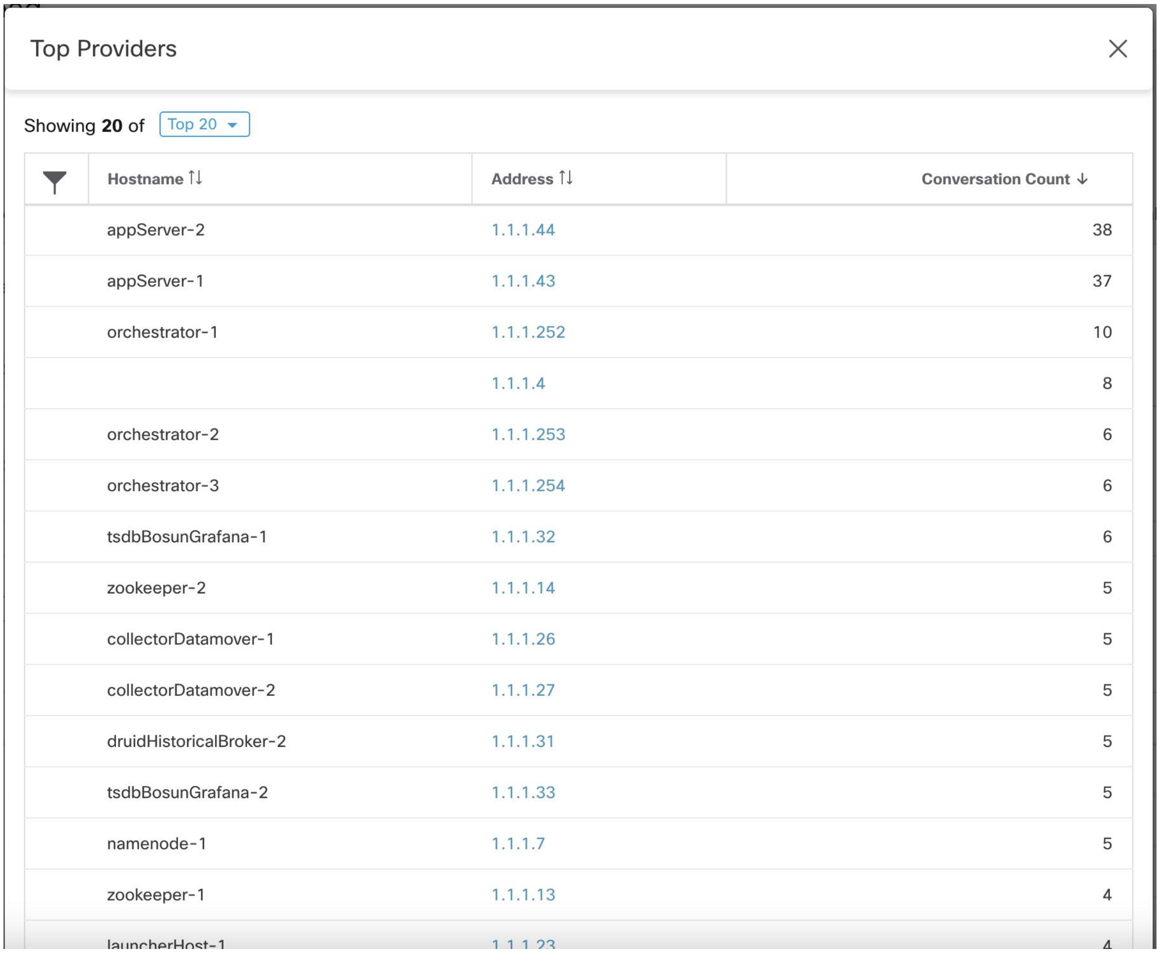


Top Consumers

Showing **20** of Top 20

Hostname	Address	Conversation Count
appServer-2		38
appServer-1		37
orchestrator-1		10
		8
orchestrator-2		6
orchestrator-3		6
tsdbBosunGrafana-1		6
zookeeper-2		5
collectorDatamover-1		5
collectorDatamover-2		5
druidHistoricalBroker-2		5
tsdbBosunGrafana-2		5
namenode-1		5
zookeeper-1		4

Figure 326: Top Providers Modal



Top Providers

Showing **20** of Top 20

	Hostname ↑↓	Address ↑↓	Conversation Count ↓
	appServer-2	1.1.1.44	38
	appServer-1	1.1.1.43	37
	orchestrator-1	1.1.1.252	10
		1.1.1.4	8
	orchestrator-2	1.1.1.253	6
	orchestrator-3	1.1.1.254	6
	tsdbBosunGrafana-1	1.1.1.32	6
	zookeeper-2	1.1.1.14	5
	collectorDatamover-1	1.1.1.26	5
	collectorDatamover-2	1.1.1.27	5
	druidHistoricalBroker-2	1.1.1.31	5
	tsdbBosunGrafana-2	1.1.1.33	5
	namenode-1	1.1.1.7	5
	zookeeper-1	1.1.1.13	4
	launcherHost-1	1.1.1.23	4

Automated Load Balancer Config for Automatic Policy Discovery (F5 Only)

Important **This is an experimental feature.**

This feature and its APIs are in **ALPHA** and are subject to changes and enhancements in future releases.

Automatic policy discovery generates policies from configuration for load balancers connected to an external orchestrator. Generating policies from configuration minimizes reliance on flow data and improves the accuracy of discovered clusters and policies.

It relies on clients to report flows to the load balancer for generating policies to permit this traffic.

Terminology

VIP Virtual IP: IP to which the client sends traffic that is destined for a service.

SNIP SNAT IP: IP used by the load balancer for sending traffic to backend hosts.

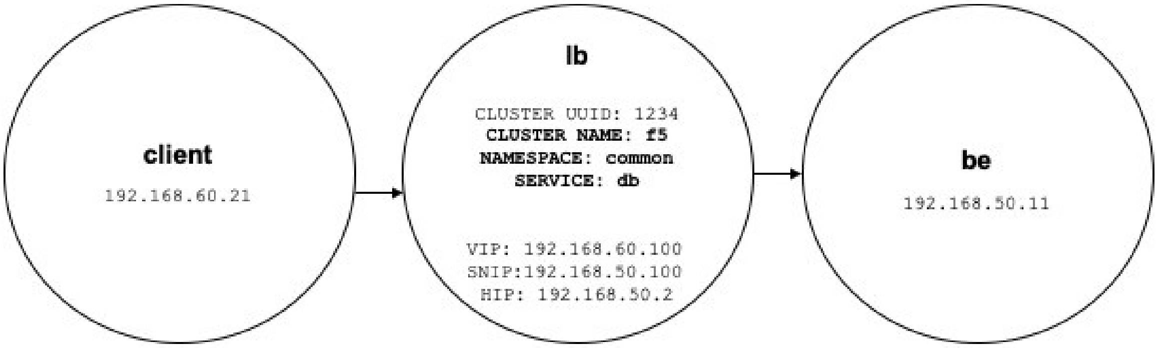
BE Backend Endpoint: IP of the backend host.

HIP Health-check IP: Source IP used by the load balancer for sending health-check traffic to backend hosts.

Note HIPs are the same as SNIPs in automap mode. However, HIPs and SNIPs can differ when a SNAT pool is configured.

Deployment

Figure 327: Deployment



Consider the following deployment where load balancer VIPs, SNIPs, and HIPs are part of the *lb* scope, and BEs are part of the *be* scope. Scopes are created as follows.

- Client

  The client scope includes clients communicating with the load balancer. For the example above, the *client* scope query is as follows:

  ```
  address eq 192.168.60.21 or address eq 192.168.60.22
  ```

- lb

  The F5 external orchestrator labels VIPs, SNIPs, HIPs, and BEs used by the load balancer. These labels can be used to construct scope queries, where *orchestrator_system/service_name* is used for selecting VIPs, *orches- trator_system/service_startpoint* SNIPs, and *orchestrator_system/service_healthcheck_startpoint* HIPs for the service. For the example above, a scope query that includes VIPs, SNIPs, and HIPs for service *db* is as follows:

  ```
  user_orchestrator_system/cluster_id eq 1234 and
  (user_orchestrator_system/service_name eq db or
  user_orchestrator_system/service_startpoint eq db or
  user_orchestrator_system/service_healthcheck_startpoint eq db)
  ```

Note It is required that SNIPs and VIPs be part of the same scope.

- Be

  user_orchestrator_system/service_endpoint selects BEs for a service. For the example above, a scope query that includes BEs for service *db* is as follows:

  ```
  user_orchestrator_system/cluster_id eq 1234 and
  user_orchestrator_system/service_endpoint eq db
  ```

Clusters

Each service generates up to four discovered clusters, of which only the service cluster is visible to the user. SNIP, HIP, and BE clusters appear as related clusters for the service cluster. HIP and BE clusters are generated only when HIPs and BEs are present in the *lb* scope.

For the example above, automatic policy discovery generates a SNIP cluster and HIP cluster in the *lb* scope that include SNIPs and HIPs for service. Since BEs lie outside the *lb* scope, automatic policy discovery does not generate a backend cluster but instead adds the *be* scope to the list of related clusters for *db*.

Clusters are generated as follows:

- Service

  The service cluster includes VIPs for service. The query for the service cluster as follows:

  ```
  user_orchestrator_system/cluster_id eq 1234 and
  user_orchestrator_system/namespace eq common and
  user_orchestrator_system/service_name eq db
  ```

- SNIP

  SNIPs for a service are included in the SNIP cluster. The query for the SNIP cluster is as follows:

  ```
  user_orchestrator_system/cluster_id eq 1234 and
  user_orchestrator_system/service_startpoint eq db
  ```

- HIP

  HIPs for a service are included in the HIP cluster. The query for the HIP cluster is as follows:

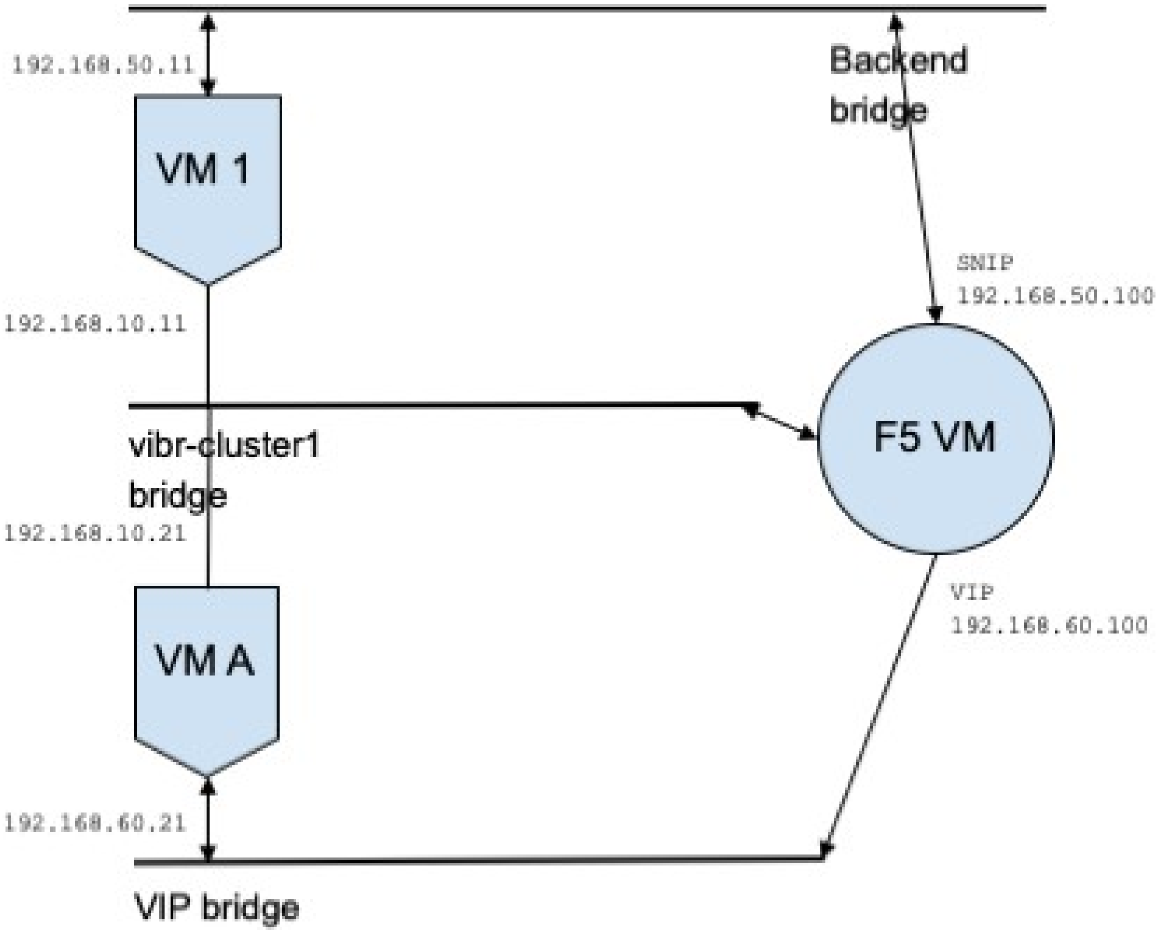
  ```
  user_orchestrator_system/cluster_id eq 1234 and
  user_orchestrator_system/service_healthcheck_startpoint eq db
  ```

- Backend

  A backend cluster for the service is generated when one or more BEs are part of the *lb* scope. This doesn’t apply to the example above, resulting in a backend cluster not being generated in the *lb* scope.

Policies

Figure 328: Policy Generation



Assume we have a service *db* with VIP *192.168.60.100*, SNIP *192.168.50.100*, and a backend VM with IP *192.168.50.11* listening on port 10000. Traffic from client VM *192.168.60.21* to *db* results in the following policies:

- Policy from client to VIP

  The following policy permits from the client VM to service *db*.

```
{
"src": "<uuid of client scope>",
"dst": "<uuid of service cluster>",
"l4_params": [
{
"port": [
10000,
10000
],
"proto": 6,
}
]
}
```

- Policy from SNIP to BE.

  A policy permitting traffic from the SNIP to the BE is autogenerated from configuration, and shows up as a related policy for *db*.

  ```
  {
  "src": "<uuid of SNIP cluster>",
  "dst": "<uuid of be scope>",
  "l4_params": [
  {
  "port": [
  10000,
  10000
  ],
  "proto": 6,
  }
  ]
  ```

  A policy connector from the *lb* scope to the *be* scope pushes the following policy to it.

Consumer	Provider	Port	Protocol	Action
SNIP	be	10000	TCP	Allow

  This generates firewall rules on BE host 192.168.50.11 allowing incoming traffic from LB SNIP 192.168.50.100 on port 10000.

- Policy from HIP to BE.

  A policy permitting traffic from the HIP to the BE is autogenerated from configuration, and shows up as a related policy for *db*.

  ```
  {
  "src": "<uuid of HIP cluster>",
  "dst": "<uuid of be scope>",
  "l4_params": [
  {
  "port": [
  0,
  0
  ],
  "proto": ICMP,
  }
  ]
  }
  ```

  A policy connector from the *lb* scope to the *be* scope pushes the following policy to it.

Consumer	Provider	Port	Protocol	Action
HIP	be	0	ICMP	Allow

  This generates firewall rules on BE host *192.168.50.11* allowing incoming ICMP traffic from LB HIP *192.168.50.2*.

Caveats

- When multiple services from the same load balancer instance have the same name, backend rules generated for any of these services will include backend pools for all of them, i.e. rules will be more permissive than needed.

Policies Publisher

Policies Publisher is an advanced Cisco Secure Workload feature allowing third -party vendor to implement their own enforcement algorithms that are optimized for network appliances such as load balancers or firewalls. This feature is realized by publishing defined policies to a Kafka instance residing within Secure Workload cluster and by providing customers with Kafka client certificates, which allows third-party vendor code to retrieve policies from Kafka and to translate them into their network appliances configuration appropriately.

This section aims to describe the procedure third-party vendors, in short users in the following, must perform to exploit the *Policies Publisher* feature with Java on Linux.

Prerequisites

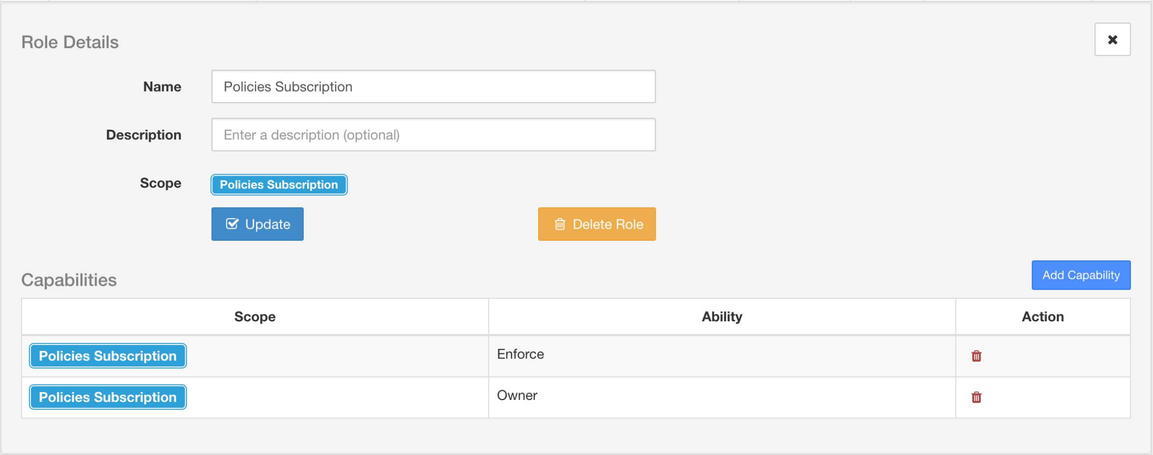
The following software packages are installed on a Linux system, such as Ubuntu 16.04.

- Java 8 JDK
- Apache Kafka Clients: kafka-clients-1.0.0.jar
- Protocol Buffers Core: protobuf-java-3.4.1.jar
- Apache Log4j: log4j-1.2.17.jar
- Simple Logging Facade for Java: slf4j-api-1.7.25.jar, slf4j-log4j12-1.7.25.jar
- Snappy compressor/decompressor for Java: snappy-java-1.1.4.jar

Getting Kafka Client Certificates

- Create a user role with capability *“Owner”* and assign it to a user account of choice:

Figure 329: User Role Configuration to Receive Policies from Kafka



Role Details

Name: Policies Subscription

Description: Enter a description (optional)

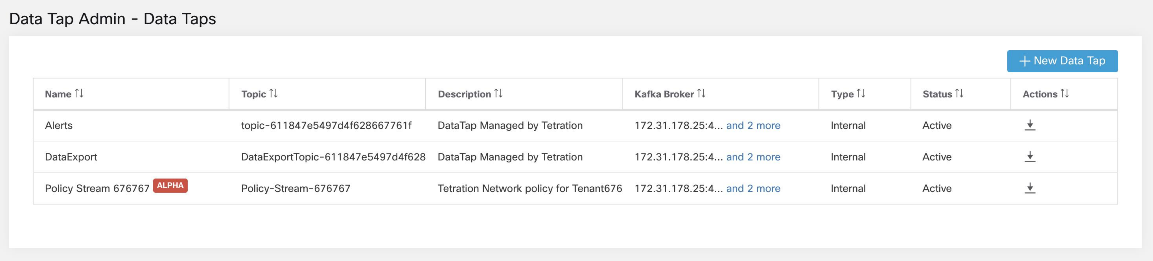
Scope: Policies Subscription

Capabilities

Scope	Ability	Action
Policies Subscription	Enforce	🗑
Policies Subscription	Owner	🗑

- Perform policies enforcement as described in Enforce Policies. This first step is necessary as it creates a Kafka topic that is associated with active scope.
- Navigate to **Manage** > **Data Tap Admin**
- Select the tab *"Data Taps"* and download Kafka client certificates by clicking on the download button under column *"Actions"*. Make sure to select the *Java Keystore* format in the download dialog.

Figure 330: Data Taps View



Data Tap Admin - Data Taps

Name ⇅	Topic ⇅	Description ⇅	Kafka Broker ⇅	Type ⇅	Status ⇅	Actions ⇅
Alerts	topic-611847e5497d4f628667761f	DataTap Managed by Tetration	172.31.178.25:4... and 2 more	Internal	Active	⤓
DataExport	DataExportTopic-611847e5497d4f628	DataTap Managed by Tetration	172.31.178.25:4... and 2 more	Internal	Active	⤓
Policy Stream 676767 ALPHA	Policy-Stream-676767	Tetration Network policy for Tenant676	172.31.178.25:4... and 2 more	Internal	Active	⤓

- The downloaded clients certificates file usually has a name like *Policy-Stream-10-Policies-Subscription.jks.tar.gz*. Create a directory and unpack it underneath the created directory as below:

```
    mkdir Policy-Stream-10-Policies-Subscription
    tar -C Policy-Stream-10-Policies-Subscription -zxf
Policy-Stream-10-Policies-Subscription.jks.tar.gz
```

Protobuf Definition File

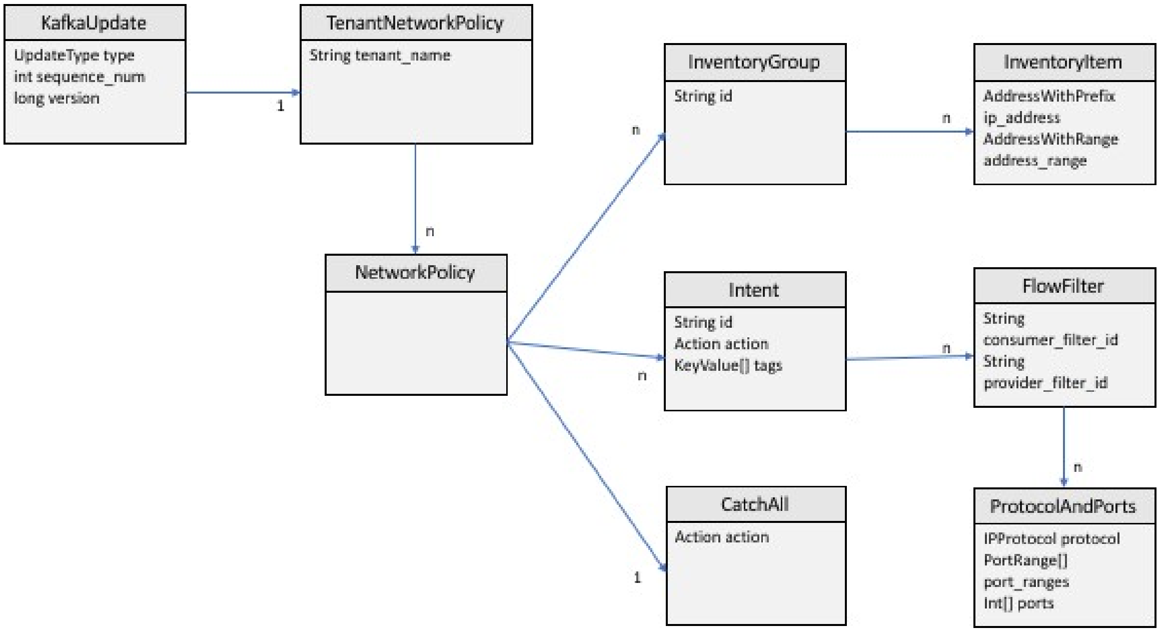
The network policies exposed by Secure Workload backend to Kafka are encoded in Google Protocol Buffers format. Refer to this guide for instructions how to download and install it on your Linux system.

The proto file of Secure Workload network policy can be downloaded from here.

Data Model of Secure Workload Network Policy

Picture below shows a simplified UML diagram of Secure Workload entities exposed to Kafka:

Figure 331: Data Model of Secure Workload Network Policy



A *Secure Workload Network Policy* as modeled in protobuf consists of a list of *InventoryGroups*, a list of *Intents* and a *CatchAll* policy. Each policy contains all the items belonging to one root scope. An *InventoryGroup* contains a list of *InventoryItems*, which represent Secure Workload entities such as servers or appliances by specifying their network address, be it a singular network address, subnet or address range. An *Intent* describes action (allow or deny) to be taken when a network flow matches with the given consumer's *InventoryGroup*, provider's *InventoryGroup* and network protocols and ports. The *CatchAll* represents the catch-all action that is defined for the root scope inside Secure Workload. If no workspace with enforcement enabled exists for the root scope, a default policy of *ALLOW* is written to the produced policy.

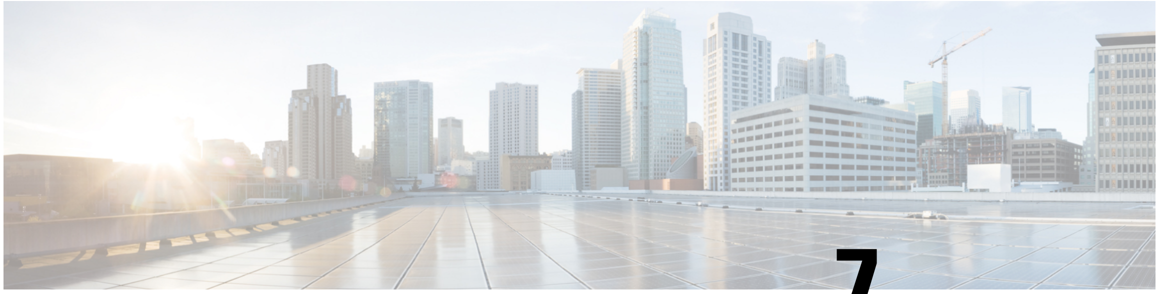
When an enforcement is triggered by the users or by a change of inventory groups, Secure Workload backend sends a full snapshot of defined network policies to Kafka as a sequence of messages that are represented as *KafkaUpdates*. Refer to *KafkaUpdate*'s comments in *tetration_network_policy.proto* file for details how to reconstruct those messages to a full snapshot and how to handle error conditions.

In case *KafkaUpdate* message size is greater than 10MB, Secure Workload backend splits this message into multiple fragments, each of size 10MB. If there is multiple fragments, only the first fragment has the *ScopeInfo* field of *TenantNetworkPolicy*. The *ScopeInfo* will be set to nil in the remaining fragments of *KafkaUpdate* message.

Reference Implementation of Secure Workload Network Policies Client

For implementation and instructions on how to compile and run a demo client, see tnp-enforcement-client in Java.

This implementation provides common code to read network policies from Secure Workload policy stream via Kafka only. Vendor-specific code to program the actual policies to a network device can be plugged in by implementing the required interface PolicyEnforcementClient.



CHAPTER 7

Forensics

The **Forensics** feature set enables monitoring and alerting for possible security incidents by capturing real-time forensic events and applying user-defined rules. Specifically, it enables:

- Defining of rules to specify forensic events of interest
- Defining trigger actions for matching forensic events
- Searching for specific forensic events
- Visualizing event-generating processes and their full lineages

Warning When the **Forensics** feature is enabled, the software agents may consume additional host resources depending on the agent configuration. See the Software Agent Config section.

Compatibility

The forensics signals are reported by the deep visibility agents on all platforms, except Solaris. Currently, only a few forensic signals are supported for AIX. For more information, see the Forensics signals section.

Forensics information is provided through Linux kernel APIs, Audit and syslog, Windows kernel APIs, Windows events, AIX audit system, and others. In general, OS vendors guarantee compatibility within a major release. However, it is possible that APIs could differ slightly across platforms and minor releases, as OS vendors may backport features and fixes. As a result, some forensic event types might not be available on some platforms. Also, the agent does not attempt to recover or enable any OS services that are disabled when the agent starts.

For example, there are number of forensic signals that use the Linux Audit Framework. If forensics are enabled, a deep visibility agent will insert Secure Workload audit rules into the system after the agent starts. The rule insertion requires the system to have the augenrules utility that is installed and /etc/audit/rules.d directory. If any of these prerequisites are not satisfied, Secure Workload audit rules will not be inserted. As a result, Forensics signals including File Access and Raw Socket Creation will not be reported.

If a user has enabled forensics previously and disables it, the agent removes the audit rules that are inserted by Secure Workload. On Red Hat 7.3 and CentOS 7.3, we observed an operating system bug that may impact the rule removal process. The agent removes the audit rules by: 1. Removing the taau.rules in */etc/audit/rules.d/* 2. Running *$service auditd restart*. The OS regenerates the ruleset based on the *audit.rules* and **.rules* files in */etc/audit/rules.d/*. Then auditd will load the rules into the system.

The operating system adds *-D* at the beginning of /etc/audit/rules.d/audit.rules file to clear all the rules before inserting the new ruleset. However, on Red Hat 7.3 and CentOS 7.3 machines the */etc/audit/rules.d/audit.rules* may not have *-D*. This is because the OS creates an empty */etc/audit/rules.d/audit.rules* file if this file does not exist and a default rule file in the subdirectory of */usr/share/doc/audit-<version>/* does not exist either, for example, */usr/share/doc/audit- 2.8.4/rules/10-base-config.rules* is one possible default rule location. The exact OS behavior can be observed from the RPM update script by running *$rpm -qf -scripts /etc/audit/rules.d*

In Linux, some forensics signals rely on the observation of 64-bit system calls. 32-bit Linux system calls are not supported in the current release.

Forensics Signals

The **Forensics** feature must be enabled for software agents to capture and report forensic events. The feature can be enabled in Software Agent Config. For more information, see the Software Agent Config section.

When the **Forensics** feature is enabled, the agent reports the following forensic events.

Signal	Description
Privilege Escalation	Privilege escalations, such as commands executed with sudo.
User Logon	User login events.
User Logon Failed	User login failed attempts.
Shellcode	Suspicious shell executions resembling shellcode attempts.
File Access	Accesses on sensitive files such as password files.
User Account	Adding or removing user accounts.
Unseen Command	New commands that the agent has not seen. Users can use the command anomaly score to tune results based on scope. See Unseen Command for details.
Unseen Library	New library that agent have not seen process that is loaded before.

Signal	Description
Raw Socket Creation	Processes creating raw sockets. For example, port knocking.
Binary Changed	Changes to hash values or modification times of known binaries.
Library Changed	Changes to hash values or modification times of known libraries.
Side Channel	Side channel attack attempts (Meltdown).
Follow User Logon	Descendant processes forked or executed after the login events.
Follow Process	Follow Process events report processes that match user forensic config rules based on process attributes such as binary path, command string, and others.
Network Anomaly	Anomalies in network traffic of the workload, see PCR-Based Network Anomaly Detection for more information.

Table 29: Forensic Signals Supported on AIX

Signal	Description
Privilege Escalation	Privilege escalations, such as commands executed with sudo.
Raw Socket Creation	Processes creating raw sockets. For example, port knocking.
User Account	Adding or removing user accounts.

Privilege Escalation

When the process changes its privilege from low to high, it is considered a Privilege Escalation. In Linux, this means the user-id of the process has changed from non zero to zero. There are legitimate cases such as changing the password for a normal user and other special-purpose binaries such as sudo. This event is currently not available in Windows. Privilege escalation in Windows is typically done through other mechanisms rather than changing the privilege of the process itself, i.e., integrity level. Privilege escalations on Windows are covered by other types of forensics events, such as unseen commands or binary changes.

User Log on

User log on events including SSH, RDP, and other types of logons. Whenever available, sensors captures who, when, and how a user logs in. For example, for SSH in Linux, sensors report username, authentication type (password, public), and source IP.

User Log on Failed

Similar to User Log on events above, sensors report failed attempts to log in with similar information whenever available.

Shellcode

Shellcode events have different interpretations in Linux and Windows. In Linux, sensors identify processes running as interactive shell without a login session or terminal. (There are no good reasons for interactive shell running outside of a login session.) In this release, detection of shellcode events is limited in that it assumes the attack will utilize a shell already available in the system. If an attack uploads new binaries, sensors flag these binaries as either unseen commands or binary changes, if they replace existing binaries. In Windows, every process that is linked with the PowerShell DLL will be labeled as shellcode. Users can create rules to filter out legitimate cases.

File Access

File Access events report accesses to sensitive files, such as password files. In this release, the list of files to be monitored cannot be changed by users. In Linux, the sensor monitors write access to /etc/passwd. Sensor also monitors read and write accesses to /etc/shadow. Windows will not trigger this event in this release.

User Account

User Account events report the creation of local user accounts whenever the information is available.

Unseen Command

Unseen Command events report commands that the sensor has not seen before. Unseen command is defined as an unseen transition/edge from a parent to a child process. For example, assuming a web server (httpd) is executing a CGI script that is called abc.sh, when the sensor sees it for the first time, it will report abc.sh as unseen command. Subsequent executions of abc.sh by the web server will not result in forensic events since the sensor has seen and reported it before. If a service or process never executes any binary, an unseen command event from that service/process indicates a possible compromise. Note that sensors are stateless across restarts, so a previously seen command will be reported again after a sensor restart.

Since 3.4, for SaaS clusters, each Unseen Command event is associated with a command anomaly score ranging from 0.0 to 1.0. The lower the score, the more anomalous the transition is. The command transitions, that is, the tuples (parent command line, command line), are cross-checked for anomalous transitions among those events having the same tuple below:

- The narrowest scopes that the sensor belongs to. For example, the unseen command event is observed on workload W which belongs to the following scope lineages: `Root Scope -> A -> B -> C and Root Scope -> D -> E`. Then, the command is cross-checked among all workloads in scopes C and E (Note that C and E can be either overlapping or nonoverlapping). The anomaly score of the event is the maximum of the anomaly scores of the event regarding those 2 scopes.
- The execution path of the running process.
- The execution path of the parent process.
- The binary hash of the running process.

A score 1.0 means the same command transition having the same tuple `(narrowest scope, execution path, parent execution path, binary hash)` has been seen. A score 0.0 means such command transition with such execution path, parent execution path and binary hash of the running process has never been observed on any hosts within the same scopes. The anomaly score can be used to suppress similar unseen command alerts from firing within the same scope and reduce false positives. See Default Secure Workload Rules for an example of how this score can be used.

Note The anomaly score is only available for SaaS clusters from 3.4 and later.

Unseen Library

Unseen Library events report libraries that the sensor has not seen a process that is loaded before. An unseen library is defined as an unseen pair of binary execution path and library path. For example, an application usually loads a relatively stable list of libraries. An attacker who has access to the machine may restart the application and LD_PRELOAD malicious libraries. When the sensor sees the newly loaded malicious libraries in this application binary execution path for the first time, it reports unseen library events. Subsequent load of the malicious libraries will not result in forensic events since the sensor has seen and reported it before. Legitimate cases include application loads new libraries after upgrade or applications dynamically load new libraries. Note that sensors might report a previously seen library again after restart.

Note that this is an experimental feature and is subject to change in future releases.

Raw Socket Creation

Raw Socket Creation events are only supported on Linux in this release. Raw sockets are typically used to snoop or inject/spoof traffic. There are legitimate uses of raw sockets, such as in diagnosis tools like tcpdump, or when crafting special IP packets like ping or arp. Malicious uses include stealth scans to avoid logging by target/victim machines, malware port knocking, and so on. Secure Workload sensors also create raw sockets for collecting flow-related information. (For consistency, sensors do not suppress events that are triggered by their own flow information collection.)

Binary Changed

Binary Changed events report changes to the file contents and attributes of binaries for running processes. Sensors record the file attributes of every running process. If a process runs a binary at the same path, but with different file attributes (ctime, mtime, size, or hash), the sensor flags the process as a binary change. Legitimate cases include application upgrade.

Library Changed

Library Changed events report changes to the file contents and attributes of libraries for running processes. Sensors record the file attributes of loaded libraries. If a process loads a library at the same path, but with different file attributes (ctime, mtime, size, or hash), the sensor will flag the process with a library change. Legitimate cases include library upgrade.

Note that this is an experimental feature and is subject to change in future releases.

Side Channel

Side Channel events report running software that exploits side channel vulnerabilities. This release provides one side channel detection capability on selected Linux platform: Meltdown. See the details below for supported machine configurations. These are advanced security features and therefore disabled by default. Users should expect to see increased CPU usage when side channel reporting is enabled. The CPU quota that is configured in the UI will still be honored. If the forensic collection subprocess of the sensor determines that its CPU usage is too high for too long, it shuts down, and the parent sensor process will restart it with a small delay. Enabling this feature on old or unsupported kernels could lead to system instability. Testing in similar nonproduction environments is recommended.

This feature can be turned on/off from the agent config page in the UI and they can be turned on/off in each agent config profile.

Meltdown is a side channel attack that abuses the speculative execution and cache features in the CPU (https://meltdownattack.com/). It allows an attacker to read privileged-domain data from an unprivileged domain, for example, reading kernel memory from a user space application without ring 0 privileges. Meltdown detection currently supports CentOS 7 and Ubuntu 16.04.

Follow User Logon

Follow User Logon events report descendant processes (up to 4 levels) that are executed after a User Logon event process (SSH, RDP, and so on.). Processes reported under this Follow User Logon event are for auditing purposes and not necessary having any security events.

Follow Process

Follow Process events report processes that match user forensic config rules based on process attributes such as binary path, command string, and so on. Processes that are reported under this Follow Process event are for auditing purposes and not necessary having any security events.

Example 1: Report processes that are run by cmd.exe or powershell.exe

Event Type = Follow Process AND (Process Info - Exec Path contains cmd.exe OR Process Info - Exec Path contains powershell.exe)

Example 2: Report any processes which are created by winword.exe or excel.exe or powerpnt.exe.

Event Type = Follow Process with_ancestor (Process Info - Exec Path contains winword.exe OR Process Info - Exec Path contains excel.exe OR Process Info - Exec Path contains powerpnt.exe)

Note: Follow Process events can be tracked by one of the following process signals:

- Process Info - Exec Path
- Process Info - Command String
- Process Info - Username
- Follow Process - Parent Exec Path
- Follow Process - Parent Command String
- Follow Process - Parent Username

Forensic Configuration

Forensics feature uses intent-based configuration. Intents specify how to apply forensic profiles to inventory filters. Forensic profile consists of multiple forensic rules. Profiles in an intent are applied in order from top to bottom.

Forensic Rules

Note The maximum number of rules per root scope is 100.

Adding a Forensic Rule

This section explains how to add new forensic rules.

Before You Begin

You must login as **Site Admin**, **Customer Support** or **Scope Owner** in the system.

Procedure

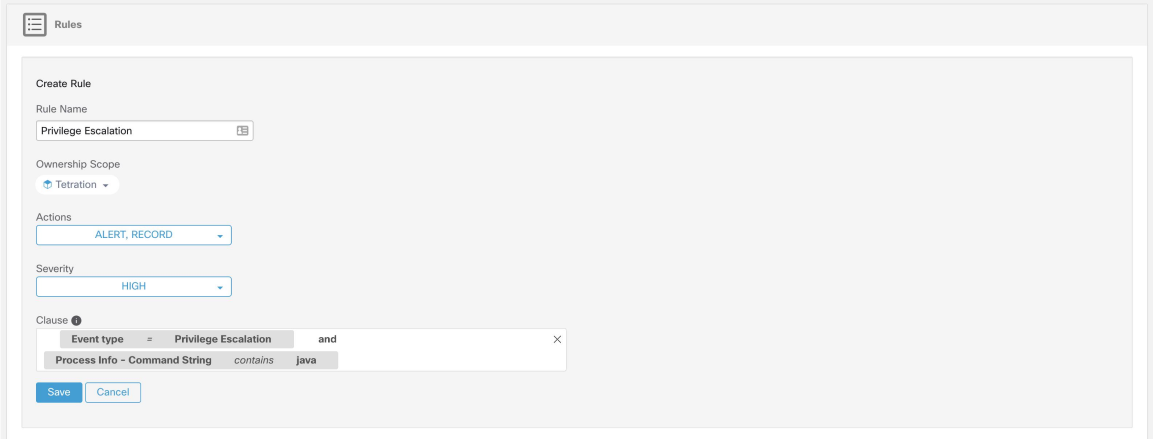
Step 1 In the navigation bar on the left, click **Defend** > **Forensic Rules**.

Step 2 Click **Create Rule**.

Step 3 Enter the appropriate values in the following fields.

Field	Description
Rule Name	Enter a name for the rule. Name cannot be empty.
Ownership scope	Enter an ownership scope for this rule.
Actions	Select actions when this rule is triggered. **Record** means matching security events persist for further analysis. **Alert** action means to publish matching security events to Secure Workload Alert system.
Severity	Select severity level of this rule: **LOW**, **MEDIUM**, **HIGH**, **CRITICAL** or **REQUIRES IMMEDIATE ACTION**
Clause	Enter a rule clause. A clause must contain security event signals from either a process forensic event or a workload event. A clause is invalid if it contains both process and workload signals.

Figure 332: Create rule



Rules

Create Rule

Rule Name: Privilege Escalation

Ownership Scope: Tetration

Actions: ALERT, RECORD

Severity: HIGH

Clause: Event type = Privilege Escalation and Process Info - Command String *contains* java

Step 4 Click **Save**.

Basic Forensic Rule Composition

A forensic rule must contain **exactly one** forensic event type (for example, **Event Type == Unseen Command**). The following optional clauses uses attributes of that event (for example, **Unseen Command - Parent Uptime**).

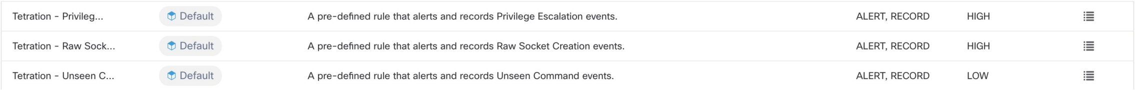
Below is an example of using **Unseen Command** event type. For more examples, see the default rules and MITRE rules.

EventType = Unseen Command and Unseen Command - Parent Uptime (microseconds) >= 60000000.

Default Secure Workload Rules

Default Secure Workload rules are provided to help the users to construct rules that are meaningful in their environment. These rules are displayed in the forensic config page and they are not editable. The rules are available in all root scopes.

Figure 333: Default Rules



Tetration - Privileg...	Default	A pre-defined rule that alerts and records Privilege Escalation events.	ALERT, RECORD	HIGH
Tetration - Raw Sock...	Default	A pre-defined rule that alerts and records Raw Socket Creation events.	ALERT, RECORD	HIGH
Tetration - Unseen C...	Default	A pre-defined rule that alerts and records Unseen Command events.	ALERT, RECORD	LOW

This release contains four Secure Workload forensic rules:

1. **Name** Secure Workload - Privilege Escalation

   Clause EventType = Privlege Escalation and (**ProcessInfo - ExecPath** *doesn't contain* **sudo and ProcessInfo - ExecPath** *doesn't contain* **ping and Privilege Escalation Is≠ Type - Suid Binary**)

   Description. This rule reports privilege escalation events that are not generated by setuid binaries. To reliably filter out the setuid binaries, it also filters out **sudo** and **ping** based on "ProcessInfo - ExecPath". Secure Workload users can also filter out other setuid binaries by defining their own rules.

2. **Name** Tetration - Unseen Command

Clause EventType = Unseen Command and Unseen Command - Parent Uptime (microseconds) >= 60000000 or ProcessInfo - ExecPath *contains* **/bash or ProcessInfo - ExecPath** *contains* **/sh or ProcessInfo - ExecPath** *contains* **/ksh or Parent - ExecPath** *contains* **httpd or Parent - ExecPath** *contains* **apache or Parent - ExecPath** *contains* **nginx or Parent - ExecPath** *contains* **haproxy**

Description. This rule reports unseen command events that match one of the following criteria:

a. Process parent is alive for more than **60,000,000** microseconds.

b. Process ExecPath contains some type of shell, for example, **/bash**, **/sh**, and **/ksh**.

c. Process parent ExecPath contains some type of server application, for example, **httpd**, **apache**, **nginx**, and **haproxy**.

3. **Name** Tetration - Raw Socket

Clause EventType = Raw Socket Creation and (Raw Socket - ExecPath *doesn't contain* **ping and Raw Socket - ExecPath** *doesn't contain* **iptables and Raw Socket - ExecPath** *doesn't contain* **xtables-multi**)

Description This rule reports raw socket creation events that are not generated by **ping** and **iptables**. Secure Workload users can also filter out other binaries by defining their own rules.

4. **Name** Tetration - Network Anomaly with Unseen Command

Clause EventType = Network Anomaly and Network Anomaly - Unseen Command Count > 3 and Network Anomaly - Non-seasonal Deviation > 0

Description This rule reports network anomaly events that match the following criteria:

a. There are more than 3 Unseen Command events on the same workload within 15 minutes.

b. The Rule Attributes is greater than 0 (which also means it is greater than or equal to 6.0 because 6.0 is the minimum reported deviation for all network anomaly events).

5. **Name** Tetration - Anomalous Unseen Command

Clause EventType = Unseen Command and Unseen Command - Anomaly - Score < 0.6

Description This rule reports unseen command events whose anomaly score is less than 0.6. This means only highly anomalous events whose commands do not look similar to previously observed commands are reported. The threshold 0.6 is decided based on Secure Workload's experiments on how similar commands are at different thresholds. See Unseen Command for a detailed explanation of the score.

6. **Name** Tetration - Unusual Parent of smss

Clause EventType = Follow Process and ProcessInfo - ExecPath *contains* **smss.exe and (Follow Process - ParentExecPath** *doesn't contain* **smss.exe and Follow Process - ParentExecPath** *doesn't contain* **System**)

Description This rule is specific for windows. This rule alerts if smss.exe has a parent that is different from another instance of smss.exe or the System process.

7. **Name** Tetration - Unusual Parent of wininit

Clause EventType = Follow Process and ProcessInfo - ExecPath *contains* **wininit.exe and Follow Process - ParentExecPath** *doesn't contain* **smss.exe**

Description This rule is specific for windows. This rule alerts if wininit.exe has a parent that is different from smss.exe.

8. **Name** Tetration - Unusual Parent of RuntimeBroker

   Clause EventType = Follow Process and ProcessInfo - ExecPath *contains* **RuntimeBroker.exe and Follow Process - ParentExecPath** *doesn't contain* **svchost.exe**

   Description This rule is specific for windows. This rule alerts if RuntimeBroker.exe has a parent that is different from svchost.exe.

9. **Name** Tetration - Unusual Parent of services

   Clause EventType = Follow Process and ProcessInfo - ExecPath *contains* **services.exe and Follow Process - ParentExecPath** *doesn't contain* **wininit.exe**

   Description This rule is specific for windows. This rule alerts if services.exe has a parent that is different from wininit.exe.

10. **Name** Tetration - Unusual Parent of lsaio

    Clause EventType = Follow Process and ProcessInfo - ExecPath *contains* **lsaio.exe and Follow Process - ParentExecPath** *doesn't contain* **wininit.exe**

    Description This rule is specific for windows. This rule alerts if lsaio.exe has a parent that is different from wininit.exe.

11. **Name** Tetration - Unusual Child of lsass

    Clause (EventType = Follow Process and ProcessInfo - ExecPath *doesn't contain* **efsui.exe and ProcessInfo - ExecPath** *doesn't contain* **werfault.exe**) **with ancestor Process Info - ExecPath** *contains* **lsass.exe**

    Description This rule is specific for windows. This rule alerts if lsass.exe has any descendants that are not efsui.exe or werfault.exe.

Default MITRE ATT&CK Rules

Default MITRE ATT&CK rules are provided to alert techniques from the MITRE ATT&CK Framework (https://attack.mitre.org/). There are 24 rules pertaining to adversarial behaviour and most of them are mapped to a particular MITRE technique. The complete list of the rules is below.

1. **Name** Suspicious MS Office behavior

   Clause (Event type = Follow Process and (Process Info - Exec Path doesn't contain **Windowssplwow64.exe) and (Process Info - Exec Path** *doesn't contain* **chrome.exe) and (Process Info - Exec Path** *doesn't contain* **msip.executionhost.exe) and (Process Info - Exec Path** *doesn't contain* **msip.executionhost32.exe) and (Process Info - Exec Path** *doesn't contain* **msosync.exe) and (Process Info - Exec Path** *doesn't contain* **ofccccaupdate.exe) with ancestor (Process Info - Exec Path** *contains* **winword.exe or Process Info -Exec Path** *contains* **excel.exe or Process Info -Exec Path contains powerpnt.exe)**

   Description This rule alerts and records if Microsoft Office processes (WIN-WORD.exe/EXCEL.exe/POWERPNT.exe) create any child processes. Based on our research we have allowed a few common child processes known to be created by these MS Office binaries, to reduce the number of false positives.

2. **Name** T1015 - Accessibility features 1

   Clause Event type = Follow Process (Process Info - Exec Path *contains* **cmd.exe or Process Info -Exec Path** *contains* **powershell.exe or Process Info - Exec Path** *contains* **cscript.exe or Process**

Info - Exec Path *contains* **wscript.exe) and (Follow Process - Parent Exec Path** *contains* **winlogon.exe or Follow Process - Parent Exec Path** *contains* **atbroker.exe or Follow Process - Parent Exec Path** *contains* **utilman.exe**)

Description This rule alerts and records if any of the Accessibility features binaries (On-screen Keyboard, Magnifier, Sticky keys, and so on.) are abused and are tricked into opening cmd/powershell/cscript/wscript. The invocation of accessibility binaries is controlled by either winlogon, atbroker or utilman processes depending on from where they are invoked (from the logon screen or after a user logs in). This rule captures suspicious child processes (cmd.exe, pow- ershell.exe, cscript.exe, wscript.exe) of the accessibility processes (winlogon.exe, utilman.exe and atbroker.exe). Use this with **T1015 - Accessibility features 2** to also catch the additional child processes of these four suspicious child processes**.

3. **Name** T1015 - Accessibility features 2

   Clause Event type = Follow Process with ancestor ((Process Info - Exec Path *contains* **cmd.exe or Process Info - Exec Path** *contains* **powershell.exe or Process Info - Exec Path** *contains* **cscript.exe or Process Info - Exec Path** *contains* **wscript.exe) and (Follow Process - Parent Exec Path** *contains* **winlogon.exe or Follow Process - Parent Exec Path** *contains* **atbroker.exe or Follow Process - Parent Exec Path** *contains* **utilman.exe))**

   Description This rule alerts and records if any of the Accessibility features binaries (On-screen Keyboard, Magnifier, Sticky keys, and so on.) are abused and are tricked into opening cmd.exe/powershell.exe/cscript.exe/wscript.exe. The invocation of accessibility binaries is controlled by either winlogon, atbroker or utilman processes depending on from where they are invoked (from the logon screen or after a user logs in). This rule captures child processes of the suspicious child processes of these processes (winlogon, utilman and atbroker). One should use this with **T1015 - Accessibility features 1** which alerts the suspicious child processes of accessibility binaries.

4. **Name** T1085 - rundll32

   Clause (Event type = Follow Process and Process Info Exec Path *doesnt contain* **msiexec.exe and Process Info Exec Path** *does not contain* **WindowsSystem32SystemPropertiesRemote.exe with ancestor (Process Info - Exec Path** *contains* **rundll32.exe and Follow Process - Parent Exec Path** *does not contain* **msiexec.exe and not (Process Info -command string** *contains* **Windowssystem32shell32.dll or (Process Info -command string** *contains* **Windowssyswow64shell32.dll or (Process Info -command string** *contains* **WindowsSystem32migrationWinInetPlugin.dll))**

   Description This rule alerts and records if rundll32.exe creates child processes. This binary can be called to execute arbitrary binary/dll or used by control.exe to install malicious control panel items. However, we have allowed if msiexec.exe is either the parent or the descedant of rundll32.exe. We have also permitted some of the common rundll32 commands that make use of well-known dlls.

5. **Name** T1118 - InstallUtil

   Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **installutil.exe**

   Description This rule alerts and records if InstallUtil.exe creates child processes.

6. **Name** T1121 - Regsvcs/Regasm

   Clause Event type = Follow Process and (Process Info - Exec path *does not contain* **fondue.exe or Process Info - Exec path** *does not contain* **regasm.exe or Process Info - Exec path** *does not contain* **regsvr32.exe with ancestor (Process Info - Exec Path** *contains* **regasm.exe or Process Info - Exec Path** *contains* **regsvcs.exe)**

Description This rule alerts and records if regsvcs.exe or regasm.exe create child processes. However, we have permitted if fondue.exe/regasm.exe/regsvr32.exe is spawned by regasm.exe or regsvcs.exe to reduce the number of false positives.

7. **Name** T1127 - Trusted Developer Utilities - msbuild.exe

   Clause (Event type = Unseen Command with ancestor Process Info - Exec Path *contains* **MSBuild.exe) and (Process Info - Exec Path** *does not contain* **Tracker.exe) and (Process Info -Exec Path** *doesn't contain* **csc.exe) and (Process Info - Exec Path** *does not contain* **Microsoft Visual Studio) and (Process Info - Exec Path** *does not contain* **al.exe) and (Process Info - Exec Path** *does not contain* **lc.exe) and (Process Info - Exec Path** *does not contain* **dotnet.exe) and (Process Info - Exec Path** *does not contain* **cvtres.exe) and (Process Info - Exec Path** *does not contain* **conhost.exe) and not (Event type = Unseen Command with ancestor (Process Info - Exec Path** *contains* **Tracker.exe or Process Info - Exec Path** *contains* csc.exe or Process Info - Exec Path *contains* **Microsoft Visual Studio or Process Info - Exec Path** *contains* **al.exe or Process Info - Exec Path** *contains* **lc.exe or Process Info - Exec Path** *contains* **dotnet.exe or Process Info - Exec Path** *contains* **cvtres.exe))**

   Description This rule alerts and records if msbuild.exe creates child processes which do not belong to an allowlist of child processes it usually creates. This rule is currently Unseen Command based, as opposed to Follow Process, since Follow Process does not yet support allowing process subtrees. The current rule allows the following processes and their descedants: Tracker.exe, csc.exe, any process from "Microsoft Visual Studio" path, al.exe, lc.exe, dotnet.exe and cvtres.exe. The rule also allows conhost.exe. These processes can be seen during regular usage of MSBuild.exe (for example, compiling a project via Visual Studio). All the other descendants (not usual behavior) of MSBuild.exe are alerted.

8. **Name** T1127 - Trusted Developer Utilities - rcsi.exe

   Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **rcsi.exe**

   Description This rule alerts and records if rcsi.exe creates child processes.

9. **Name** T1127 - Trusted Developer Utilities - tracker.exe

   Clause (Event type = Unseen Command with_ancestor Process Info - Exec Path *contains* **tracker.exe) and not (Event type = Unseen Command with_ancestor Process Info - Exec Path** *contains* **MSBuild.exe)**

   Description This rule alerts and records if tracker.exe creates child processes and tracker itself is not a descendant of MSBuild.exe. Thus legitimate invocations of tracker via Visual Studio are approved, but other invocations are alerted. One limitation with the Tracker.exe and the previous MSBuild.exe rules is that if an attacker uses MSBuild technique to create Tracker, and then make Tracker create a malicious child, it would not be alerted by either of the rules since Tracker having MSBuild as an ancestor is considered legitimate.

10. **Name** T1128 - Netsh Helper Dll

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **netsh.exe**

    Description This rule alerts and records if netsh.exe creates child processes.

11. **Name** T1136 - Create Account

    Clause Event type = User Account

    Description This rule alerts and records if a new user is created.

12. **Name** T1138 - Application Shimming

Clause Event type = Follow Process Process Info - Exec Path *contains* **sdbinst.exe**

Description This rule alerts and records if sdbinst.exe is invoked.

13. **Name** T1180 - Screensaver

    Clause Event type = Follow Process AND with ancestor Process Info - Exec Path *contains* **.scr**

    Description This rule alerts and records if a process is created with ".scr" in the exec path.

14. **Name** T1191 - CMSTP

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **cmstp.exe**

    Description This rule alerts and records if cmstp.exe creates child processes.

15. **Name** T1202 - Indirect Command Execution - forfiles.exe

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **forfiles.exe**

    Description This rule alerts and records if forfiles.exe creates child processes.

16. **Name** T1202 - Indirect Command Execution - pcalua.exe

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **pcalua.exe**

    Description This rule alerts and records if pcalua.exe creates child processes.

17. **Name** T1216 - Signed Script Proxy Execution - pubprn.vbs

    Clause Event type = Follow Process with ancestor ((Process Info - Exec Path *contains* **cscript.exe or Process Info - Exec Path** *contains* **wscript.exe) and Process Info - Command String** *contains* **.vbs and Process Info - Command String** *contains* **script)**

    Description This rule alerts and records if any vbs script is run using wscript.exe or cscript.exe, to create a new process, with a parameter "script". This technique could be used by an attacker to execute pubprn.vbs with a script parameter pointing to a malicious sct file which then gives code execution.

18. **Name** T1218 - Signed Binary Proxy Execution - msiexec.exe

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **msiexec.exe**

    Description This rule alerts and records if msiexec.exe creates child processes.

19. **Name** T1218 - Signed Binary Proxy Execution - odbcconf.exe

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **odbcconf.exe**

    Description This rule alerts and records if odbcconf.exe creates child processes.

20. **Name** T1218 - Signed Binary Proxy Execution - Register-CimProvider

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **Register-CimProvider.exe**

    Description This rule alerts and records if Register-CimProvider.exe creates child processes.

21. **Name** T1220 - XSL Script Processing - msxsl.exe

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **msxsl.exe**

    Description This rule alerts and records if msxsl.exe creates child processes.

22. **Name** T1220 - XSL Script Processing - wmic

Clause Event type = Follow Process and (Process Info - Exec Path *contains* **wmic.exe and Process Info - Command String** *contains* **.xsl**)

Description This rule alerts and records if an xsl script is used by wmic. This can be used to launch arbitrary binaries.

23. **Name** T1223 - Compiled HTML Files

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **hh.exe**

    Description This rule alerts and records if hh.exe creates child processes.

24. **Name** T1003 - Credential Dumping - Lsass

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **procdump.exe and Process Info - Command String** *contains* **lsass**

    Description This rule alerts and records if procdump.exe is used to dump the memory of lsass processes.

25. **Name** T1140 - Deobfuscate/Decode Files or Information

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **certutil.exe and (Process Info - Command String** *matches* **.*encode\s.* or Process Info - Command String** *matches* **.*decode\s.***

    Description This rule alerts and records if certutil.exe is used to either encode or decode a file. This technique is often used by attackers to decode their encoded payload on the victim machine.

26. **Name** T1076 - Remote Desktop Protocol

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **tscon.exe**

    Description This rule alerts and records if tscon.exe is executed. Attackers can use tscon.exe to hijacking existing RDP sessions.

27. **Name** T1197 - BITS Jobs - Powershell

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **powershell.exe and Process Info - Command String** *contains* **Start-BitsTransfer**

    Description This rule alerts and records if the powershell.exe is used to run the cmdlet Start-BitsTransfer to copy/move files.

28. **Name** T1170 - MSHTA

    Clause Event type = Follow Process with ancestor Process Info - Exec Path *contains* **mshta.exe**

    Description This rule alerts and records if mshta.exe is used to run malicious HTA scripts that spawn child processes.

29. **Name** T1158 - Hidden Files and Directories

    Clause Event type = Follow Process and (Process Info - Exec Path *contains* **attrib.exe and Process Info - Command String** *contains* **+h)**

    Description This rule alerts and records if attrib.exe is used to set a file/directory as hidden.

30. **Name** T1114 - Email Collection

    Clause Event type = Follow Process (Process Info - Command String *matches* **.*.(ost|pst)(\s|"|’).* or Process Info - Command String** *matches* **.*.(ost|pst)$) Process Info - Exec Path** *doesn’t contain* **outlook.exe**

Description This rule alerts and records if email files (.ost and .pst) are accessed from any other process other than outlook.exe.

31. **Name** T1070 - Indicator Removal on Host - Event Log

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **wevtutil.exe and Process Info - Command String** *matches* **.*\s(cl|clear-log)\s.***

    Description This rule alerts and records if wevtutil.exe is used to clear event logs.

32. **Name** T1070 - Indicator Removal on Host - USN

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **fsutil.exe and Process Info - Command String** *matches* **.*\susn\s.* and Process Info - Command String** *matches* **.*\sdeletejournal.***

    Description This rule alerts and records if fsutil.exe is used to delete USN journals.

33. **Name** T1053 - Scheduled Task

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **schtasks.exe and Process Info - Command String** *contains* **create**

    Description This rule alerts and records if schtasks.exe is used to create new scheduled tasks.

34. **Name** T1003 - Credential Dumping - Vaultcmd

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **vaultcmd.exe and Process Info - Command String** *matches* **.*\/list.***

    Description This rule alerts and records if vaultcmd.exe is used access Windows Credentials vault.

35. **Name** T1003 - Credential Dumping - Registry

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **reg.exe and ((Process Info - Command String** *contains* **save or Process Info - Command String** *contains* **export) and (Process Info - Command String** *contains* **hklm or Process Info - Command String** *contains* **hkey_local_machine) and (Process Info - Command String** *contains* **sam or Process Info - Command String** *contains* **security or Process Info - Command String** *contains* **system))**

    Description This rule alerts and records if reg.exe is used dump certain registry hives.

36. **Name** T1201 - Password Policy Discovery 1

    Clause Event type = Follow Process and Process Info - Exec Path *contains* **chage and Process Info - Command String** *contains* **-l**

    Description This rule alerts and records if chage utility is used to list the password policy (password age policy) on a linux machine.

37. **Name** T1081 - Credentials in Files - Linux

    Clause Event type = Follow Process and (Process Info - Exec Path *contains* **cat or Process Info - Exec Path** *contains* **grep) and (Process Info - Command String** *contains* **.bash_history or Process Info - Command String** *contains* **.password or Process Info - Command String** *contains* **.passwd)**

    Description This rule alerts and records if attempts are made to search for passwords stored in files on a linux machine.

38. **Name** T1081 - Credentials in Files - Windows

Clause Event type = Follow Process and Process Info - Exec Path *contains* **findstr.exe and Process Info - Command String** *contains* **password**

Description This rule alerts and records if attempts are made to search for passwords stored in files on a windows machine.

39. **Name** T1089 - Disabling Security Tools

    Clause Event type = Follow Process and ((Process Info - Exec Path *contains* **fltmc.exe and Process Info - Command String** *contains* **unload sysmon) or (Process Info - Exec Path** *contains* **sysmon.exe and Process Info - Command String** *contains* **/u))**

    Description This rule alerts and records if attempts are made to unload sysmon driver using fltmc.exe or sysmon.exe

Forensic profiles

Add a Profile

This section explains how to add new forensic profiles.

Before You Begin

You must log in as **Site Admin**, **Customer Support** or **Scope Owner** in the system.

Procedure

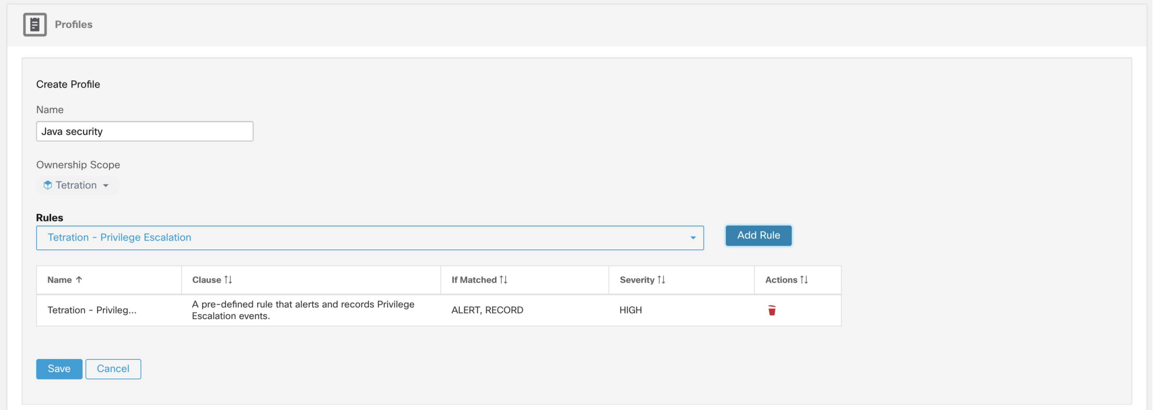
Step 1 In the navigation bar on the left, click **Defend** > **Forensic Rules**.

Step 2 Click **Create Profile**.

Step 3 Enter the appropriate values in the following fields.

Field	Description
Name	Enter a name for the profile. Name cannot be empty.
Ownership scope	Enter an ownership scope for this profile.
Rules	Add rules into this profile.

Figure 334: Create Profile



Create Profile

Name: Java security

Ownership Scope: Tetration

Rules: Tetration - Privilege Escalation

Name ↑	Clause ↑↓	If Matched ↑↓	Severity ↑↓	Actions ↑↓
Tetration - Privileg...	A pre-defined rule that alerts and records Privilege Escalation events.	ALERT, RECORD	HIGH	🗑

Step 4 Click **Save**.

Edit a Profile

This section explains how a user edit forensic profiles.

Before You Begin

You must login as **Site Admin**, **Customer Support** or **Scope Owner** in the system.

Procedure

Step 1 In the navigation bar on the left, click **Defend** > **Forensic Rules**.

Step 2 Find the profile you want to edit and click the **pencil** icon in the column on the right.

Step 3 Enter the appropriate values in the following fields.

Field	Description
Name	Update a name for the profile. Name cannot be empty.
Ownership scope	Update an ownership scope for this profile.
Rules	Add/remove rules into this profile.

Step 4 Click **Save**.

Clone a Profile

This section explains how a user clones forensic profiles.

Procedure

Step 1 In the navigation bar on the left, click **Defend** > **Forensic Rules**.

Step 2 Find the profile that you want to clone and click the **clone** icon in the column on the right.

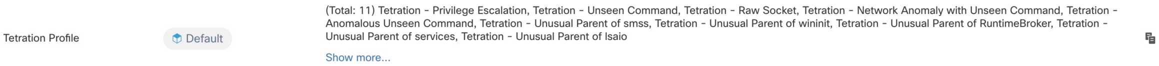
Step 3 Enter the name for the cloned profile.

Step 4 Click **Save**.

Default Profile - Secure Workload Profile

The Secure Workload profile contains 11 default forensic rules and can be added to intents. It is not editable by the user but it can be cloned. The cloned default forensic profile is editable.

Figure 335: Default profiles



Tetration Profile

Default

(Total: 11) Tetration - Privilege Escalation, Tetration - Unseen Command, Tetration - Raw Socket, Tetration - Network Anomaly with Unseen Command, Tetration - Anomalous Unseen Command, Tetration - Unusual Parent of smss, Tetration - Unusual Parent of wininit, Tetration - Unusual Parent of RuntimeBroker, Tetration - Unusual Parent of services, Tetration - Unusual Parent of Isaio

Show more...

Default Profile - MITRE ATT&CK Profile

The MITRE ATT&CK Profile contains 39 MITRE ATT&CK rules and can be added to intents. It is not editable by the user but it can be cloned. The cloned profile is editable. MITRE ATT&CK Profile includes the following rules:

1. Suspicious MS Office behavior
2. T1015 - Accessibility features 1
3. T1015 - Accessibility features 2
4. T1085 - rundll32
5. T1118 - InstallUtil
6. T1121 - Regsvcs/Regasm
7. T1127 - Trusted Developer Utilities - msbuild.exe
8. T1127 - Trusted Developer Utilities - rcsi.exe
9. T1127 - Trusted Developer Utilities - tracker.exe
10. T1128 - Netsh Helper Dll
11. T1136 - Create Account
12. T1138 - Application Shimming
13. T1180 - Screensaver
14. T1191 - CMSTP
15. T1202 - Indirect Command Execution - forfiles.exe
16. T1202 - Indirect Command Execution - pcalua.exe
17. T1216 - Signed Script Proxy Execution - pubprn.vbs

18. T1218 - Signed Binary Proxy Execution - msiexec.exe
19. T1218 - Signed Binary Proxy Execution - odbcconf.exe
20. T1218 - Signed Binary Proxy Execution - Register-CimProvider
21. T1220 - XSL Script Processing - msxsl.exe
22. T1220 - XSL Script Processing - wmic
23. T1223 - Compiled HTML Files
24. T1003 - Credential Dumping - Lsass
25. T1140 - Deobfuscate/Decode Files or Information
26. T1076 - Remote Desktop Protocol
27. T1197 - BITS Jobs - Powershell
28. T1170 - MSHTA
29. T1158 - Hidden Files and Directories
30. T1114 - Email Collection
31. T1070 - Indicator Removal on Host - Event Log
32. T1070 - Indicator Removal on Host - USN
33. T1053 - Scheduled Task
34. T1003 - Credential Dumping - Vaultcmd
35. T1003 - Credential Dumping - Registry
36. T1201 - Password Policy Discovery 1
37. T1081 - Credentials in Files - Linux
38. T1081 - Credentials in Files - Windows
39. T1089 - Disabling Security Tools

Forensic visualization

Accessing Forensic Page

This section explains how to access forensic page.

Before You Begin

You must log in as **Site Admin**, **Customer Support** or **Scope Owner** in the system.

Procedure

Step 1 Click on **Security** link on the left panel.

Step 2 Click on **Forensics** item. Forensic page appears.

Figure 336: Security Forensic

Browsing Forensic Events

This section explains how to browse matching forensic events.

Before You Begin

You must log in as **Site Admin**, **Customer Support** or **Scope Owner** in the system and navigate to the forensic page.

Procedure

Step 1 Choose a specific range in the **Time Range Picker** at the top of the page.

Step 2 Select **Severity** drop-down.

Step 3 In **Filters**, enter filters for matching forensic events and click on **Filter Forensic Events**.

Step 4 Table of matching forensic events is updated, according to the selected time range, severity, and filters.

Note Forensic events are visible under the root scope level and will not be visible upon switching to sub/child scopes.

Inspecting a Forensic Event

This section explains how to inspect forensic events.

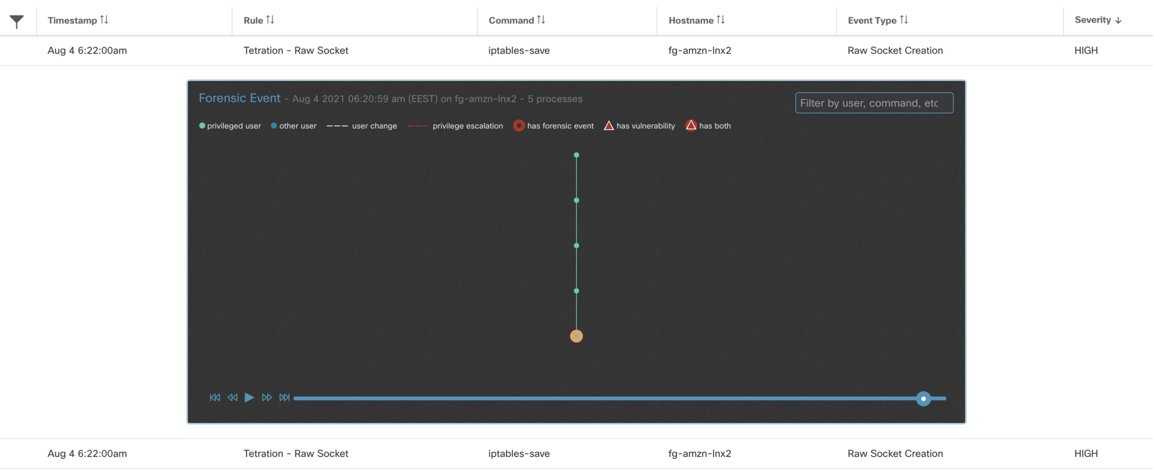
Before You Begin

You must log in as **Site Admin**, **Customer Support** or **Scope Owner (Root Scope)** in the system.

Procedure

Step 1 Click on the event to be inspected. The **Process detail** pane appears.

Figure 337: Forensic Event Table

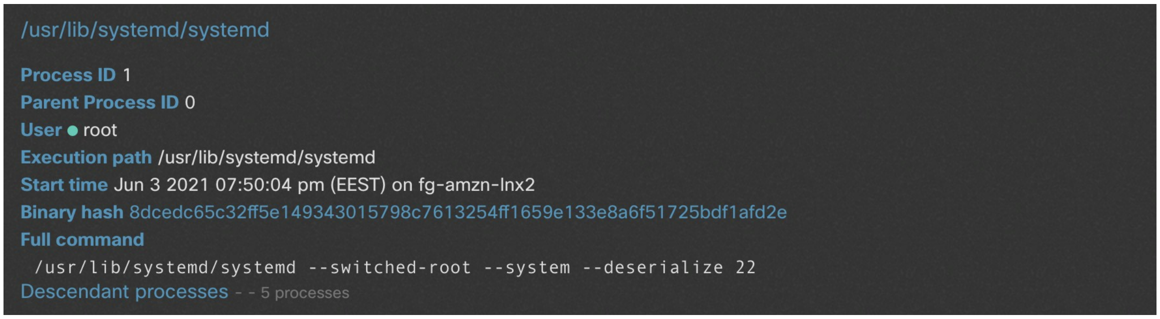


Timestamp ⇅	Rule ⇅	Command ⇅	Hostname ⇅	Event Type ⇅	Severity ↓
Aug 4 6:22:00am	Tetration - Raw Socket	iptables-save	fg-amzn-lnx2	Raw Socket Creation	HIGH
Aug 4 6:22:00am	Tetration - Raw Socket	iptables-save	fg-amzn-lnx2	Raw Socket Creation	HIGH

Forensic Event - Aug 4 2021 06:20:59 am (EEST) on fg-amzn-lnx2 - 5 processes

Step 2 On lineage tree, click on process to be inspected for details.

Figure 338: Forensic Process Details



/usr/lib/systemd/systemd

Process ID 1
Parent Process ID 0
User ● root
Execution path /usr/lib/systemd/systemd
Start time Jun 3 2021 07:50:04 pm (EEST) on fg-amzn-lnx2
Binary hash 8dcedc65c32ff5e149343015798c7613254ff1659e133e8a6f51725bdf1afd2e
Full command

```
 /usr/lib/systemd/systemd --switched-root --system --deserialize 22
```

Descendant processes - - 5 processes

Fields Displayed in Forensic Events

Each Forensic Event has several fields which provide useful data. There are a few fields common to all the different types of forensic events, and there are a few fields unique to a particular forensic event.

Below is a list of the fields that are part of the UI. The first table describes the fields common to all forensics event, followed by a table that describes process information that is displayed with each alert and then the tables with unique fields per forensic event. Some of the fields may be present in multiple tables, because of the way the data is stored and exported.

Common Fields

Field	Description
Bin attr ctime	Changed time in linux/ Create time in windows of the binary

Field	Description
Bin attr hash	Sha256 hash of the binary
Bin attr mtime	Modified time of the binary
Bin attr name	Name of the binary on the file system
Bin attr size	Size of the binary on the file system
Bin exec path	Full path of the binary
Cmdline	Full command line of the process that gets executed
Event time usec	Time (in microseconds) when this event is observed

Process Info

Field	Description
Process ID	Process ID of the process
Parent Process ID	Process ID of the parent of the process
User	User that executed the process
Execution path	Full path of the binary that corresponds to the process.
Start time	Time when the process was started
Full command	Full command line of the process that gets executed

Privilege Escalation

Field	Description
Parent cmdline	Full command line of the parent of the process
Parent exe	Full path of the parent of the process
Parent Uptime (microseconds)	Time since the parent of the process was executed
Parent Username	User that executed the parent of the process
Types bitmap suid binary	Indicates whether the binary has the suid bit set

User Logon

Field	Description
Auth type password	Indicates password authentication

Field	Description
Auth type pubkey	Indicates key based authentication
Type login ssh	Indicates that a user logged in via ssh
Type login win batch	Indicates windows batch login (Type 4, eg schtasks)
Type login win cached	Indicates logon via cached credentials (Type 11, CachedIntetractive)
Type login win interactive	Indicates interactive logon (Type 2, eg RDP)
Type login win network cleartext	Indicates logon via ssh (Type 8)
Type login win network	Indicates network login (Type 3, eg Psexec)
Type login win new cred	Indicates the usage of new credentials (Type 9, eg Runas command)
Type login win remote interactive	Indicates remote logon (Type 10, eg RDP)
Type login win service	Indicates that a service was started by SCM (Type 5)
Type login win unlock	Indicates that the workstation was unlocked (Type 7)
Src IP	The source IP from which the login event was generated
Src Port	The source port from which the login event was generated
Username	Username associated with the log in event

User Logon Failed

Field	Description
Auth type password	Indicates password authentication
Auth type pubkey	Indicates key based authentication
Type login ssh	Indicates that a user logged in via ssh
Type login win batch	Indicates windows batch login (Type 4, eg schtasks)
Type login win cached	Indicates logon via cached credentials (Type 11, CachedIntetractive)
Type login win interactive	Indicates interactive logon (Type 2, eg RDP)
Type login win network cleartext	Indicates logon via ssh (Type 8)
Type login win network	Indicates network login (Type 3, eg Psexec)

Field	Description
Type login win new cred	Indicates the usage of new credentials (Type 9, eg Runas command)
Type login win remote interactive	Indicates remote logon (Type 10, eg RDP)
Type login win service	Indicates that a service was started by SCM (Type 5)
Type login win unlock	Indicates that the workstation was unlocked (Type 7)
Src IP	The source IP from which the login event was generated
Src Port	The source port from which the login event was generated
Username	Username associated with the log in event

Shellcode

Field	Description
Signal sources bitmap cmd as sh no tty	Indicates that a shell process has no tty that is associated with it
Signal sources bitmap powershell	Indicates that the process has powershell dll loaded (System.Management.Automation)

File Access

Field	Description
File	Full path of the file that was accessed
Perm read perm	Indicates that the file had Read permission
Perm read write perm	Indicates that the file had Read and Write permissions
Perm write perm	Indicates that the file had Write permission

User Account

Field	Description
Username	Username of the user that was created
Ops acct add	Indicates that a new account was added

Unseen Command

Field	Description
Anomaly - Score	Score (0 to 1.0) indicating how frequently the command line was seen previously, lower score implies that the command is more anomalous
Anomaly - Similarity - High	True if the anomaly score is larger than 0.8 and is smaller than 1
Anomaly - Similarity - Medium	True if the anomaly score is larger than 0.6 and is smaller than or equal to 0.8
Anomaly - Similarity - Low	True if the anomaly score is larger than 0 and is smaller than or equal to 0.6
Anomaly - Similarity - Seen	True if the anomaly score is 1, i.e. the same command has been seen before
Anomaly - Similarity - Unique	True if the anomaly score is 0, i.e. the command has never been seen before
Parent cmdline	Full command line of the parent process
Parent exepath	Binary path of the parent process
Parent uptime	Time since the parent process was executed
Parent username	Username of the user that executed the parent process
Sensor uptime	Uptime of the sensor

Unseen Library

Field	Description
Lib Path	The full path of the library file that was previously not associated to the process

Raw Socket Creation

Field	Description
Exe Path	Full path of the process that created the raw socket

Library Changed

Field	Description
Library changed name	The full path of the Library that was changed

Side Channel

Field	Description
Signal sources bitmap meltdown	Indicates the use of Meltdown exploit

Follow User Logon

Field	Description
Username	Username that executed the process

Follow Process

Field	Description
Parent cmdline	Full command line of the parent process
Parent exepath	Binary path of the parent process
Parent uptime usec	Time since the parent process was executed
Parent username	Username of the user that executed the parent process
Time since last changed usec	Time elapsed between the process start time and its binary file change time (mtime)
Username	Username of the user that executed the process

Network Anomaly

For more information, see Forensic Rules for Network Anomaly Events for the list of attributes associated with Network Anomaly events.

Forensic Analysis - Searchable Fields

The below tables describe searchable fields on the Forensics Analysis page search bar.

Miscellaneous Fields

Field	Description
Forensic Rule Name	Events labeled by a particular forensic rule
Hostname	Events from a particular hostname
Sensor ID	Events from a particular Sensor
Severity	Events of a particular severity

Search Terms in Forensic Analysis

Common Fields

These fields are common to various event types. They have the prefix “Event name - Event”, for example, “Binary Changed - Binary Attribute - CTime (epoch nanoseconds)”

Field	Description
Binary Attribute - CTime (epoch nanoseconds)	Changed time in linux/ Create time in windows of the binary
Binary Attribute - Hash	Sha256 hash of the binary
Binary Attribute - MTime (epoch nanoseconds)	Modified time of the binary
Binary Attribute - Filename	Name of the binary on the file system
Binary Attribute - Size (bytes)	Size of the binary on the file system
Event Binary Path	Full path of the binary
Command Line	Full command line of the process that gets executed

Binary Changed

There are no other search terms other than the ones described in “Common Fields” table.

File Access

File Access search terms have the prefix “File Access - “, for example, “File Access - Filename”

Field	Description
Filename	Full path of the file that was accessed
Is = Permission - Read	Indicates that the file had Read permission

Field	Description
Is = Permission - ReadWrite	Indicates that the file had Read and Write permissions
Is = Permission - Write	Indicates that the file had Write permission

Follow Process

Follow Process search terms have the prefix “Follow Process - “, for example, “Follow Process - Parent Command Line”

Field	Description
Parent Command Line	Full command line of the parent process
Parent Exec Path	Binary path of the parent process
Parent Uptime (microseconds)	Time since the parent process was executed
Parent Username	Username of the user that executed the parent process
Process Start Time Since Last File Changed (microseconds)	Time that is elapsed between process start and the most recent (corresponding) file change
Username	Username that are associated with the process being followed

Follow User Logon

Follow User Logon search terms have the prefix "Follow User Logon - ", for example, "Follow User Logon - Username"

Field	Description
Username	Username that is associated with a process

Ldap

Ldap search terms have the prefix “Ldap - “, for example, “Ldap - Department”

Field	Description
Department	AMS Ldap user department associated with the process username (if available)
Description	AMS Ldap user description associated with the process username (if available)
Username	AMS Ldap username associated with the process (if available)

Library Changed

Library Changed search terms have the prefix “Library Changed - “, for example, “Library Changed - Department”

Field	Description
Lib Filename	The full path of the Library that was changed

Privilege Escalation

Privilege Escalation search terms have the prefix “Privilege Escalation - “, for example, “Privilege Escalation - Parent Com- mand Line”

Field	Description
Parent Command Line	Full command line of the parent of the process
Parent Exec Path	Full path of the parent of the process
Parent Uptime (microseconds)	Time since the parent of the process was executed
Parent Username	User that executed the parent of the process
Type - Suid Binary	Indicates whether the binary has the suid bit set

Process Info

Process Info search terms have the prefix “Process Info - “, for example, “Process Info - Binary Hash”

Field	Description
Binary Hash	Hash of the binary associated with the process
Command String Tokenized	Tokenized command line of the process
Command String	Full command line of the process
Exec Path	Full path of the binary that corresponds to the process

Raw Socket

Raw Socket search terms have the prefix “Raw Socket - ”, for example, “Raw Socket - Exec Path”

Field	Description
Exec Path	Full path of the process that created the raw socket

Shellcode

Shellcode search terms have the prefix “Shellcode - ”, for example, “Shellcode - Source - Not From Login”

Field	Description
Source - Not From Login	Indicates that a shell process has no tty that is associated with it
Source - Powershell	Indicates that the process has powershell dll loaded (System.Management.Automation)

Side Channel

Side Channel search terms have the prefix “Shellcode - ”, for example, “Shellcode - Source - Meltdown”

Field	Description
Source - Meltdown	Indicates the use of Meltdown exploit

Unseen Command

Unseen Command search terms have the prefix “Unseen Command - ”, for example, “Unseen Command - Anomaly - Similarity - High”

Field	Description
Anomaly - Score	Score (0 to 1.0) indicating how frequently the command line was seen previously, lower score implies that the command is more anomalous
Anomaly - Similarity - High	True if the anomaly score is larger than 0.8 and is smaller than 1
Anomaly - Similarity - Medium	True if the anomaly score is larger than 0.6 and is smaller than or equal to 0.8
Anomaly - Similarity - Low	True if the anomaly score is larger than 0 and is smaller than or equal to 0.6
Anomaly - Similarity - Seen	True if the anomaly score is 1, i.e. the same command has been seen before
Anomaly - Similarity - Unique	True if the anomaly score is 0, i.e. the command has never been seen before
Parent Cmdline	Full command line of the parent process
Parent Exepath	Binary path of the parent process
Parent Uptime	Time since the parent process was executed

Field	Description
Parent Username	Username of the user that executed the parent process
Sensor Uptime	Uptime of the sensor
Anomaly - Latest Similar Commands	5 latest previously observed command which are similar to the command of the event

Unseen Library

Unseen Library search terms have the prefix “Unseen Library - ”, for example, “Unseen Library - Lib Filename”

Field	Description
Lib Filename	The full path of the library file that was previously not associated to the process

User Account

User Account search terms have the prefix “User Account - ”, for example, “User Account - Account Name”

Field	Description
Account Name	Username of the user that was created
Operation - Add Account	Indicates that a new account was added

User Logon

User Logon search terms have the prefix “User Logon - ”, for example, “User Logon - Auth Type - Password”

Field	Description
Auth Type - Password	Indicates password authentication
Auth type - Pubkey	Indicates key based authentication
Login Type - Login Via SSH	Indicates that a user logged in via ssh
Login Type - Windows Login Batch	Indicates windows batch login (Type 4, eg schtasks)
Login Type - Windows Login Cached	Indicates logon via cached credentials (Type 11, CachedIntetractive)
Login Type - Windows Login Interactive	Indicates interactive logon (Type 2, eg RDP)
Login Type - Windows Network Cleartext	Indicates logon via ssh (Type 8)
Login Type - Windows Network	Indicates network login (Type 3, eg Psexec)

Field	Description
Login Type - Windows Login New Credential	Indicates the usage of new credentials (Type 9, eg Runas command)
Login Type - Windows Login Remote Interactive	Indicates remote logon (Type 10, eg RDP)
Login Type - Windows Login Service	Indicates that a service was started by SCM (Type 5)
Login Type - Windows Login Unlock	Indicates that the workstation was unlocked (Type 7)
Source IP	The source IP from which the login event was generated
Source Port	The source port from which the login event was generated
Username	Username associated with the log in event

User Logon Failed

User Logon Failed search terms have the prefix “User Logon Failed - “, e.g., “User Logon Failed - Auth Type - Password”

Field	Description
Auth Type - Password	Indicates password authentication
Auth type - Pubkey	Indicates key based authentication
Login Type - Login Via SSH	Indicates that a user logged in via ssh
Login Type - Windows Login Batch	Indicates windows batch login (Type 4, eg schtasks)
Login Type - Windows Login Cached	Indicates logon via cached credentials (Type 11, CachedIntetractive)
Login Type - Windows Login Interactive	Indicates interactive logon (Type 2, eg RDP)
Login Type - Windows Network Cleartext	Indicates logon via ssh (Type 8)
Login Type - Windows Network	Indicates network login (Type 3, eg Psexec)
Login Type - Windows Login New Credential	Indicates the usage of new credentials (Type 9, eg Runas command)
Login Type - Windows Login Remote Interactive	Indicates remote logon (Type 10, eg RDP)
Login Type - Windows Login Service	Indicates that a service was started by SCM (Type 5)
Login Type - Windows Login Unlock	Indicates that the workstation was unlocked (Type 7)
Source IP	The source IP from which the login event was generated

Field	Description
Source Port	The source port from which the login event was generated
Username	Username associated with the log in event

Forensics alerts

Forensic events can be found in the Secure Workload Alert System if their matching rules contain an **Alert** action.

Accessing Forensic Alerts

This section explains how to access forensic alerts.

Before You Begin

- You must log in as **Site Admin**, **Customer Support** or **Scope Owner** in the system.
- You must turn on alerts for **Forensics** alert source.

Procedure

Step 1 From the left toolbar, click on **Alerts**.

Step 2 Alert page appears.

Checking Alert Details

Before You Begin:

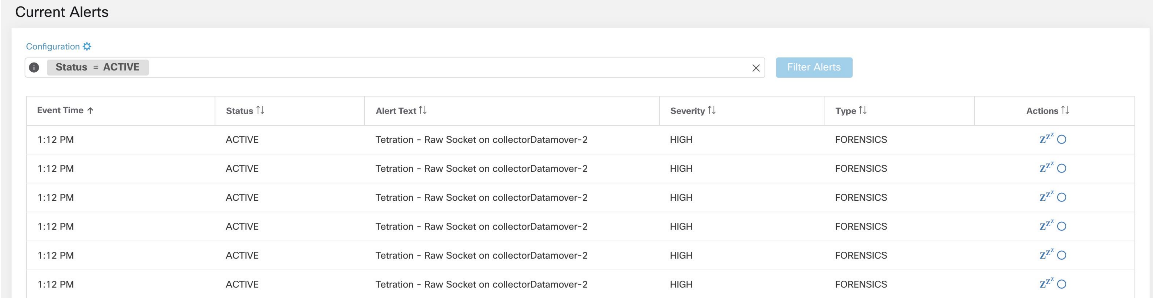
You must log in as **Site Admin**, **Customer Support** or **Scope Owner** in the system.

Procedure

Step 1 From the alert page, click on the alert to be checked.

Step 2 Click on profile/rule to see the details of the matching forensic profile/rule. If the matching profile/rule is updated after alerts are raised, there will be a warning indicator.

Figure 339: Forensic Alert Page



Current Alerts

Configuration

Status = ACTIVE

Event Time	Status	Alert Text	Severity	Type	Actions
1:12 PM	ACTIVE	Tetration - Raw Socket on collectorDatamover-2	HIGH	FORENSICS	zᶻᶻ ○
1:12 PM	ACTIVE	Tetration - Raw Socket on collectorDatamover-2	HIGH	FORENSICS	zᶻᶻ ○
1:12 PM	ACTIVE	Tetration - Raw Socket on collectorDatamover-2	HIGH	FORENSICS	zᶻᶻ ○
1:12 PM	ACTIVE	Tetration - Raw Socket on collectorDatamover-2	HIGH	FORENSICS	zᶻᶻ ○
1:12 PM	ACTIVE	Tetration - Raw Socket on collectorDatamover-2	HIGH	FORENSICS	zᶻᶻ ○
1:12 PM	ACTIVE	Tetration - Raw Socket on collectorDatamover-2	HIGH	FORENSICS	zᶻᶻ ○

In addition, you can snooze or include/exclude an alert. Refer to the section Current Alerts for more details.

External Integration

Forensics alerts can be sent to external monitoring tools such as syslog. The forensics alert is sent in JSON format. The JSON field definitions are defined in the section “Fields Displayed in Forensic Events” above.

A sample JSON Kafka output is shown below:

```
  {
    "severity": "HIGH",
    "tenant_id": 0,
    "alert_time": 1595573847156,
    "alert_text": "Tetration - Anomalous Unseen Command on collectorDatamover-1",
    "key_id":
"d89f926cddc7577553eb8954e492528433b2d08e:5efcfdf5497d4f474f1707c2:5efcfdf6497d4f474f1707d6:20196:CMD_NOT_SEEN",

    "alert_id": "/Alerts/5efcfdf5497d4f474f1707c2/DataSource{location_type='TETRATION',
location_name='forensics', location_grain='MIN',
root_scope_id='5efcfdf5497d4f474f1707c2'}/db10d21631eebefc3b8d3aeaba5a0b1b45f4259e85b591763d7eaee9161ca076",

    "root_scope_id": "5efcfdf5497d4f474f1707c2",
    "type": "FORENSICS",
    "event_time": 1595573795135,
    "alert_details": "{\"Sensor
Id\":\"d89f926cddc7577553eb8954e492528433b2d08e\",\"Hostname\":\"collectorDatamover-1\",\"Process
 Id\":20196,\"scope_id\":\"5efcfdf5497d4f474f1707c2\",\"forensic\":{\"Unseen
Command\":\"true\",\"Unseen Command - Sensor Uptime (microseconds)\":\"34441125356\",\"Unseen
 Command - Parent Uptime (microseconds)\":\"35968418683\",\"Unseen Command - Parent
Username\":\"root\",\"Unseen Command - Parent Command Line\":\"svlogd -tt
/local/logs/tetration/efe/ \",\"Unseen Command - Parent Exec Path\":\"/sbin/svlogd\",\"Unseen
 Command - Anomaly - Score\":\"0\",\"Unseen Command - Anomaly - Similarity -
Unique\":\"true\",\"Process Info - Command String\":\"gzip \",\"Process Info - Exec
Path\":\"/bin/gzip\"},\"profile\":{\"id\":\"5efcfdf6497d4f474f1707e4\",\"name\":\"Tetration

Profile\",\"created_at\":1593638390,\"updated_at\":1593638390,\"root_app_scope_id\":\"5efcfdf5497d4f474f1707c2\"},\"rule\":{\"id\":\"5efcfdf6497d4f474f1707d6\",\"name\":\"Tetration
 - Anomalous Unseen
Command\",\"clause_chips\":\"[{\\\"type\\\":\\\"filter\\\",\\\"facet\\\":{\\\"field\\\":\\\"event_type\\\",\\\"title\\\":\\\"Event

type\\\",\\\"type\\\":\\\"STRING\\\"},\\\"operator\\\":{\\\"label\\\":\\\"\\u003d\\\",\\\"type\\\":\\\"eq\\\"},\\\"displayValue\\\":\\\"Unseen
 Command\\\",\\\"value\\\":\\\"Unseen
Command\\\"},{\\\"type\\\":\\\"filter\\\",\\\"facet\\\":{\\\"field\\\":\\\"forensic_event__cmd_not_seen_data__cmdline_anomaly_info__score\\\",\\\"title\\\":\\\"Unseen
 Command - Anomaly -
Score\\\",\\\"type\\\":\\\"NUMBER\\\"},\\\"operator\\\":{\\\"label\\\":\\\"\\u003c\\\",\\\"type\\\":\\\"lt\\\"},\\\"displayValue\\\":\\\"0.6\\\",\\\"value\\\":\\\"0.6\\\"}]\",\"created_at\":1593638390,\"updated_at\":1595573948,\"root_app_scope_id\":\"5efcfdf5497d4f474f1707c2\"}}"
```

```
  }
```

The value in alert_details is itself an escaped JSON string whose content for the above alert can be seen below:

```
  {
    "Sensor Id": "d89f926cddc7577553eb8954e492528433b2d08e",
    "Hostname": "collectorDatamover-1",
    "Process Id": 20196,
    "scope_id": "5efcfdf5497d4f474f1707c2",
    "forensic": {
      "Unseen Command": "true",
      "Unseen Command - Sensor Uptime (microseconds)": "34441125356",
      "Unseen Command - Parent Uptime (microseconds)": "35968418683",
      "Unseen Command - Parent Username": "root",
      "Unseen Command - Parent Command Line": "svlogd -tt /local/logs/tetration/efe/ ",
      "Unseen Command - Parent Exec Path": "/sbin/svlogd",
      "Unseen Command - Anomaly - Score": "0",
      "Unseen Command - Anomaly - Similarity - Unique": "true",
      "Process Info - Command String": "gzip ",
      "Process Info - Exec Path": "/bin/gzip"
    },
    "profile": {
      "id": "5efcfdf6497d4f474f1707e4",
      "name": "Tetration Profile",
      "created_at": 1593638390,
      "updated_at": 1593638390,
      "root_app_scope_id": "5efcfdf5497d4f474f1707c2"
    },
    "rule": {
      "id": "5efcfdf6497d4f474f1707d6",
      "name": "Tetration - Anomalous Unseen Command",
      "clause_chips":
"[{\"type\":\"filter\",\"facet\":{\"field\":\"event_type\",\"title\":\"Event
type\",\"type\":\"STRING\"},\"operator\":{\"label\":\"=\",\"type\":\"eq\"},\"displayValue\":\"Unseen
 Command\",\"value\":\"Unseen
Command\"},{\"type\":\"filter\",\"facet\":{\"field\":\"forensic_event__cmd_not_seen_data__cmdline_anomaly_info__score\",\"title\":\"Unseen
 Command - Anomaly -
Score\",\"type\":\"NUMBER\"},\"operator\":{\"label\":\"<\",\"type\":\"lt\"},\"displayValue\":\"0.6\",\"value\":\"0.6\"}]",

      "created_at": 1593638390,
      "updated_at": 1595539498,
      "root_app_scope_id": "5efcfdf5497d4f474f1707c2"
    }
 }
```

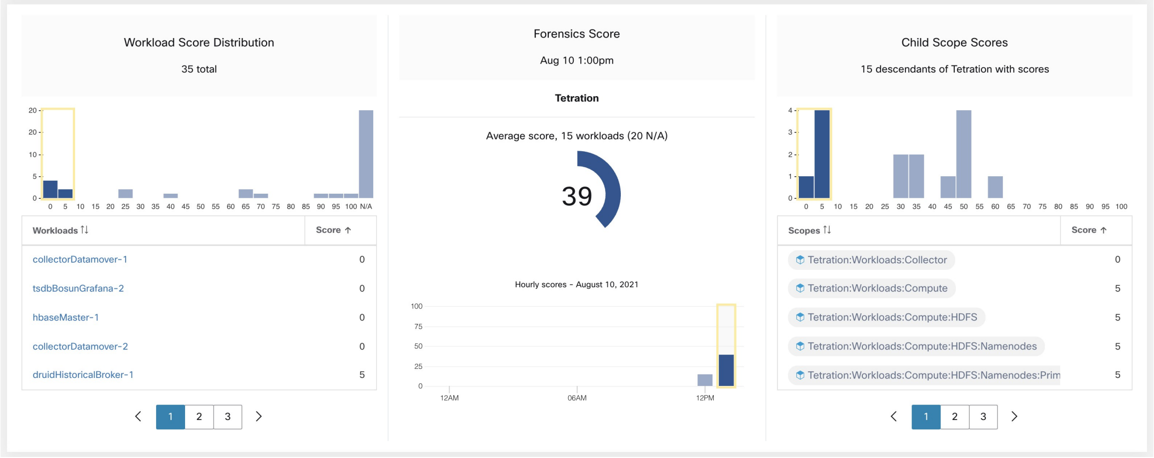
The details of the forensic events are included in the field forensic. For the list of attributes of the forensic events, see Fields Displayed in Forensic Events. These attributes are also shown in the alert details in the UI.

Forensics Score

Where to See Forensic Score

Security Dashboard:

Figure 340: Forensics Score Section in Security Dashboard



Workload Score Distribution

35 total

20
20
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 N/A

Workloads ↑↓	Score ↑
collectorDatamover-1	0
tsdbBosunGrafana-2	0
hbaseMaster-1	0
collectorDatamover-2	0
druidHistoricalBroker-1	5

Forensics Score

Aug 10 1:00pm

Tetration

Average score, 15 workloads (20 N/A)

39

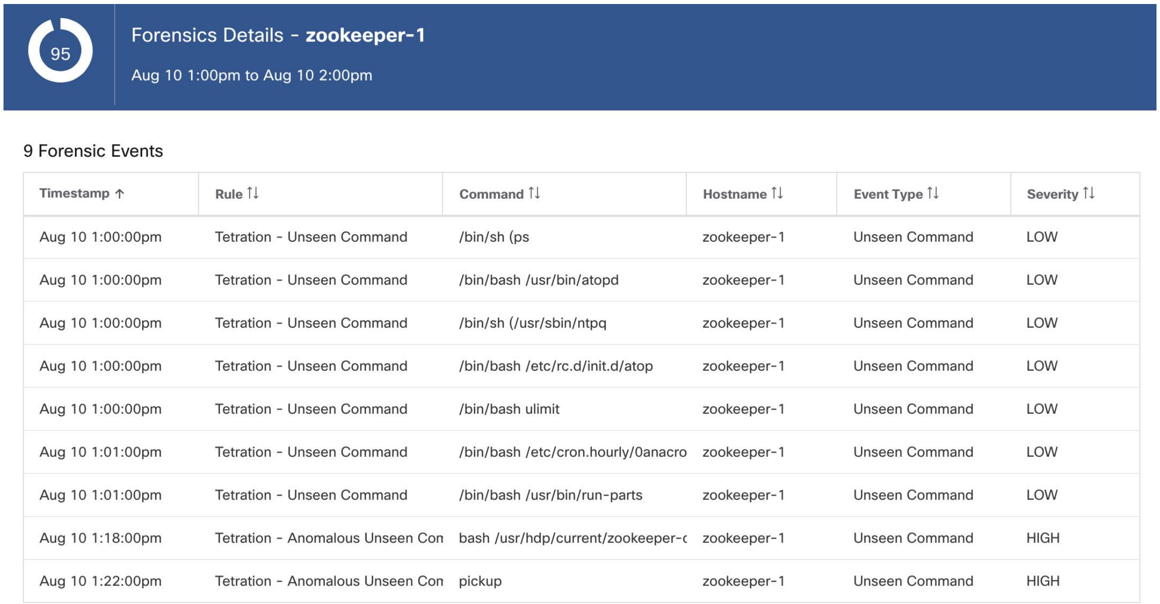
Hourly scores - August 10, 2021

Child Scope Scores

15 descendants of Tetration with scores

Scopes ↑↓	Score ↑
Tetration:Workloads:Collector	0
Tetration:Workloads:Compute	5
Tetration:Workloads:Compute:HDFS	5
Tetration:Workloads:Compute:HDFS:Namenodes	5
Tetration:Workloads:Compute:HDFS:Namenodes:Prim	5

Figure 341: Forensics Score Details Section in Security Dashboard



95

Forensics Details - **zookeeper-1**

Aug 10 1:00pm to Aug 10 2:00pm

9 Forensic Events

Timestamp ↑	Rule ↑↓	Command ↑↓	Hostname ↑↓	Event Type ↑↓	Severity ↑↓
Aug 10 1:00:00pm	Tetration - Unseen Command	/bin/sh (ps	zookeeper-1	Unseen Command	LOW
Aug 10 1:00:00pm	Tetration - Unseen Command	/bin/bash /usr/bin/atopd	zookeeper-1	Unseen Command	LOW
Aug 10 1:00:00pm	Tetration - Unseen Command	/bin/sh (/usr/sbin/ntpq	zookeeper-1	Unseen Command	LOW
Aug 10 1:00:00pm	Tetration - Unseen Command	/bin/bash /etc/rc.d/init.d/atop	zookeeper-1	Unseen Command	LOW
Aug 10 1:00:00pm	Tetration - Unseen Command	/bin/bash ulimit	zookeeper-1	Unseen Command	LOW
Aug 10 1:01:00pm	Tetration - Unseen Command	/bin/bash /etc/cron.hourly/0anacro	zookeeper-1	Unseen Command	LOW
Aug 10 1:01:00pm	Tetration - Unseen Command	/bin/bash /usr/bin/run-parts	zookeeper-1	Unseen Command	LOW
Aug 10 1:18:00pm	Tetration - Anomalous Unseen Con	bash /usr/hdp/current/zookeeper-c	zookeeper-1	Unseen Command	HIGH
Aug 10 1:22:00pm	Tetration - Anomalous Unseen Con	pickup	zookeeper-1	Unseen Command	HIGH

How the Forensic Score is Calculated

For each Workload, we compute a Forensics Score. A Workload's Forensics Score is derived from the Forensic Events observed on that Workload based on the profiles that are enabled for this scope. A score of 100 means that no Forensic Events were observed via configured rules in enabled profiles, and a score of 0 means that there is a Forensic Event detected that requires immediate action. The Forensics Score for a Scope is the average Workload score within that Scope. Forensics Score for a given hour is a minimum of all scores within that hour.

- A Forensic Event with the severity REQUIRES IMMEDIATE ACTION reduces the Score for the entire Scope to zero.
- A Forensic Event with the severity CRITICAL reduces workload's score with the weight of 10.

- A Forensic Event with the severity HIGH reduces workload’s score with the weight of 5.
- A Forensic Event with the severity MEDIUM reduces workload’s score with the weight of 3.
- A Forensic Event with the severity LOW doesn’t contribute to the Forensics Score. This is recommended for new rules where the quality of the signal is still being tuned and is likely to be noisy.

For example, a workload has 3 forensic events that match 2 rules with *CRITICAL* severity, 1 rule with *HIGH* severity, 1 rule with *LOW*, respectively. The forensic score for that workload is: 100 - 1 * 10 - 1 * 5 - 1 * 0 = 85.

The Forensics Scores are N/A for workloads in which the Forensics feature is not enabled.

How to Improve Forensic Score

Tuning your Forensics Score can be done by adjusting the Forensic Rules enabled. Creating rules that are less noisy will give you a more accurate score. Acting upon and preventing legitimate Forensic Events (events that are evidence of an intrusion or other bad activity) is another good way to improve your Forensics Score.

Caveats

- Forensics Score details show all forensic events within that hour. That means Forensic Score details may show forensic events other than the ones used for computing forensic score.
- Forensics Score is currently available for Deep Visibility and Enforcement sensors.

PCR-Based Network Anomaly Detection

Network Anomaly feature detects abnormally large amounts of data flowing into or out of the workloads based on the concept of Producer Consumer Ratio (PCR). The PCR is defined as:

```
Egress app byte count - Ingress app byte count
  PCR = ----------------------------------------------
        Egress app byte count + Ingress app byte count
```

The value of PCR is in the [-1.0, 1.0] range where:

- PCR = 1.0 means the workload purely sends data out.
- PCR = -1.0 means the workload purely receives data.
- PCR = 0.0 means the workload has balanced amounts of data in and data out.

Similar to other Forensics features, you can use the intent-based configuration to configure the Network Anomaly events you want to record and/or alert. Detected Network Anomaly events from workloads are exported every 5 minutes and are matched against configured rules 5 minutes later. As a result, new Network Anomaly events are only observed on the UI every 5 minutes with delay of up to 10 minutes from the time of the event.

Note In 3.2 and 3.1 versions of Secure Workload software, Network Anomaly detection was known as Data Leak detection.

Forensic Rules for Network Anomaly Events

Refer to Forensic Configuration on how to add forensic rules.

Rule Attributes

This section explains the details of the attributes to define a Network Anomaly related rule. The simplest Network Anomaly rule is

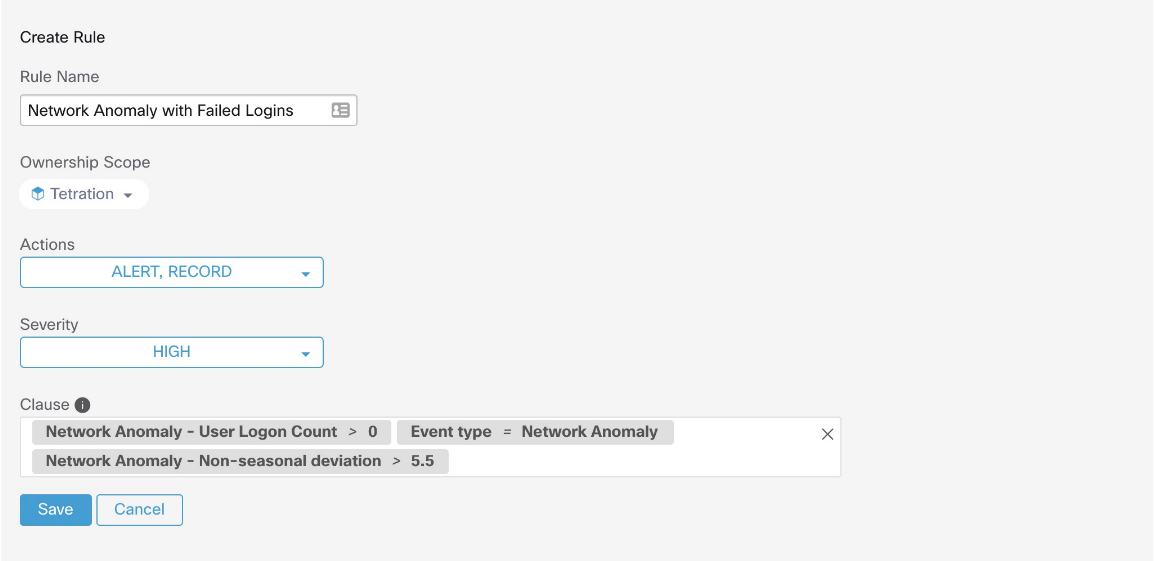
Event Type = Network Anomaly

Below are other attributes in the Network Anomaly event to refine the rules for your data centers.

Attribute	Description
Host Name	The host name of the workload emitting this event.
Timestamp (epoch milliseconds)	The timestamp (in milliseconds) of the event.
PCR Deviation	The deviation of PCR from the mean at the event time as a multiple of historical standard deviation.
Non-seasonal Deviation	This is the PCR deviation after removing the seasonality pattern (for example, by cron-jobs). The value of Non-seasonal Deviation is always larger than or equal to 6.0.
PCR	The Producer Consumer Ratio.
EIR	The Egress Ingress Ratio, which is the ratio between the total Egress App Byte Count and the Ingress App Byte Count.
Egress App Byte Count	The egress application byte count, which is the total byte count of packet contents (excluding headers) flowing out of the work-load.
Ingress App Byte Count	The ingress application byte count, which is the total byte count of packet contents (excluding headers) flowing into the work-load.
Protocol	The protocol for which the PCR time series is calculated. Currently, the supported protocols are TCP, UDP, and Aggregate. Aggregate PCR is calculated based on the total sum of TCP, UDP, and ICMP byte counts.
User Logon Count	The number of user logon events on the workload within approximately the last 15 minutes. This is the count of the User Logon events regardless of whether there are matched rules. To know the details of the User Logon events, you must define rules to record the events for workloads of interests and view them in Forensics Analysis page.

Attribute	Description
User Logon Failed Count	The number of users logon failed events on the workload within approximately the last 15 minutes. This is the count of the User Logon failed events regardless of whether there are matched rules. To know the details of the User Lo gon Failed events, you must define rules to record the events for workloads of interests and view them on Forensics Analysis page.
Unseen Command Count	The number of unseen command events on the workload within approximately the last 15 minutes. This is the count of the Unseen Command events regardless of whether there are matched rules. To know the details of the Useen Command events, you must define rules to record the events for workloads of interests and view them on the Forensics Analysis page.
Date Time (UTC) - Year	The year of the event time.
Date Time (UTC) - Month	The month of the event time (1, 2, . . .).
Date Time (UTC) - Day	The day of a month of the event time (1, 2, . . .).
Date Time (UTC) - Hour	The hour of a day of the event time (1, 2, . . . , 24).
Date Time (UTC) - Minute	The minute of an hour of the event time (1, 2, . . . , 60).
Date Time (UTC) - Second	The second of minute of the event time (1, 2, . . . , 60).
Date Time (UTC) - Day of Week	The day of a week of the event time (0-7, for Monday to Sunday).

Figure 342: Defining Forensic Rules for Network Anomaly Events



Create Rule

Rule Name

Network Anomaly with Failed Logins

Ownership Scope

Tetration

Actions

ALERT, RECORD

Severity

HIGH

Clause

Network Anomaly - User Logon Count > 0 | Event type = Network Anomaly | Network Anomaly - Non-seasonal deviation > 5.5

Below are some sample rules:

Listing 7.10.1.1.1: Detects network anomalies for UDP only.

```
Event Type = Network Anomaly AND Network Anomaly Is = Protocol - UDP
```

Listing 7.10.1.1.2: Detects large deviation after removing seasonal pattern (if detected), with a threshold on the egress app byte count for a subset of workloads whose names contain *sensitiveDataServer*.

```
Event Type = Network Anomaly AND Network Anomaly - Non-seasonal Deviation > 10.0)
AND Network Anomaly - Egress App Byte Count > 1000000
AND Network Anomaly - Host Name CONTAINS sensitiveDataServer
```

Listing 7.10.1.1.3: Detects Network Anomaly events on workloads with unseen command events except the Network Anomaly events happen from 7.30AM UTC to 7.35AM UTC everyday.

```
   Event Type = Network Anomaly AND Network Anomaly - Unseen Command Count > 0
   AND ( Network Anomaly - Date Time (UTC) - Hour != 7
   OR Network Anomaly - Date Time (UTC) - Minute < 30 OR Network Anomaly - Date Time (UTC)
- Minute > 35 )
```

Rule Actions

Action	Description
RECORD	The matched events contribute to the Network Anomaly Score and can be found via the Security Dashboard or the Network Anomalies Tab.
ALERT	The matched events shows up in the Current Alerts and the chosen Choose Alert Publishers.

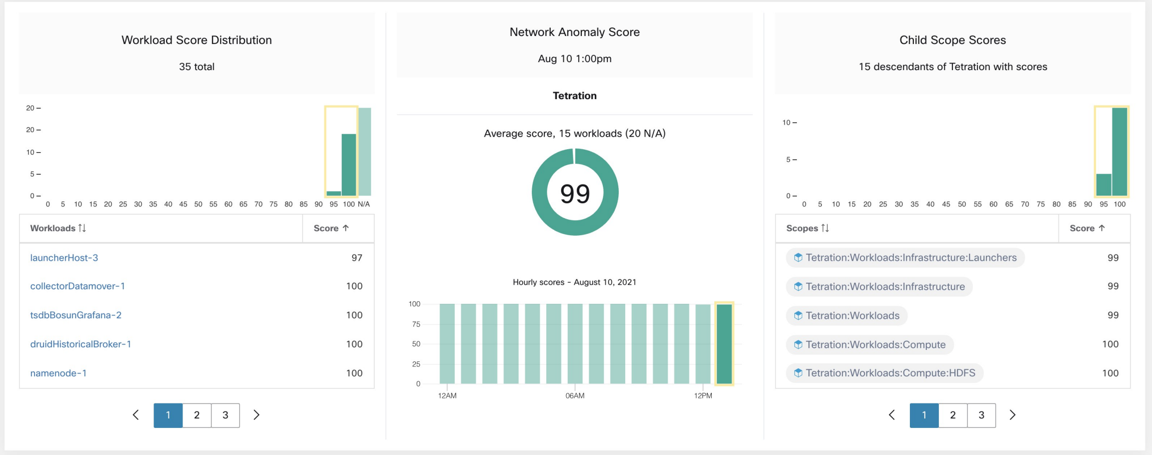
The next section describes in more detail where to find detected Network Anomaly events in the UI.

Where to See Network Anomaly Events

Note Network Anomaly events are *not* currently shown on Forensics Analysis page. You can find Network Anomaly events on the following pages.

- **Security Dashboard:** Network Anomaly events that match rules with **RECORD** action can be found in the Network Anomaly score section in the Security Dashboard. If there are workloads with nonbest (less than 100) scores, clicking on the workload name, you are able to view the PCR time series and the Network Anomaly events on that workload. On the right side of each row of the Network Anomaly event table, you can see action links that can help you search for flows and other forensic events around the time of the corresponding Network Anomaly event. See Network Anomaly Latency for known delay in Network Anomaly score reporting.

Figure 343: Network Anomaly Score in Security Dashboard



Workload Score Distribution

35 total

20 –
20 –
10 –
5 –
0 –
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 N/A

Workloads ↑↓	Score ↑
launcherHost-3	97
collectorDatamover-1	100
tsdbBosunGrafana-2	100
druidHistoricalBroker-1	100
namenode-1	100

Network Anomaly Score

Aug 10 1:00pm

Tetration

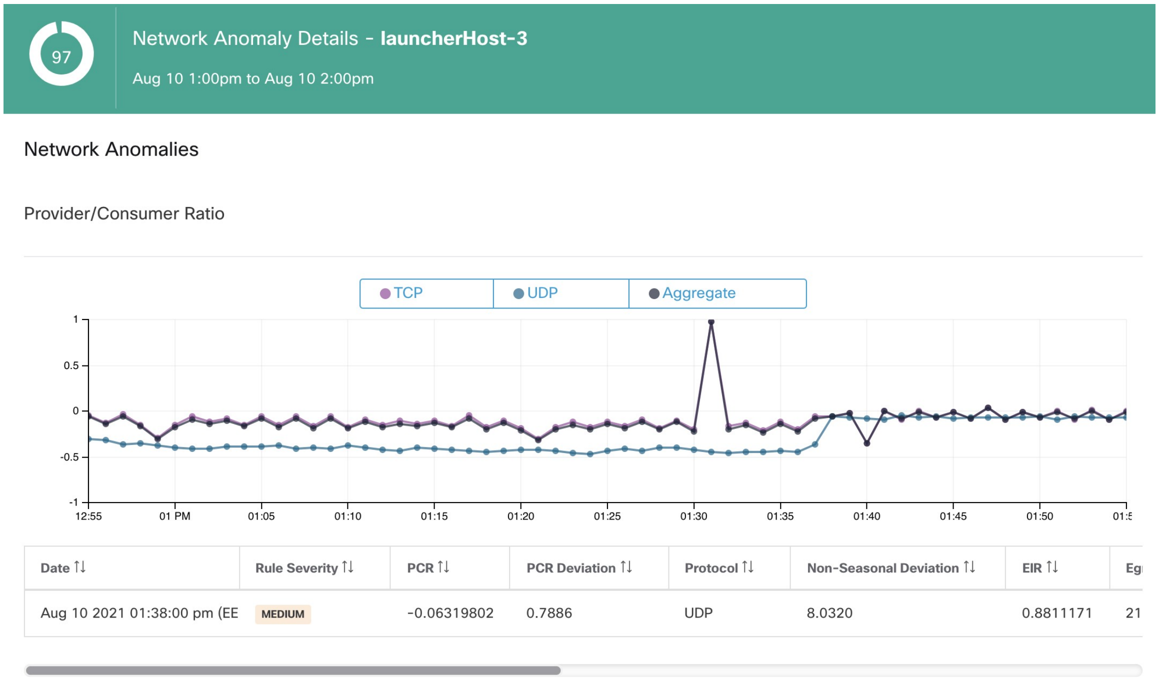
Average score, 15 workloads (20 N/A)

Child Scope Scores

15 descendants of Tetration with scores

Scopes ↑↓	Score ↑
Tetration:Workloads:Infrastructure:Launchers	99
Tetration:Workloads:Infrastructure	99
Tetration:Workloads	99
Tetration:Workloads:Compute	100
Tetration:Workloads:Compute:HDFS	100

Figure 344: Network Anomaly score in Security Dashboard Drilled-Down by Workload



97

Network Anomaly Details - **launcherHost-3**

Aug 10 1:00pm to Aug 10 2:00pm

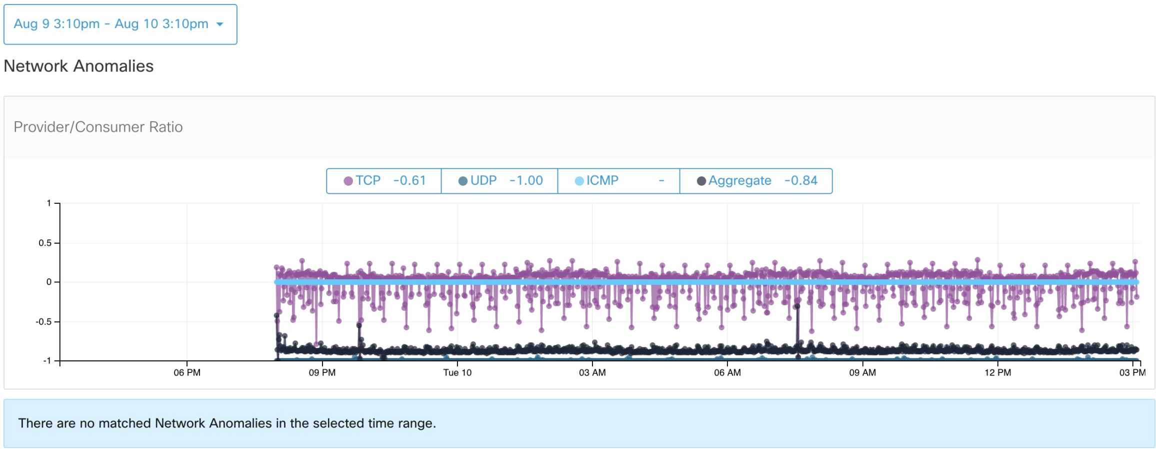
Network Anomalies

Provider/Consumer Ratio

Date ⇅	Rule Severity ⇅	PCR ⇅	PCR Deviation ⇅	Protocol ⇅	Non-Seasonal Deviation ⇅	EIR ⇅	Eg
Aug 10 2021 01:38:00 pm (EE	MEDIUM	-0.06319802	0.7886	UDP	8.0320	0.8811171	21

- [Network Anomalies Tab](#): on this page, you can see the PCR time series graph and the Network Anomaly events that match rules with **RECORD** action. What you can see that on this page is similar to what you find by clicking on the workload name in the security dashboard.

Figure 345: Network Anomaly Tab on Workload Profile Page



Aug 9 3:10pm - Aug 10 3:10pm ▾

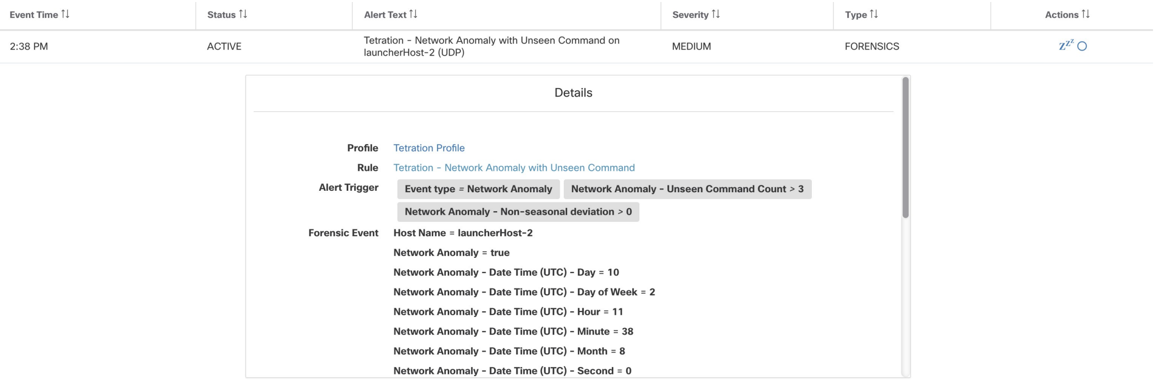
Network Anomalies

Provider/Consumer Ratio

There are no matched Network Anomalies in the selected time range.

- **Alerts:** If the Network Anomaly rule is configured with **ALERT** action, the matched events is displayed on the [Current Alerts](#) and are also available via Alert Publisher.

Figure 346: Network Anomaly Alert



Event Time ↑↓	Status ↑↓	Alert Text ↑↓	Severity ↑↓	Type ↑↓	Actions ↑↓
2:38 PM	ACTIVE	Tetration - Network Anomaly with Unseen Command on launcherHost-2 (UDP)	MEDIUM	FORENSICS	zᶻᶻ ○

Details

Profile Tetration Profile

Rule Tetration - Network Anomaly with Unseen Command

Alert Trigger Event type = Network Anomaly | Network Anomaly - Unseen Command Count > 3 | Network Anomaly - Non-seasonal deviation > 0

Forensic Event Host Name = launcherHost-2
Network Anomaly = true
Network Anomaly - Date Time (UTC) - Day = 10
Network Anomaly - Date Time (UTC) - Day of Week = 2
Network Anomaly - Date Time (UTC) - Hour = 11
Network Anomaly - Date Time (UTC) - Minute = 38
Network Anomaly - Date Time (UTC) - Month = 8
Network Anomaly - Date Time (UTC) - Second = 0

Rule Severities and Network Anomaly Scores

The Network Anomaly Score is computed similarly to the Forensics Score. For each Workload we compute a Network Anomaly Score. The Network Anomaly Score of a Workload is derived from the Network Anomaly Events observed on that Workload based on the profiles that are enabled for this scope. A score of 100 means no Network Anomaly Events were observed via configured rules in enabled profiles. A score of 0 means there is a Network Anomaly Event detected that requires immediate action.

- A Network Anomaly Event with the severity REQUIRES IMMEDIATE ACTION reduces the Score for the entire Scope to 0.
- A Network Anomaly Event with the severity CRITICAL reduces workload’s score with the impact of 10.
- A Network Anomaly Event with the severity HIGH reduces workload’s score with the impact of 5.
- A Network Anomaly Event with the severity MEDIUM reduces workload’s score with the impact of 3.
- A Network Anomaly Event with the severity LOW doesn’t contribute to the Network Anomaly Score. This is recommended for new rules where the quality of the signal is still being tuned and is likely to be noisy.

For each workload, the total impact score is aggregated every 5 minutes to compute the score of that workload within those 5 minutes.

For workloads without Network Anomaly enabled sensor types, the Network Anomaly scores are N/A.

PCR Data and Network Anomaly Events Retention

PCR data and Network Anomaly events are kept for 7 days.

Network Anomaly Latency

Network Anomaly scores reported in the security dashboard have 5-minute delays. For instance, the score of a workload for the hour 10:00 a.m-10:59 a.m is based on Network Anomaly events happen from 9:55 a.m to 10:54 a.m.

Caveats

- Old Data Leak events remain as Data Leak events instead of Network Anomaly events.
- Network Anomaly detection per protocol is a new feature in 3.3 and the protocol is not set in old Data Leak events.

Process Hash Anomaly Detection

As the name suggested, this feature detects process hash anomaly by assessing the consistency of process binary hashes across the system. The motivation of this feature is as follows. Imagine that you have a farm of Apache web servers that are cloned from the same setup configuration (for example, those servers are deployed from the same automation scripts). You can expect that the hashes of httpd binaries on all servers are the same. If there is a mismatch, it is an anomaly and might worth a further investigation.

Formally, we define a *process group* as the set of processes across workloads in the same rootscope that have the same combination of executable binary path, OS version, and package info (if applicable)1.

Note Package info is included since 3.4 release; in the previous releases, the process group is defined based on the combination of executable binary path and OS version only.

In the above example, if all Apache web servers are running httpd 2.4.43 on CentOS 7.7 and in the same rootscope, then the corresponding process group is the set of processes (across all servers) that have the same combination: binary path of `/usr/sbin/ httpd` & OS version of `CentOS-7.7` & package version of `httpd-2.4.43`. It is expected that the hashes of all binaries in the same process group are the same, and an anomaly will appear if any mismatch is detected.

Besides detecting anomalous process hashes, this feature also detects process hashes that appear in a Flagged list User Uploaded Filehashes by you. The motivation is that you may have a list of known malware hashes, and want to know if a process associated with any of these hashes is run.

To reduce false alarms, we use the National Software Reference Library’s Reference Data Set (RDS) provided by NIST (we also call it NIST RDS dataset) as a Benign list; a benign hash is considered “safe” (see Threat Intelligence, on page 659 on how to enable NIST RDS dataset). Also, you can User Uploaded Filehashes your own hash Benign list.

In addition to the NIST RDS dataset, we also curate **Secure Workload Hash Verdict** service. When this service is enabled, if any known malware hash shows up, it is detected as a malicious hash. However, if the hash is known and legit, then it is also marked as benign in the anomaly analysis. Due to the large dataset and fast updates that cover all known and legit process hashes that can be used to either approve or red flag processes running on a workload, Secure Workload Hash Verdict is only available via Secure Workload Cloud. Refer to Automatic Updates to ensure Secure Workload a Hash Verdict service is accessible from your appliance.

Output of this feature is a security score known as **process hash score**. This score is calculated and output hourly. Like all other security scores, a higher process hash score is better. In particular, for a process hash:

- Hash score of 0 means that the hash is flagged or malicious.
- Hash score of 100 means that the hash is either benign, or consistent across workloads (no mismatch)

- Hash score from 1-99 means that the hash is considered anomalous (that is, there is some mismatch)

The process hash score of a workload is the minimum process hash score of all hashes observed in that workload, with 0 meaning there is a flagged or malicious process hash in the system, and 100 meaning there is no hash anomaly observed in the system.

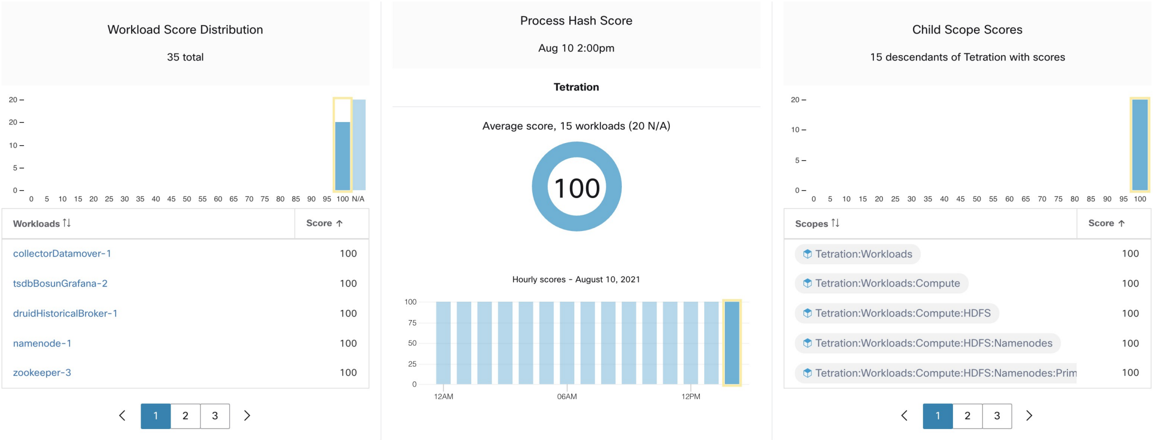
How to Enable Process Hash Feature

Process hash feature is enabled by default on deep visibility agents and enforcement agents; no forensic config is needed. If there are such agents in your system, you should begin to see scores within 2 hours after the system starts.

Where to See Process Hash Score

- **Security Dashboard:**

Figure 347: Process Hash Score Section in Security Dashboard



Workload Score Distribution

35 total

Workloads ↑↓	Score ↑
collectorDatamover-1	100
tsdbBosunGrafana-2	100
druidHistoricalBroker-1	100
namenode-1	100
zookeeper-3	100

Process Hash Score

Aug 10 2:00pm

Tetration

Average score, 15 workloads (20 N/A)

Child Scope Scores

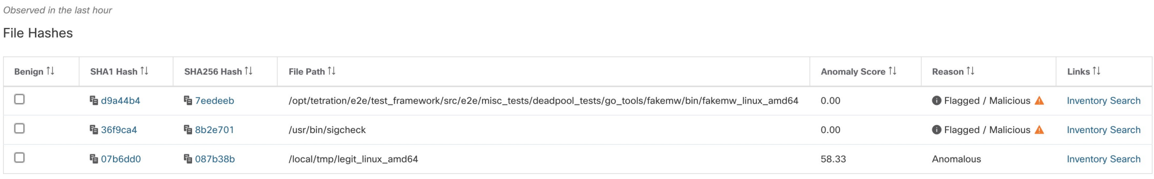
15 descendants of Tetration with scores

Scopes ↑↓	Score ↑
Tetration:Workloads	100
Tetration:Workloads:Compute	100
Tetration:Workloads:Compute:HDFS	100
Tetration:Workloads:Compute:HDFS:Namenodes	100
Tetration:Workloads:Compute:HDFS:Namenodes:Prim	100

Process Hash Score section in Security Dashboard

- **Workload Profile Page** / File Hashes Tab:

Figure 348: File Hashes Tab on Workload Profile Page



Observed in the last hour

File Hashes

Benign ↑↓	SHA1 Hash ↑↓	SHA256 Hash ↑↓	File Path ↑↓	Anomaly Score ↑↓	Reason ↑↓	Links ↑↓
□	d9a44b4	7eedeeb	/opt/tetration/e2e/test_framework/src/e2e/misc_tests/deadpool_tests/go_tools/fakemw/bin/fakemw_linux_amd64	0.00	Flagged / Malicious ⚠	Inventory Search
□	36f9ca4	8b2e701	/usr/bin/sigcheck	0.00	Flagged / Malicious ⚠	Inventory Search
□	07b6dd0	087b38b	/local/tmp/legit_linux_amd64	58.33	Anomalous	Inventory Search

File Hashes tab in Workload Profile

How the Process Hash Score is Calculated

For each process hash, we compute a score as follows:

1. If the hash is flagged or malicious, `score = 0`
2. Else, if hash is benign, `score = 100`
3. Else, if hash is an anomaly, `score` is in the range of `[1, 99]`, the higher the better.
4. Else, `score = 100`

The logic for calculating score in (3) is that we first calculate the minority score of the hash (which is one minus the population ratio of that hash in workload population under the same rootscope), then map it to range `[0.0, 1.0]` using an information function `-log2(x)` if the minority score of the hash is above 0.5, then map the score again to a range `[1.0, 99.0]`. Let us take the above example of the Apache web server farm and consider the hash of `httpd`. Below are some scenarios:

- Suppose that `httpd` has two hash values (`h1` and `h2`) across 1000 servers in the farm: `h1` in 1 server, `h2` in the rest 999 servers. In this case:
  - `population_ratio(h1) = 0.001, population_ratio(h2) = 0.999.` Then:
  - `minority_score(h1) = 0.999, minority_score(h2) = 0.001.` Then:
  - `score(h1) = -log2(0.999) * 98 + 1 = 1.14;`
  - Since `minority_score(h2) < 0.5, h2` is not considered an anomaly, hence `score(h2) = 100.`
- Suppose that `httpd` has two hash values (`h1` and `h2`) across 10 servers in the farm: `h1` in 1 server, `h2` in the rest 9 servers. In this case:
  - `population_ratio(h1) = 0.1, population_ratio(h2) = 0.9.` Then:
  - `minority_score(h1) = 0.9, minority_score(h2) = 0.1.` Then:
  - `score(h1) = -log2(0.9) * 98 + 1 = 15.90;`
  - Since `minority_score(h2) < 0.5, h2` is not considered an anomaly, hence `score(h2) = 100.`
- Suppose that `httpd` has two hash values (`h1` and `h2`) across 2 servers in the farm: `h1` in one server, `h2` in the other. In this case:
  - `population_ratio(h1) = population_ratio(h2) = 0.5.` Then:
  - `minority_score(h1) = minority_score(h2) = 0.5.` Then:
  - `score(h1) = score(h2) = -log2(0.5) * 98 + 1 = 99.0.` This is the highest score for any hash that is considered an anomaly.
- Suppose that `httpd` has only one hash value (`h1`) across all servers. In this case, `minority_score(h1) = 0.0 < 0.5;` hence it is not considered an anomaly, and `score(h1) = 100.`

Finally, the process hash score of a workload is the minimum process hash score of all that hashes observed in that workload.

Additional information about the `-log2(x)` information function is found here.

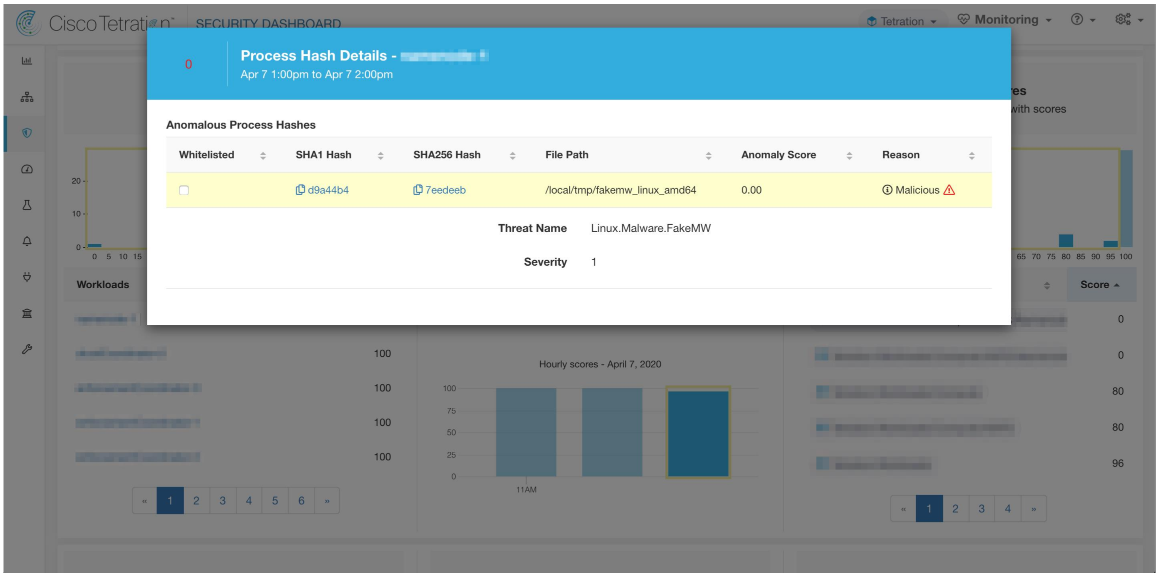
How to Improve Process Hash Score

The process hash score of 0 on a workload means that a flagged or malicious process hash has shown up in that workload; preventing such process to run again improves the score. A positive process hash score less than 100 means that there is a process hash anomaly across your system; it is not malicious but worth a further investigation. After a careful investigation, if the hash is concluded to be safe, adding it to your Benign list will also improve the score. User can mark anomalous hashes as 'benign' by clicking on the Benign checkbox in the File Hashes / Process Hash Details page or by User Uploaded Filehashes.

Threat Info Details

As mentioned earlier, if Secure Workload the Hash Verdict service is enabled, any known malware hash when showing up would be flagged as malicious. In that case, more threat information of the malicious hash (gathered via our threat intelligence platform) will be provided. Currently the additional threat data include *threat name* and *severity*. Threat name is the name of the threat, while severity is a value from 1-5 to indicate how severe the threat is, where 1 means the least and 5 means the most severe.

Figure 349: User Can Click on the Row of Malicious Hash to View Its Threat Info Details



0 Process Hash Details - [redacted]
Apr 7 1:00pm to Apr 7 2:00pm

Anomalous Process Hashes

Whitelisted	SHA1 Hash	SHA256 Hash	File Path	Anomaly Score	Reason
□	d9a44b4	7eedeeb	/local/tmp/fakemw_linux_amd64	0.00	Malicious ⚠

Threat Name	Linux.Malware.FakeMW
Severity	1

Caveats

- Process hash analysis task is run once per hour, but it may take up to 2 hours for the expected scores/results to show in the security dashboard depending on the action. For examples:
  - If you upload your hash Flagged list and a process hash in that list shows up, it may take up to 1 hour for the score to be reflected in the security dashboard.
  - If you remove a hash from your Flagged list, it may take up to 2 hours for it to be cleared and the score is reflected in the security dashboard.
- Retention:
  - Detailed results from process hash analysis are kept for at least 7 days.

- File Hashes tab in Workload Profile page only shows process hash details analyzed in the last hour.
- Previous versions of deep visibility and enforcement agents, and AnyConnect endpoints only report SHA256 hash values. Thus, matching against SHA1 hash Flagged/Benign list is not supported for those agents.
- Process hash score is calculated regarding a particular rootscope. If a workload belongs to multiple rootscopes, the process hash score of that workload is the minimum score across all rootscopes that it belongs to.
- To further reduce the false alarms in process hash anomaly analysis, we also mark all Secure Workload agent binaries as benign according to their file paths. This mechanism happens only when these hashes do not appear in any user-defined hash list, or are not flagged by Secure Workload Hash Verdict service.

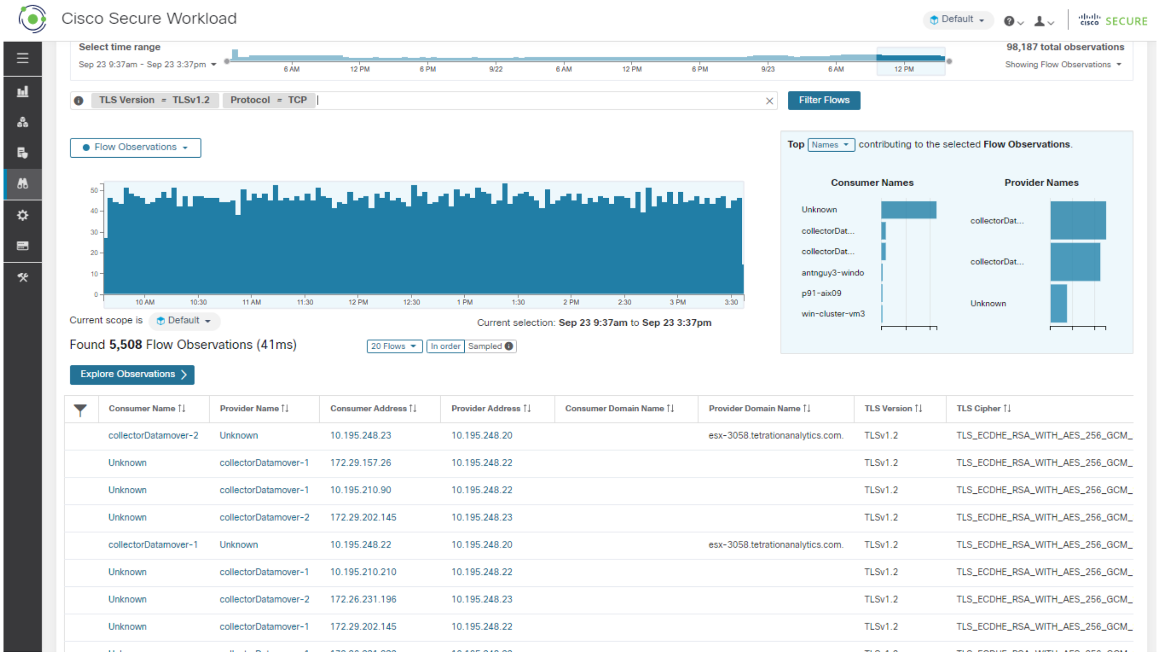
CHAPTER 8

Flows

The **Investigate** > **Traffic** option in the left navigation menu takes you to the Flow Search page. This page provides the means for quickly filtering and drilling down into the flows corpus. The basic unit is a **Flow Observation** which is a per-minute aggregation of each unique flow. The two sides of the flow are called **Consumer** and **Provider**, the consumer is the side that initiated the flow, and the provider is responding to the consumer (for example **Client** and **Server** respectively). Each observation tracks the number of packets, bytes, and other metrics in each direction for that flow for that minute interval. In addition to quickly filtering, the flows can be explored visually with **Explore Observations**. The resulting list of flows observations can be clicked to view details of that flow, including latency, packets, and bytes over the lifetime of that flow.

Warning For hosts instrumented with Deep Visibility Agents or Enforcement Agents, Secure Workload is able to correlate flow data against the process that provides or consumes the flow. As a result, full command-line arguments, which may include **sensitive information such as database or API credentials**, used to launch the process are available for analysis and display.

Figure 350: Flows Overview

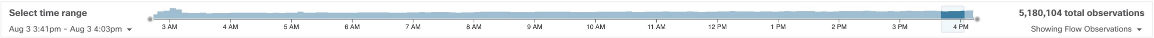


Found 5,508 Flow Observations (41ms)

Consumer Name	Provider Name	Consumer Address	Provider Address	Consumer Domain Name	Provider Domain Name	TLS Version	TLS Cipher
collectorDatamover-2	Unknown	10.195.248.23	10.195.248.20		esx-3058.tetrationanalytics.com.	TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
Unknown	collectorDatamover-1	172.29.157.26	10.195.248.22			TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
Unknown	collectorDatamover-1	10.195.210.90	10.195.248.22			TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
Unknown	collectorDatamover-2	172.29.202.145	10.195.248.23			TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
collectorDatamover-1	Unknown	10.195.248.22	10.195.248.20		esx-3058.tetrationanalytics.com.	TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
Unknown	collectorDatamover-1	10.195.210.210	10.195.248.22			TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
Unknown	collectorDatamover-2	172.26.231.196	10.195.248.23			TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_
Unknown	collectorDatamover-1	172.29.202.145	10.195.248.22			TLSv1.2	TLS_ECDHE_RSA_WITH_AES_256_GCM_

Corpus Selector

Figure 351: Corpus Selector

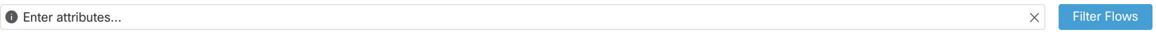

Select time range
Aug 3 3:41pm - Aug 3 4:03pm
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5,180,104 total observations
Showing Flow Observations

This is the unfiltered summary timeseries data for the current **Scope** for the entire corpus. The purpose of this component is to allow you to know what date range is being viewed, and easily change that date range by dragging within the component. The data in the chart is there in case it's useful for deciding which time range to select. You can select different metrics to be shown, by default the count of **flow observations** is shown.

The Corpus Selector can currently support selecting up to *approximately* **2 billion flow observations**.

Columns and Filters

Figure 352: Filter input



This is where you define filters to narrow-down the search results. All of the possible dimensions can be found by clicking on the **(?)** icon next to the word **Filters**. For any User Labels data, those columns will also be available for the appropriate intervals. This input also supports **and**, **or**, **not**, and **parenthesis** keywords, use these to express more complex filters. For example, a direction-agnostic filter between IP *1.1.1.1* and *2.2.2.2* can be written:

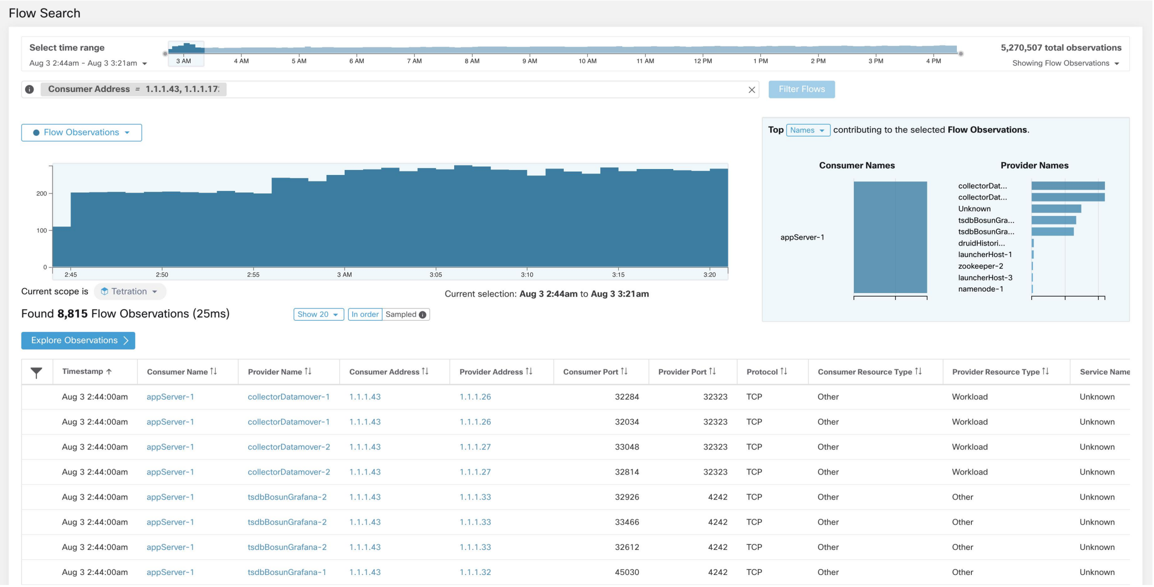
Consumer Address = 1.1.1.1 and Provider Address = 2.2.2.2 or Consumer Address = 2.2.2.2 and Provider Address = 1.1.1.1

And to additionally filter on Protocol = TCP:

(Consumer Address = 1.1.1.1 and Provider Address = 2.2.2.2 or Consumer Address = 2.2.2.2 and Provider Address = 1.1.1.1) and Protocol = TCP

The filter input also supports “,” and “-” for Port, Consumer Address and Provider Address, by translating “-” into range queries. The following are examples of a valid filter:

Figure 353: Example: Filter input supports “,” for Consumer Address



Consumer Address = 1.1.1.43, 1.1.1.17

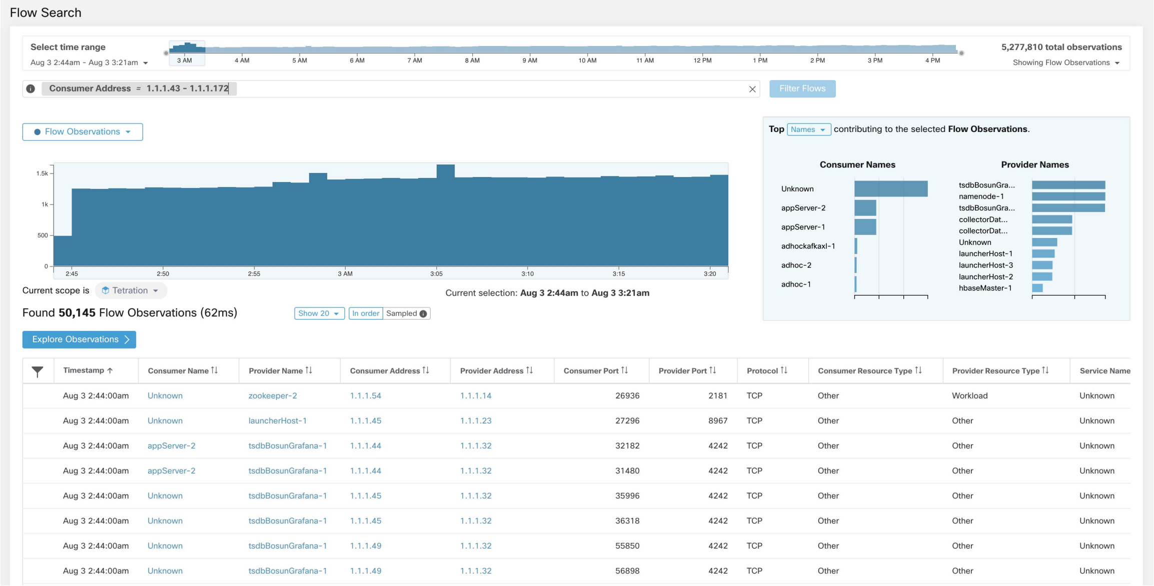
Current scope is Tetration

Current selection: **Aug 3 2:44am** to **Aug 3 3:21am**

Found **8,815** Flow Observations (25ms)

Timestamp ↑	Consumer Name ⇅	Provider Name ⇅	Consumer Address ⇅	Provider Address ⇅	Consumer Port ⇅	Provider Port ⇅	Protocol ⇅	Consumer Resource Type ⇅	Provider Resource Type ⇅	Service Name
Aug 3 2:44:00am	appServer-1	collectorDatamover-1	1.1.1.43	1.1.1.26	32284	32323	TCP	Other	Workload	Unknown
Aug 3 2:44:00am	appServer-1	collectorDatamover-1	1.1.1.43	1.1.1.26	32034	32323	TCP	Other	Workload	Unknown
Aug 3 2:44:00am	appServer-1	collectorDatamover-2	1.1.1.43	1.1.1.27	33048	32323	TCP	Other	Workload	Unknown
Aug 3 2:44:00am	appServer-1	collectorDatamover-2	1.1.1.43	1.1.1.27	32814	32323	TCP	Other	Workload	Unknown
Aug 3 2:44:00am	appServer-1	tsdbBosunGrafana-2	1.1.1.43	1.1.1.33	32926	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	appServer-1	tsdbBosunGrafana-2	1.1.1.43	1.1.1.33	33466	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	appServer-1	tsdbBosunGrafana-2	1.1.1.43	1.1.1.33	32612	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	appServer-1	tsdbBosunGrafana-1	1.1.1.43	1.1.1.32	45030	4242	TCP	Other	Other	Unknown

Figure 354: Example: Filter input supports range query for Consumer Address



Flow Search

Select time range

Aug 3 2:44am - Aug 3 3:21am

5,277,810 total observations

Showing Flow Observations

Consumer Address = 1.1.1.43 - 1.1.1.172

Current scope is Tetration

Current selection: **Aug 3 2:44am** to **Aug 3 3:21am**

Found **50,145** Flow Observations (62ms)

Top Names contributing to the selected **Flow Observations**.

Consumer Names	Provider Names
Unknown	tsdbBosunGra...
appServer-2	namenode-1
appServer-1	tsdbBosunGra...
adhockafkaxl-1	collectorDat...
adhoc-2	collectorDat...
adhoc-1	Unknown
	launcherHost-1
	launcherHost-3
	launcherHost-2
	hbaseMaster-1

Timestamp ↑	Consumer Name ⇅	Provider Name ⇅	Consumer Address ⇅	Provider Address ⇅	Consumer Port ⇅	Provider Port ⇅	Protocol ⇅	Consumer Resource Type ⇅	Provider Resource Type ⇅	Service Name
Aug 3 2:44:00am	Unknown	zookeeper-2	1.1.1.54	1.1.1.14	26936	2181	TCP	Other	Workload	Unknown
Aug 3 2:44:00am	Unknown	launcherHost-1	1.1.1.45	1.1.1.23	27296	8967	TCP	Other	Other	Unknown
Aug 3 2:44:00am	appServer-2	tsdbBosunGrafana-1	1.1.1.44	1.1.1.32	32182	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	appServer-2	tsdbBosunGrafana-1	1.1.1.44	1.1.1.32	31480	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	Unknown	tsdbBosunGrafana-1	1.1.1.45	1.1.1.32	35996	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	Unknown	tsdbBosunGrafana-1	1.1.1.45	1.1.1.32	36318	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	Unknown	tsdbBosunGrafana-1	1.1.1.49	1.1.1.32	55850	4242	TCP	Other	Other	Unknown
Aug 3 2:44:00am	Unknown	tsdbBosunGrafana-1	1.1.1.49	1.1.1.32	56898	4242	TCP	Other	Other	Unknown

Table 30: Available Columns and Filters:

Columns (names exposed in API)	Description	Source
Consumer Address (*src_address*)	Enter a subnet or IP Address using CIDR notation (eg. 10.11.12.0/24). Matches flow observations whose consumer address overlaps with provided IP Address or subnet.	Software Agents and Ingest Appliances
Provider Address (*dst_address*)	Enter a subnet or IP Address using CIDR notation (eg. 10.11.12.0/24) Matches flow observations whose provider address overlaps with provided ip address or subnet.	Software Agents and Ingest Appliances
Consumer Domain Name	Matches flow observations whose consumer domain name (associated with the consumer IP address/subnet) overlaps with the entered consumer domain name.	Software Agents and Anyconnect
Provider Domain Name	Matches flow observations whose provider domain name (associated with the provider IP address/subnet) overlaps with the entered provider domain name.	Software Agents and Anyconnect
Consumer Hostname (*src_hostname*)	Matches flows whose consumer hostname overlaps with provided host-name.	Software Agents and Anyconnect
Provider Hostname (*dst_hostname*)	Matches flows whose provider hostname overlaps with provided host-name.	Software Agents and Anyconnect

Columns (names exposed in API)	Description	Source
Consumer Enforcement Group (*src_enforcement_epg_name*)	The Consumer Enforcement Group is the name of the filter (Scope, Inventory Filter or Cluster) in the enforced policies that matches the consumer.	Internal
Provider Enforcement Group (*dst_enforcement_epg_name*)	The Provider Enforcement Group is the name of the filter (Scope, Inventory Filter or Cluster) in the enforced policies that matches the provider.	Internal
Consumer Analysis Group	The Consumer Analysis Group is the name of the filter (Scope, Inven- tory Filter or Cluster) in the analyzed policies that matches the consumer.	Internal
Provider Analysis Group	The Provider Analysis Group is the name of the filter (Scope, Inventory Filter or Cluster) in the analyzed policies that matches the provider.	Internal
Consumer Scope (*src_scope_name*)	Matches flows whose consumer belongs to the specified Scope.	Internal
Provider Scope (*dst_scope_name*)	Matches flows whose provider belongs to the specified Scope.	Internal
Consumer Port (*src_port*)	Matches flows whose Consumer port overlaps with provided port.	Software Agents, ERSPAN and Netflow
Provider Port (*dst_port*)	Matches flows whose Provider port overlaps with provided port.	Software Agents, ERSPAN and Netflow
Consumer Country (*src_country*)	Matches flows whose Consumer country overlaps with provided country.	Internal
Provider Country (*dst_country*)	Matches flows whose Provider country overlaps with provided country.	Internal
Consumer Subdivision (*src_subdivision*)	Matches flows whose Consumer subdivision overlaps with provided subdivision (state).	Internal
Provider Subdivision (*dst_subdivision*)	Matches flows whose Provider subdivision overlaps with provided subdivision (state).	Internal
Consumer Autonomous System Organization (*src_ autonomous_system_organization*)	Matches flows whose Consumer autonomous system organization over- laps with provided autonomous system organization (ASO).	Internal

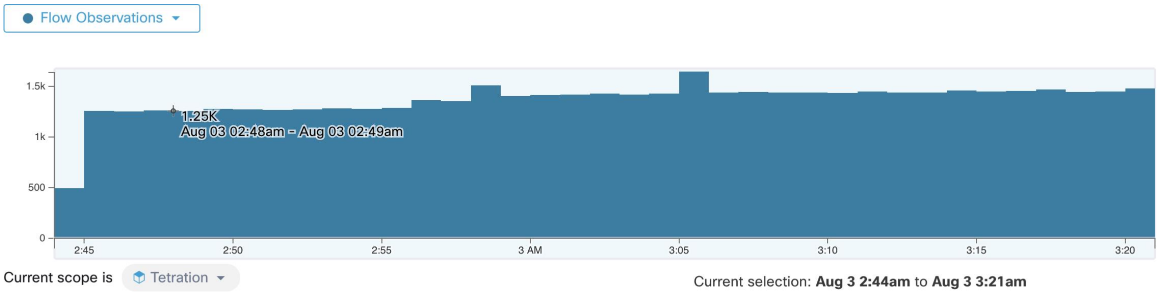
Columns (names exposed in API)	Description	Source
Provider Autonomous System Organization (*dst_autonomous_system_organization*)	Matches flows whose Provider autonomous system organization over- laps with provided autonomous system organization (ASO).	Internal
Protocol (*proto*)	Filter flow observations by Protocol type (TCP, UDP, ICMP).	Software Agents and Ingest Appliances
Address Type (*key_type*)	Filter flow observations by Address type (IPv4, IPv6, DHCPv4).	Software Agents and Ingest Appliances
Fwd TCP Flags	Filter flow observations by flags (SYN, ACK, ECHO).	Software Agents, ERSPAN and Netflow
Rev TCP Flags	Filter flow observations by flags (SYN, ACK, ECHO).	Software Agents, ERSPAN and Netflow
Fwd Process UID (*fwd_process_owner*)	Filter flow observations by process owner UID (root, admin, yarn, mapred).	Software Agents
Rev Process UID (*rev_process_owner*)	Filter flow observations by process owner UID (root, admin, yarn, mapred).	Software Agents
Fwd Process (*fwd_process_string*)	Filter flow observations by process (java, hadoop, nginx). See Process String Visibility Warning	Software Agents
Rev Process (*rev_process_string*)	Filter flow observations by process (java, hadoop, nginx). See Process String Visibility Warning	Software Agents
Consumer In Collection Rules?	Match only internal Consumers.	Internal
Provider In Collection Rules?	Match only internal Providers.	Internal
SRTT Available	Matches flows which have SRTT measurements available using the values ‘true’ or ‘false’. (This is equivalent to SRTT > 0).	Internal
Bytes	Filter flow observations by Byte traffic bucket. Matches flows whichByte traffic bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024)).	Software Agent and Ingest Appliances
Packets	Filter flow observations by Packet traffic bucket. Matches flows which Packet traffic bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024)).	Software Agent and Ingest Appliances

Columns (names exposed in API)	Description	Source
Flow Duration (µs)	Filter flow observations by Flow Duration bucket. Matches flows which Flow Duration bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024).	Internal
Data Duration (µs)	Filter flow observations by Data Duration bucket. Matches flows which Data Duration bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024).	Internal
SRTT (µs) (*srtt_dim_usec*)	Filter flow observations by SRTT bucket. Matches flows which SRTT bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024)).	Software Agent
Fwd Packet Retransmissions (*fwd_tcp_pkts_retransmitted*)	Filter flow observations by Packet Retransmissions bucket. Matches flows which Packet Retransmissions bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024)).	Software Agent
Rev Packet Retransmissions (*rev_tcp_pkts_retransmitted*)	Filter flow observations by Packet Retransmissions bucket. Matches flows which Packet Retransmissions bucket values are =, <, > (bucketed by powers of 2 (0, 2, 64, 1024)).	Software Agent
User Labels (* or *user_* prefix)	User-defined data associated to the manually uploaded custom labels prefixed with * in the UI and *user_* in OpenAPI.	CMDB
TLS Version	SSL protocol version used in the flow.	Software Agent
TLS Cipher	Algorithm type used by the SSL protocol in the flow.	Software Agent
Consumer Agent Type	Specify the consumer agent type.	Internal
Provider Agent Type	Specify the provider agent type.	Internal
Consumer Resource Type	Represents the flow of resources from a source to a consumer. It can be either workload, pods, services or others	Internal
Provider Resource Type	Represents the flow of resources from a provider to a consumer. . It can be either workload, pods, services or others.	Internal

Note Because flow data is labelled with User Labels only at ingestion time, User Labels will not appear right away after enabling them. It may take a few minutes before the labels start appearing in Flow Search. Also, the available User Labels will be different depending on which part of the **Corpus Selector** you have selected, since the enabled Labels might have been changed at various times.

Filtered Time series

Figure 355: Filtered Time series

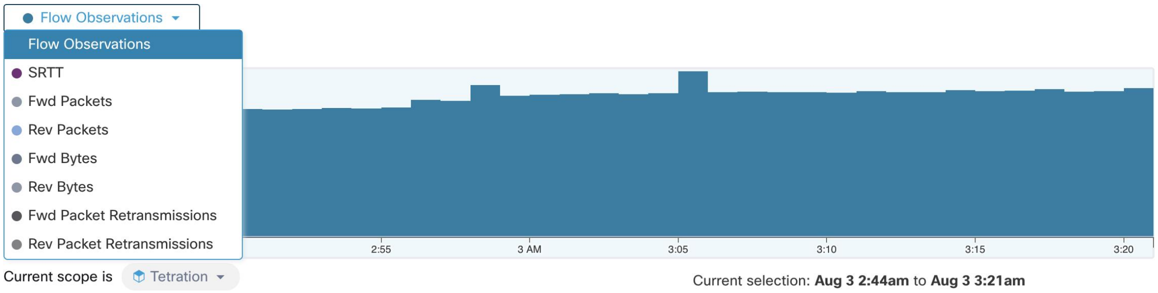


Current scope is Tetration

Current selection: **Aug 3 2:44am** to **Aug 3 3:21am**

This component displays the aggregated totals of various metrics for the interval selected (the selection made in the above Corpus Selector, on page 624). Use the dropdown to change which metric is displayed.

Figure 356: Time series dropdown

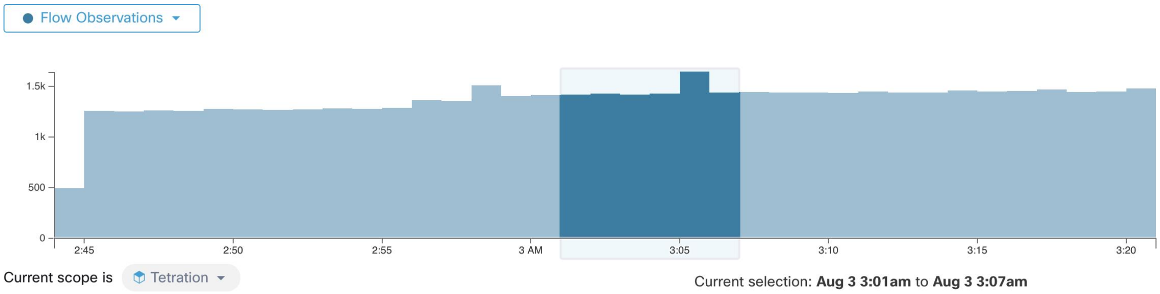


Current scope is Tetration

Current selection: **Aug 3 2:44am** to **Aug 3 3:21am**

Further-narrowing of the selected interval can also be done in this component. Click the area of the chart that you'd like to focus on, and the Top N Charts and the data below will all be updated to include only data from that selected interval.

Figure 357: Time series with selection

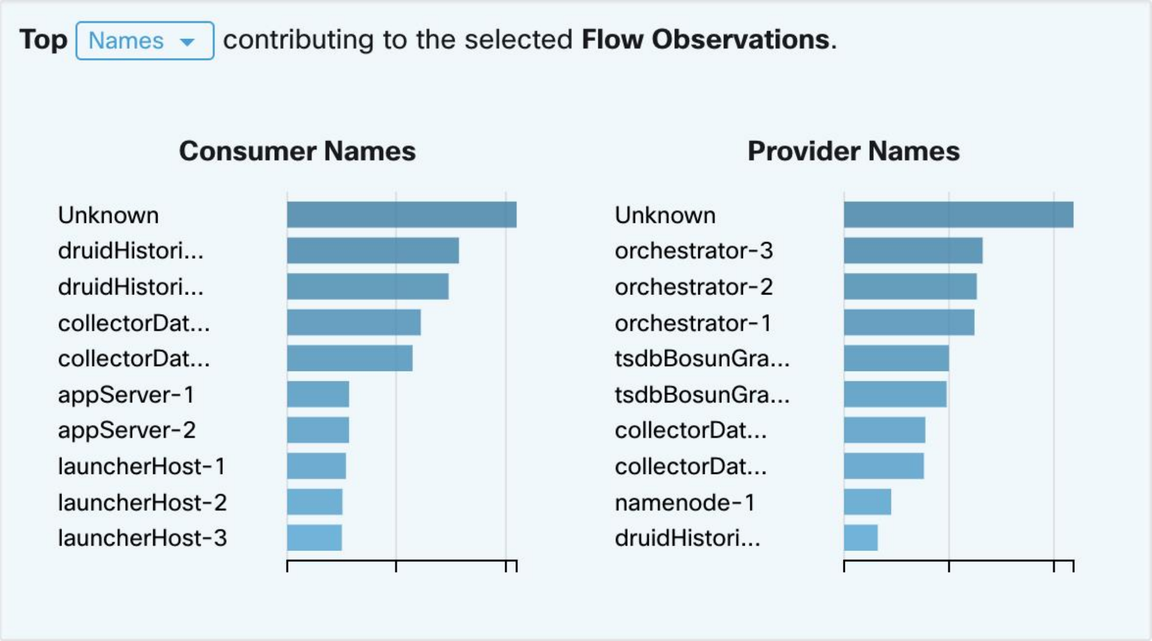


Current scope is Tetration

Current selection: **Aug 3 3:01am** to **Aug 3 3:07am**

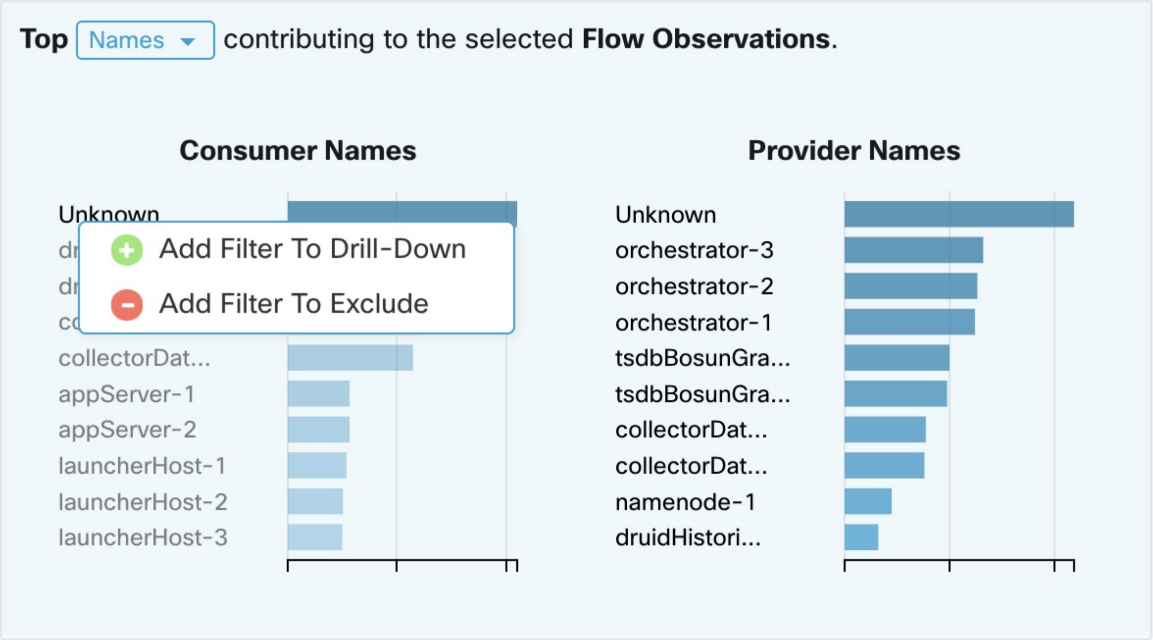
Top N Charts

Figure 358: Top N Charts



The charts display the Top N values that contribute to the selection in the Filtered Time series chart to the left. Selecting a peak in Flow Observations in the time series chart, and hostnames in the Top N charts, displays the list of hostnames (Consumer and Provider) that contribute the most to those flow observations. Also, if the time series chart is set to display SRTT, then the Top Hostnames display those that contribute most to that selected SRTT.

Figure 359: Drill-down/Exclude

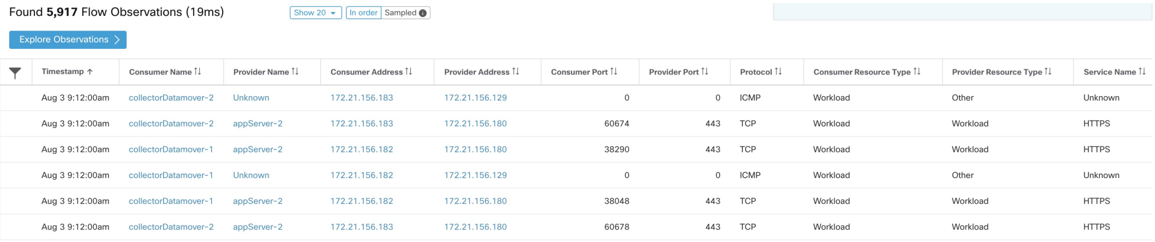


Click on any of the items in the Top N charts to display a menu that allows you to either **Drill-Down** or **Exclude** that value.

- Click **Drill-Down** to add a filter that confines the results to just that value.
- Click **Exclude** to add a filter that excludes that value from the results.

Note After clicking **Drill-Down** or **Exclude**, the **Filter** icon must be pressed for the filter to take effect. This is so that multiple **Exclude** actions can be taken quickly without having the page repeatedly update in the middle.

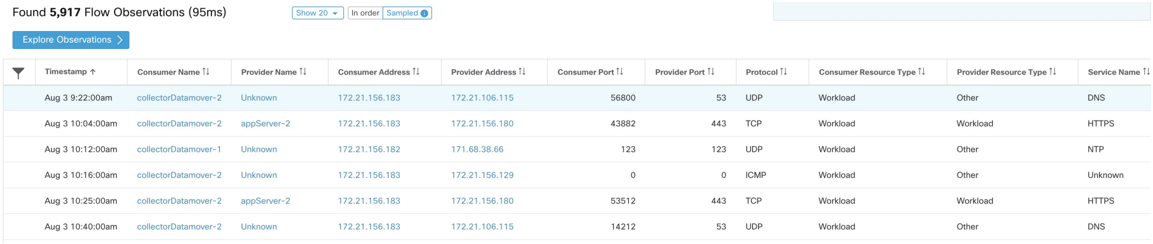
Observations List


Found **5,917** Flow Observations (19ms)

	Timestamp ↑	Consumer Name ⇅	Provider Name ⇅	Consumer Address ⇅	Provider Address ⇅	Consumer Port ⇅	Provider Port ⇅	Protocol ⇅	Consumer Resource Type ⇅	Provider Resource Type ⇅	Service Name ⇅
	Aug 3 9:12:00am	collectorDatamover-2	Unknown	172.21.156.183	172.21.156.129	0	0	ICMP	Workload	Other	Unknown
	Aug 3 9:12:00am	collectorDatamover-2	appServer-2	172.21.156.183	172.21.156.180	60674	443	TCP	Workload	Workload	HTTPS
	Aug 3 9:12:00am	collectorDatamover-1	appServer-2	172.21.156.182	172.21.156.180	38290	443	TCP	Workload	Workload	HTTPS
	Aug 3 9:12:00am	collectorDatamover-1	Unknown	172.21.156.182	172.21.156.129	0	0	ICMP	Workload	Other	Unknown
	Aug 3 9:12:00am	collectorDatamover-1	appServer-2	172.21.156.182	172.21.156.180	38048	443	TCP	Workload	Workload	HTTPS
	Aug 3 9:12:00am	collectorDatamover-2	appServer-2	172.21.156.183	172.21.156.180	60678	443	TCP	Workload	Workload	HTTPS

This is the list of actual **Flow Observations** that matches the filters and selections in the page above. By default, 20 will be loaded starting from the beginning of the interval. It’s possible to increase the number that are loaded by using the dropdown. It’s also possible to load a random set of flow observations from the selected interval by using **Sampled** rather than **In order**. The **Sampled** setting is useful for getting a more representative set of flow observations from the selected interval rather than loading them sequentially from the beginning of the interval.

Figure 360: Sampled



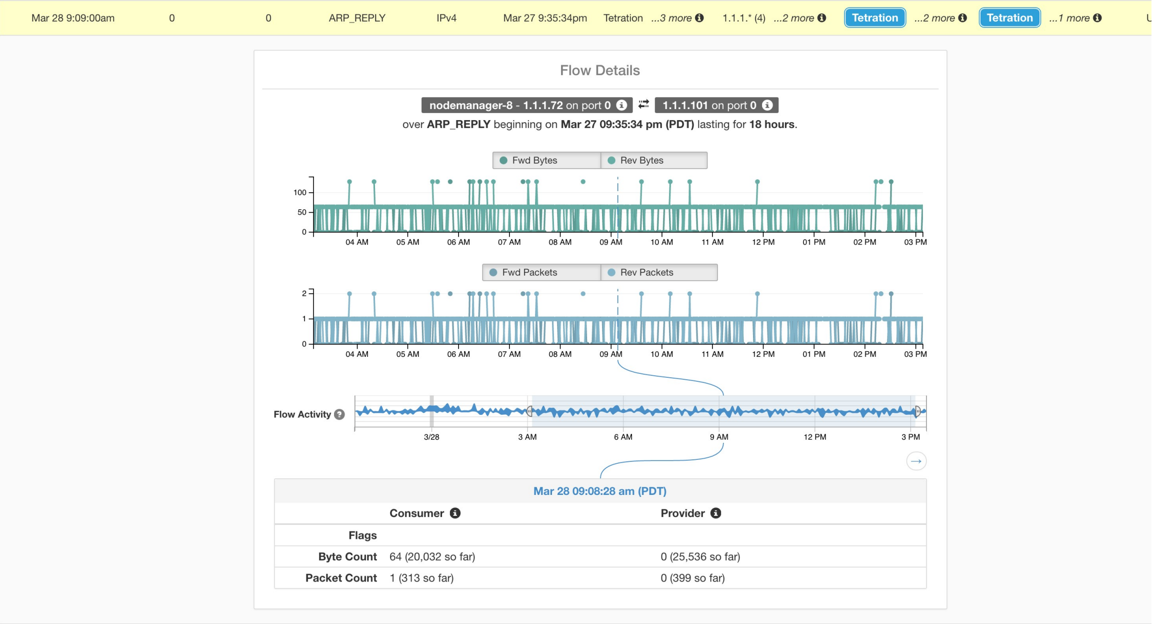
Found **5,917** Flow Observations (95ms)

Timestamp ↑	Consumer Name ↑↓	Provider Name ↑↓	Consumer Address ↑↓	Provider Address ↑↓	Consumer Port ↑↓	Provider Port ↑↓	Protocol ↑↓	Consumer Resource Type ↑↓	Provider Resource Type ↑↓	Service Name ↑↓
Aug 3 9:22:00am	collectorDatamover-2	Unknown	172.21.156.183	172.21.106.115	56800	53	UDP	Workload	Other	DNS
Aug 3 10:04:00am	collectorDatamover-2	appServer-2	172.21.156.183	172.21.156.180	43882	443	TCP	Workload	Workload	HTTPS
Aug 3 10:12:00am	collectorDatamover-1	Unknown	172.21.156.182	171.68.38.66	123	123	UDP	Workload	Other	NTP
Aug 3 10:16:00am	collectorDatamover-2	Unknown	172.21.156.183	172.21.156.129	0	0	ICMP	Workload	Other	Unknown
Aug 3 10:25:00am	collectorDatamover-2	appServer-2	172.21.156.183	172.21.156.180	53512	443	TCP	Workload	Workload	HTTPS
Aug 3 10:40:00am	collectorDatamover-2	Unknown	172.21.156.183	172.21.106.115	14212	53	UDP	Workload	Other	DNS

Flow Details

Click on any of the rows to expand the **Flow Details** section. This displays a summary of the flow and charts for various metrics for the lifetime of that flow. For long-lived flows, a summary chart is displayed at the bottom that allows you to choose different intervals for which to view time series data.

Figure 361: Flow details



Mar 28 9:09:00am 0 0 ARP_REPLY IPv4 Mar 27 9:35:34pm Tetration ...3 more 1.1.1.* (4) ...2 more Tetration ...2 more Tetration ...1 more U

Flow Details

nodemanager-8 - 1.1.1.72 on port 0 ⇄ 1.1.1.101 on port 0

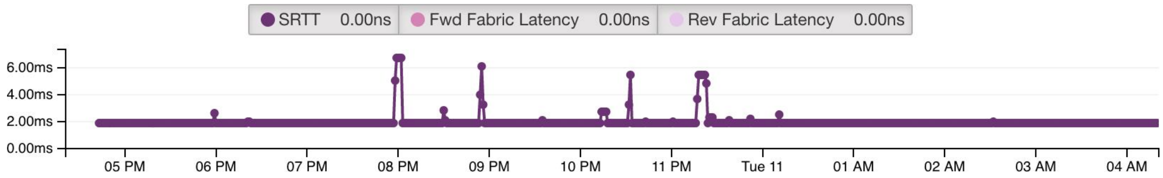
over **ARP_REPLY** beginning on **Mar 27 09:35:34 pm (PDT)** lasting for **18 hours**.

Mar 28 09:08:28 am (PDT)

	Consumer	Provider
Flags		
Byte Count	64 (20,032 so far)	0 (25,536 so far)
Packet Count	1 (313 so far)	0 (399 so far)

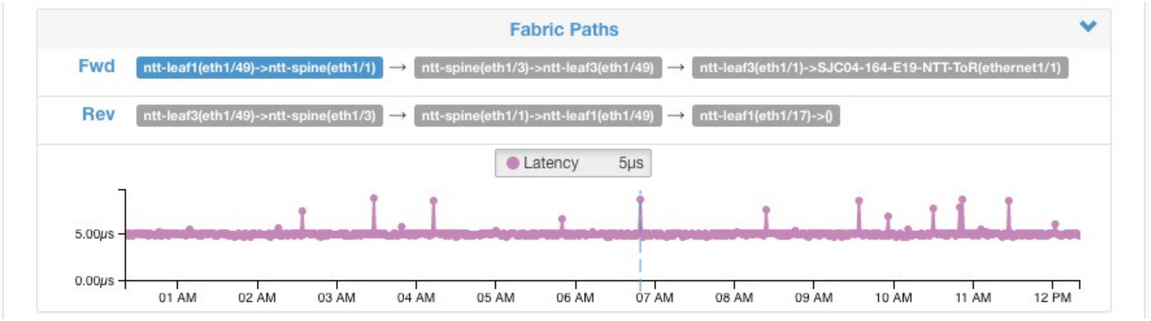
For flows labeled with Fabric Path information, **Fwd/Rev Fabric Latency** and **SRTT** are available. Time series charts for other metrics such as **Fwd/Rev Burst Indicators** and **Fwd/Rev Burst+drop Indicators** may be displayed if available. See Compatibility.

Figure 362: Latency



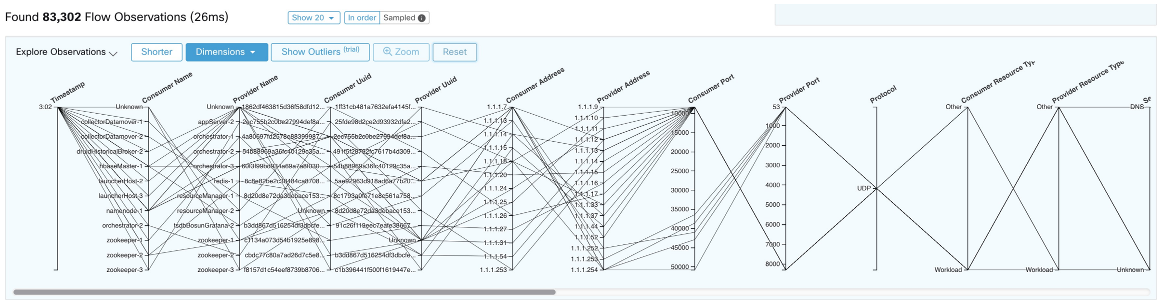
In addition, details about the **Fwd/Rev Fabric Path** are available. Each link is clickable, toggling **Latency** and **Drop Indicators** time series charts (when none-zero). Click **Fwd** or **Rev** to navigate to the Fabric Path Overlay page drill-down for the flow.

Figure 363: Fabric paths


Fabric Paths
Fwd
ntt-leaf1(eth1/49)->ntt-spine(eth1/1)
ntt-spine(eth1/3)->ntt-leaf3(eth1/49)
ntt-leaf3(eth1/1)->SJC04-164-E19-NTT-ToR(ethernet1/1)
Rev
ntt-leaf3(eth1/49)->ntt-spine(eth1/3)
ntt-spine(eth1/1)->ntt-leaf1(eth1/49)
ntt-leaf1(eth1/17)->()
Latency 5μs
5.00μs
0.00μs
01 AM
02 AM
03 AM
04 AM
05 AM
06 AM
07 AM
08 AM
09 AM
10 AM
11 AM
12 PM

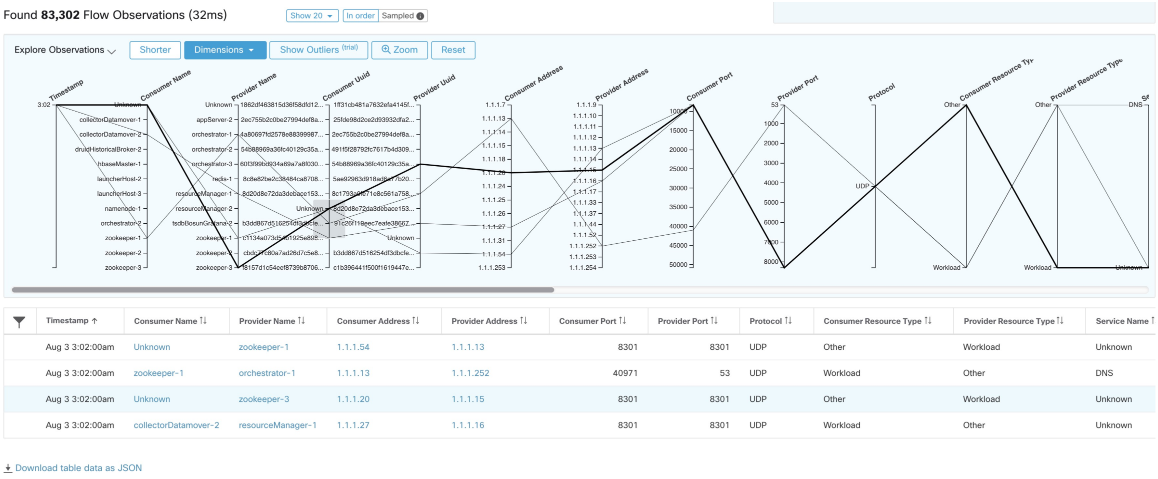
Explore Observations

Figure 364: Explore Observations



Click **Explore Observations** to enable a chart view that allows quick exploration of the high-dimensional data (**Parallel Coordinates** chart). A bit overwhelming at first, this chart is useful when enabling only the dimensions you're interested in (by unchecking items in the **Dimensions** dropdown), and when rearranging the order of the dimensions. A single line in this chart represents a single observation, and where that line intersects with the various axes indicates the value of that observation for that dimension. This can become clearer when hovering over the list of observations below the chart to see the highlighted line representing that observation in the chart:

Figure 365: Flow Observation hovered



Found **83,302** Flow Observations (32ms)

	Timestamp ↑	Consumer Name ↑↓	Provider Name ↑↓	Consumer Address ↑↓	Provider Address ↑↓	Consumer Port ↑↓	Provider Port ↑↓	Protocol ↑↓	Consumer Resource Type ↑↓	Provider Resource Type ↑↓	Service Name ↑
	Aug 3 3:02:00am	Unknown	zookeeper-1	1.1.1.54	1.1.1.13	8301	8301	UDP	Other	Workload	Unknown
	Aug 3 3:02:00am	zookeeper-1	orchestrator-1	1.1.1.13	1.1.1.252	40971	53	UDP	Workload	Other	DNS
	Aug 3 3:02:00am	Unknown	zookeeper-3	1.1.1.20	1.1.1.15	8301	8301	UDP	Other	Workload	Unknown
	Aug 3 3:02:00am	collectorDatamover-2	resourceManager-1	1.1.1.27	1.1.1.16	8301	8301	UDP	Workload	Other	Unknown

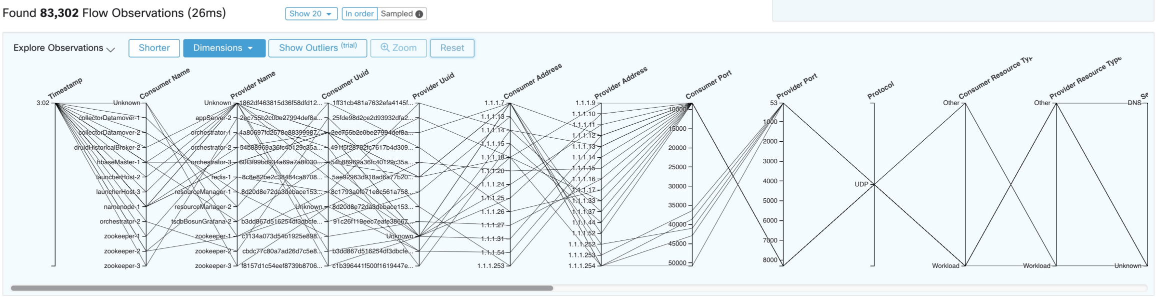
Download table data as JSON

Due to the high-dimensional nature of the flow data, this chart is wide by default, and requires scrolling to the right to see the entire chart. For this reason, it's useful to disable all but the dimensions you're interested in.

Sampling vs. In-Order

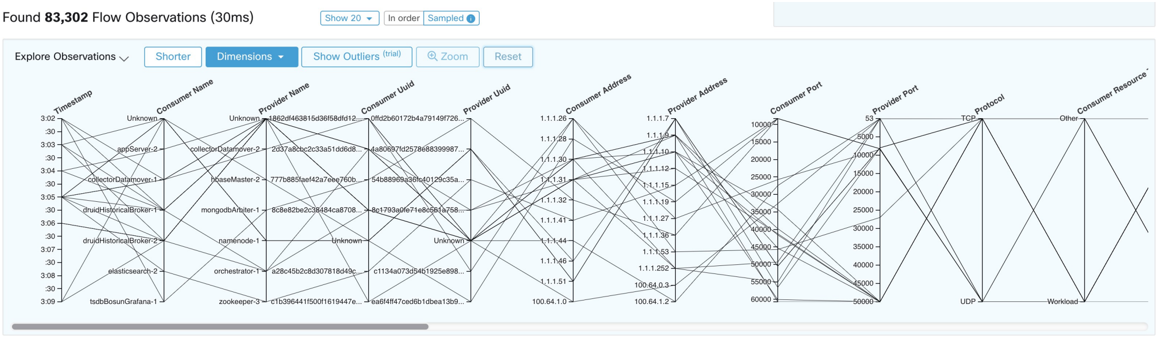
It's recommended that Explore Observations be done with **sampling** enabled, and with a larger number of flows. This allows you to see more of the variety of flows that comprise the selected interval. So, if you've selected 2 million flow observations in the time series chart above, loading a sample of 1000 will take uniformly from throughout the interval, whereas loading flows **In-order** will load the first 1000 flow observations from the very beginning of the interval:

Figure 366: 1000 In-order



Found **83,302** Flow Observations (26ms)

Figure 367: vs. 1000 sampled

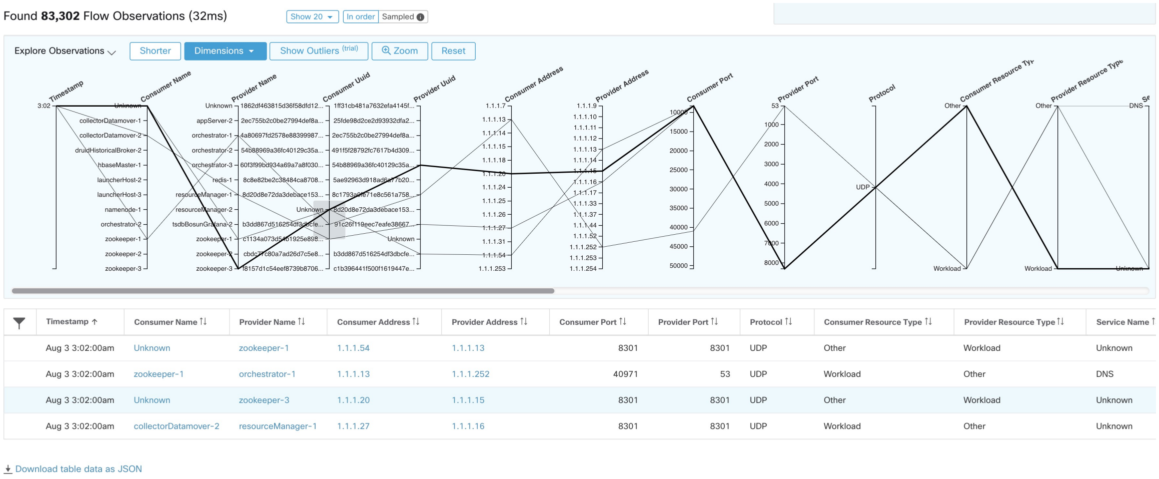

Found **83,302** Flow Observations (30ms)

Notice how the **Timestamp** for all of the in-order observations is from 9:09 and how the observations are evenly distributed through the selected interval in the sampled version.

Filtering

Dragging the cursor along any of the axes create a selection that shows only observations that match that selection. Click again on the axis to remove the selection at any time. Selections can be made on any number of axes at a time. The list of observations updates to show only the selected observations:

Figure 368: Explore with selection


Found **83,302** Flow Observations (32ms)

Timestamp	Consumer Name	Provider Name	Consumer Address	Provider Address	Consumer Port	Provider Port	Protocol	Consumer Resource Type	Provider Resource Type	Service Name
Aug 3 3:02:00am	Unknown	zookeeper-1	1.1.1.54	1.1.1.13	8301	8301	UDP	Other	Workload	Unknown
Aug 3 3:02:00am	zookeeper-1	orchestrator-1	1.1.1.13	1.1.1.252	40971	53	UDP	Workload	Other	DNS
Aug 3 3:02:00am	Unknown	zookeeper-3	1.1.1.20	1.1.1.15	8301	8301	UDP	Other	Workload	Unknown
Aug 3 3:02:00am	collectorDatamover-2	resourceManager-1	1.1.1.27	1.1.1.16	8301	8301	UDP	Workload	Other	Unknown

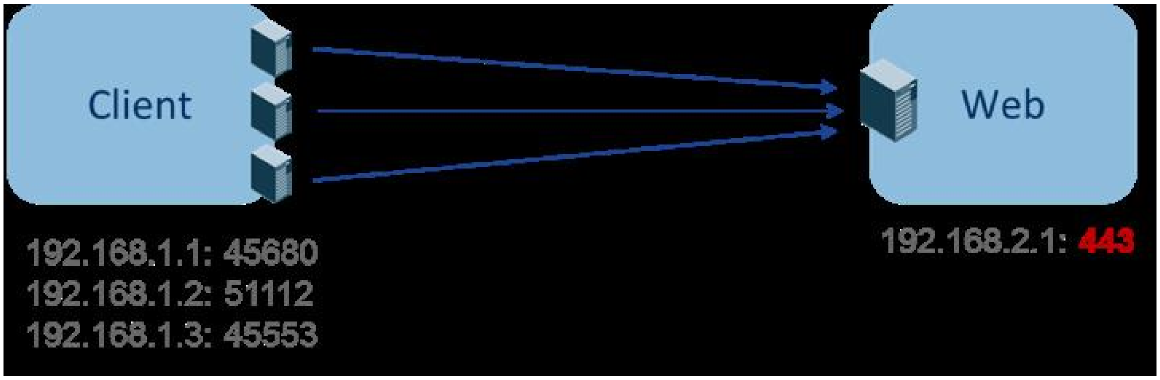
Download table data as JSON

Client-Server Classification

Flow direction (client/server or provider/consumer classification) is important for visibility, automatic policy discovery, and enforcement. Every unicast flow has a client and a server classification.

For example, if there are clients (192.168.1.1-192.168.1.3) accessing a web server (192.168.2.1) using https, typically the source port is an ephemeral port in the range 1025-65535 and the destination port is 443.

Figure 369: Client-Server Classification

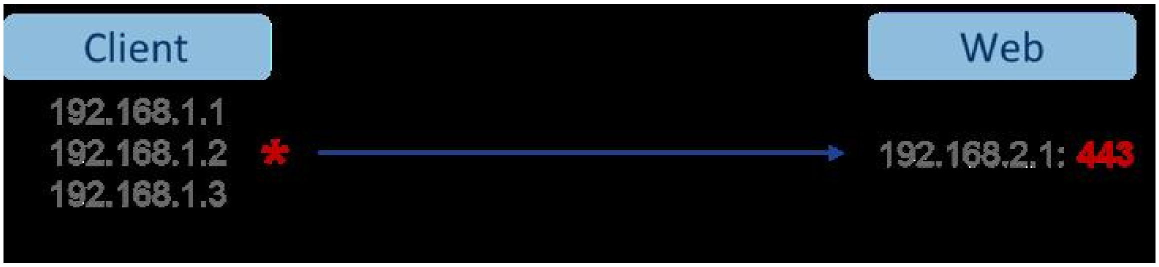


The accurate client-server direction is:

- Client: 192.168.1.1-3
- Server: 192.168.2.1
- Services: TCP port 443

Policies generated by automatic policy discovery are shown in the figure (with left endpoints grouped):

Figure 370: Policies generated

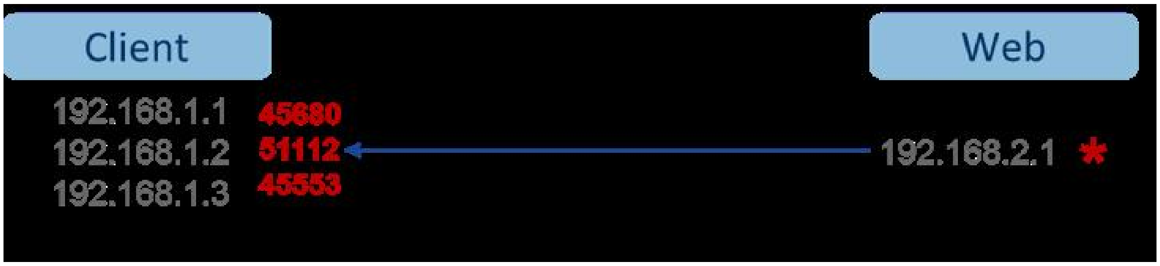


Now, if the client - server direction decision is reversed (an inaccurate classification), that is:

- Client: 192.168.2.1
- Server: 192.168.1.1-3
- Services: the list of ephemeral ports (45680, 51112, 45553)

Then, in the above inaccurate classification, the policies generated may be as shown in the figure:

Figure 371: Inaccurate classification



This consumes more resources in terms of policy enforcement. In addition, depending on how you enforce the policy, even though 192.168.1.1-3 uses these ephemeral ports, they can't access 192.168.2.1. For example, if you use Secure Workload software sensor enforcement, the enforcement policy for Client to Web above (ESTAB) doesn't match with traffic generated by Client destined to Web (NEW, ESTAB).

Timestamps and TCP flags are used in Secure Workload to determine the client-server direction. If there are no TCP flags information (SYN, SYN/ACK) because, for example, the packets could be UDP/ICMP or an HW sensor is used that doesn't support direction signals, then user-defined override rules, timestamps, and other heuristics are used to infer the flow direction. Heuristics by definition don't guarantee 100% accuracy. Client-server accuracy is a function of the type of sensor used and the conditions in which sensors are used. You can use Secure Workload's REST-API (OpenAPI) to insert client-server override rules to identify the server ports for those flow types that Secure Workload gets the direction wrong. Then allow Secure Workload to process new flow data captured with those rules in place, and then generate the policies over the time duration when the flow direction were fixed. For more details on the API to specify override rules, refer to: Client Server configuration, on page 848. You can also manually define the policies and examine/remove the undesired policies. See Policies, on page 750.

Sensor type recommendation

Deep visibility or Enforcement software agents provide best signals to Secure Workload client-server classification algorithms. It is encouraged to consider deploying deep visibility or enforcement agents. These agents get all the necessary signals to drive the correct client-server classification. If deployment of deep visibility or enforcement agents isn't possible for some workloads it is recommended to use ERSPAN sensors and stopping there for automatic policy discovery. Secure Workload assists as best as it can and we're continuously improving our heuristics algorithms based on feedback.

When the correct client-server direction information isn't available, Secure Workload uses user-defined overrides or heuristics to infer what the direction may have been. Heuristics by definition don't guarantee 100% accuracy. The accuracy drops with the type of sensor used and the condition in which it was used.

The following is the recommended order for client-server decision for policy generation use cases:

- **Deep visibility or enforcement agents**: For best results, use Software Sensors (Deep visibility or Enforcement agents). Traffic flows started before the sensor was started would be processed by heuristics discussed below.
- **ADC Sensors like F5/Citrix/. . . agents**: These agents gather the client-server state from the ADC devices and stream that source of truth to Secure Workload.
- **ERSPAN sensors** : With ERSPAN sensor, user needs to take care of providing full visibility of the traffic to and from the workload in question, and make sure the ERSPAN sensor sees all the spanned traffic. The ERSPAN sensor must also not be over subscribed, so that its visibility is not impaired of the network communication of the workload. Furthermmore, user must ensure that packet drops for ERSPAN sensors are kept to the minimum. The operator will not see process information with the network flow information for automatic policy discovery.

While using Netflow sensor listed below, user has to sign up for lot more manual work on policy analysis and generate exception rules. Secure Workload uses extensive use of heuristics, which by definition, aren't 100% accurate.

- **Netflow Sensor** : NetFlow provides sampled and aggregated flow data. The aggregation and sampling processes lose client-server direction information. This impacts automatic policy discovery and policy generation results and makes the problem harder. NetFlow data is excellent for high-level visibility. Secure Workload has to fall back to heuristics, which sometimes, if incorrect, requires more manual work on behalf of the operator – like defining exception rules for Secure Workload. NetFlow data also misses some of the short flows and the signal quality depends on the device producing NetFlow data. We recommend using NetFlow with Secure Workload for specialized use cases like stitching flows through L3/L4 NAT devices like Application Delivery Controllers (or Server Load Balancers) to provide Secure Workload visibility into which flow is related to which other flow.

More details of the client- server direction analysis follow.

Identifying Producers (aka Servers) and Consumers (aka Clients) for a flow

There are multiple ways (often heuristics) to detect servers:

- If a sensor sees the SYN handshake, it can figure out who the server is.
- Based on time - the initiator of a connection is deemed client.
- Degree model - a server typically has many clients talking to it. In contrast, the degree for client port is expected to be far less.

The priority order is SYN_ANALYSIS/NETSTAT > USER_CONFIG > DEGREE_MODEL.

The thinking behind giving SYN_ANALYSIS higher priority over user config is that config can get stale, and that sensor has the best vantage point to establish ground truth. DEGREE_MODEL is where learning/heuristics come into play, and the accuracy can’t be 100% guaranteed.

It’s possible that our heuristics for client-server detection can go wrong, despite our best intentions and continuous algorithmic refinements that we make in this area. For those scenarios, the OpenAPI interface can be used to punch well-known server ports. These configs aren’t applied to past flows, and only affect markings on flows from that point on (that is, going forward). It’s intended as a last resort fallback, rather than the normal modus operandi.

We also recommend not to keep flipping the client- server marking for the full duration of a given flow (even if we get it wrong, and when our internal models have changed - which they do over time, as more flow patterns are observed/analyzed). Higher/equal priority updates are allowed to override lower priority ones (we will flip client server for the existing flows as well). In other words, the stickiness of marking “for the lifetime of a flow” only applies to degree model based marking.

Conversation Mode

By default, the flow analysis fidelity mode in agents is “detailed”. Historically, this was the only mode available, where, every observed flow was reported by the agent along with detailed stats about the observed flow. Stats like: packet and byte counts, TCP flags, connection stats, network latency, srtt, and so on.

While this kind of reporting is desirable in numerous cases, it’s computationally intensive to report and process, also, it may not be strictly required when the primary use case is segmentation only.

The **Conversation Mode** offers a more lightweight alternative to the traditional detailed mode. Agents in conversation mode aim to report conversations as opposed to flows whenever possible (i.e, whenever they are able to make the client-server classification accurately). This is applicable to TCP, UDP, and ICMP flows.

In detailed mode, for TCP/UDP flows, we report 5-tuple flows {source and destination IP, source and destination port, and protocol}.

While for conversation mode, the agent omits the source port as they are ephemeral ports {changes on every new connection}, making it a 4-tuple flow.

Note Detecting a flow as 4-tuple also depends on client-server detection algorithms, which relies on the server/destination port being a well-known port (0–1023).

Thus, if you're using a custom application which doesn't use well-known server/destination ports, the OpenAPI interface can be used to punch well-known server ports. These configs aren't applied to past flows, and only affect markings on flows from that point on (that is, going forward). To optimize server ports, see Client Server Configuration.

Agent reports in conversation mode contain trimmed down information, full list of omitted fields includes:

- TCP/UDP source port (ephemeral ports)
- Fwd/Rev TCP bottleneck
- TCP handshake bucket
- SRTT(µs)
- Fwd/Rev Packet retransmissions
- SRTT Available
- Fwd/Rev Congestion Window Reduced
- Fwd/Rev MSS Changed
- Fwd/Rev TCP Rcv Window Zero? Fwd/Rev Burst Indicator
- Fwd/Rev Max Burst Size (KB)

To enable conversation mode, refer to the Flow Visibility config section in: Software Agent Config

Note The exact benefit gained by changing agents to report in conversation mode may vary due to multiple factors, including, but not limited to percentage of TCP flows, number of services listening on well-known service ports, and memory limitations at the agent.

Note After turning on conversation mode for some agents, there may be a mixture of conversations and flows in the observations on the flow search page.

CHAPTER 9

Configure Alerts

Alerts in Secure Workload help users monitor their workload security and respond to potential threats. The various components of alerts work together to provide users with visibility, alert sources and configuration, and the ability to send alerts from publishers. Users can configure alerts, view alerts, trigger rules and choose publishers to send alerts. Alert types that are displayed on the configuration page vary depending on the user's role. Alert publishers can be either Alerts or Notifiers.

Note The alerts and compliance apps are removed from the Secure WorkloadApp Store starting release 3.0. You can configure alerts and the compliance alerts on this page without creating an Alert Application instance or Compliance Application instance.

Alert Types and Publishers

Alerts in Secure Workload consist of many integrated components. Alerts are classified as:

Visibility:

- **Current Alerts**: Navigate to **Investigate** > **Alerts**. Preview of alerts sent to a Data Tap is available.

Alert Sources and Configuration:

- **Alerts - Configuration**: Navigate to **Manage** > **Alerts Configs**. Both alert configurations that are configured using the common modal, and alert publisher and notifier settings are displayed. It is determined by the app or component and commonly used as an interface (referred to as *Alert Configuration Modal*) that has features such as configuration of the Data Tap and summary alert options.

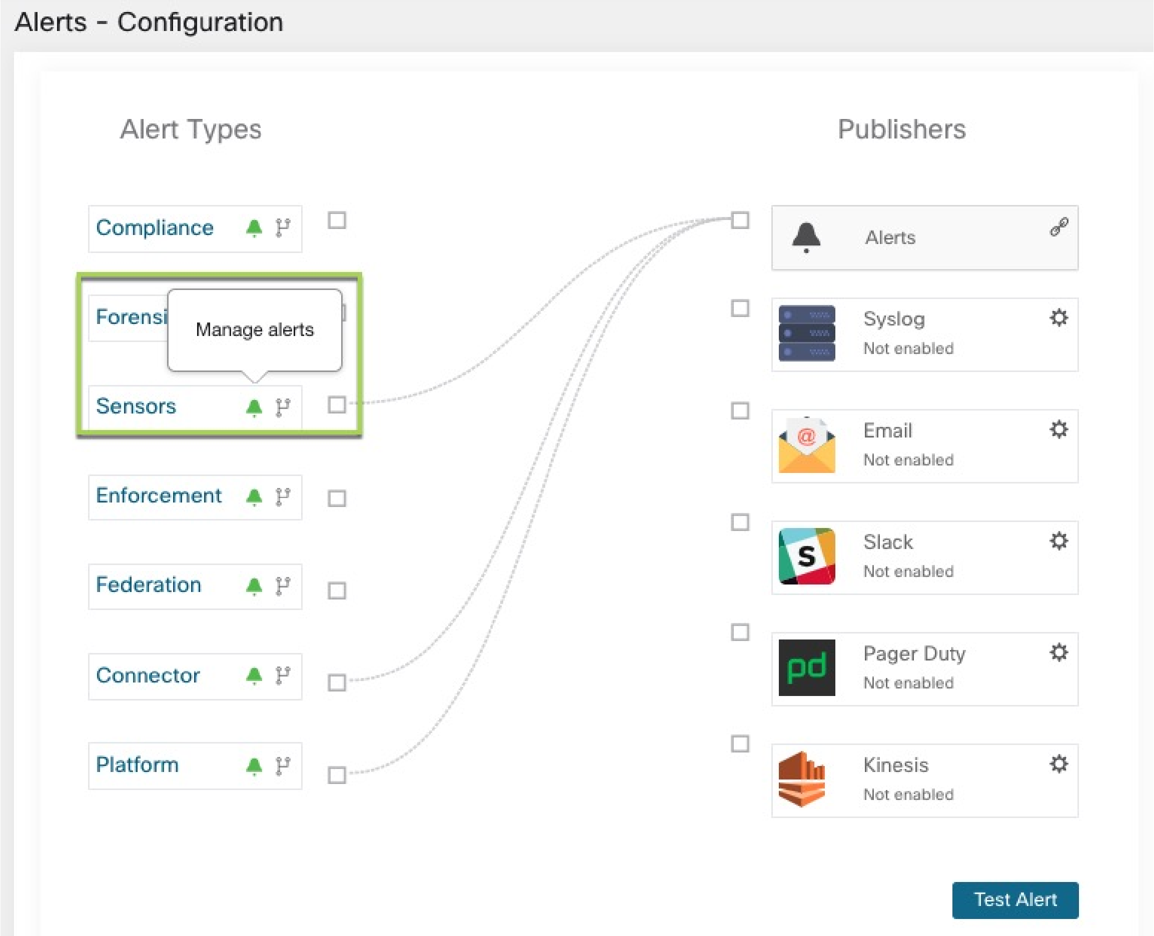
Send Alerts:

- **Alerts App**: An implicit Secure Workload App that sends generated alerts to a configured Data Tap. The Alerts App handles features such as snooze and mute, determining which alerts must be **sent**.

- **Alerts Publisher**: Limits how many alerts are displayed and pushes alerts to Kafka (MDT or DataTap) for external consumption.
- **Edge Appliance**: Pushes alerts to other systems such as Slack, PagerDuty, Email, and so on.

Create Alerts

Figure 372: Create Alert (Trigger Rule)



Several components use a common *Alert Configuration Modal* for configuring alerts. Currently, the following types are included:

- Enforcement Alerts
- Sensor Alerts

Note Only users with at least Enforced capability on the currently selected scope are able to create an alert trigger rule for the Compliance alert type.

Note Alert trigger rules are enforced on the currently selected root scope for the Enforcement and Sensors alert types.

The following types do not have a configuration modal.

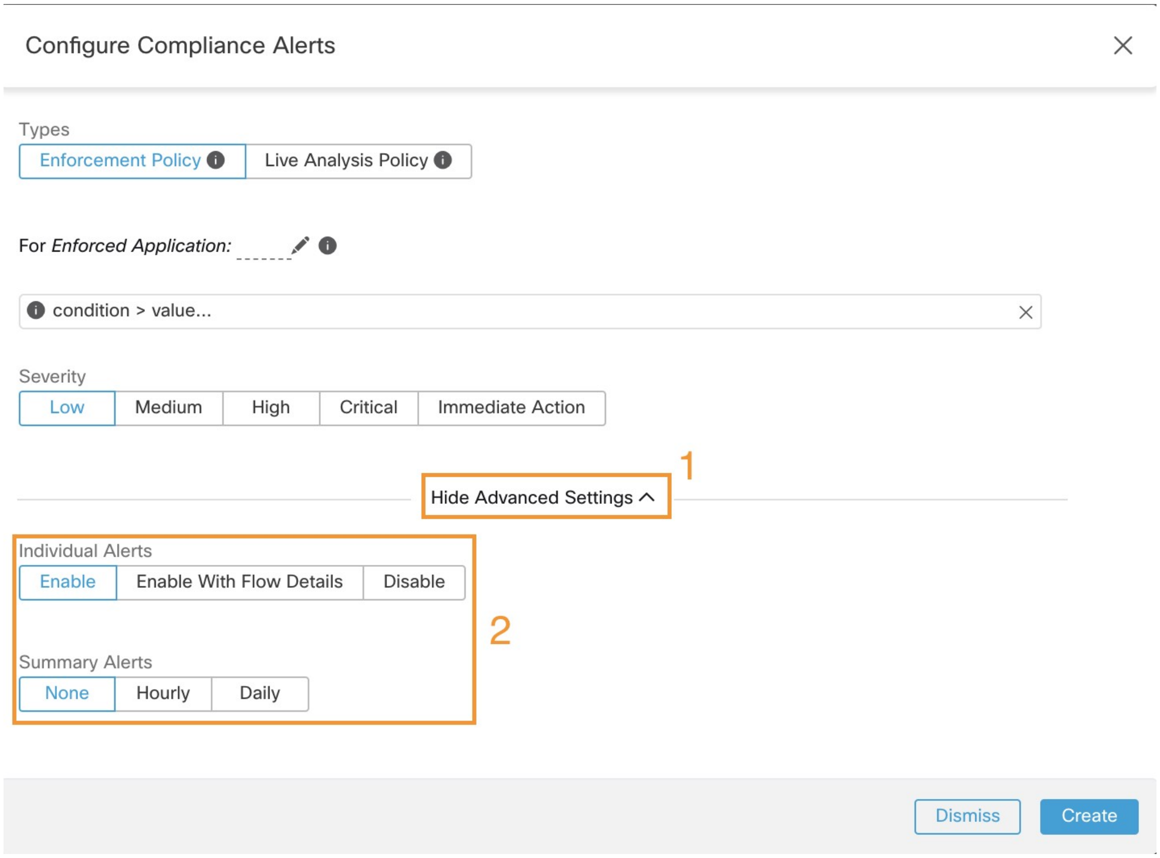
- Forensics alerts
- Connector Alerts
- Federation
- Admiral

Alert Configuration Modal

The Alert configuration modal consists of the following sections:

1. The type of alert. Note thate the alert type is displayed only when the configuration of the alert varies by *subject* .
2. The *subject* of the alert. The subject is dependent on the app, and may be pre-populated when the alert modal is contextual.
3. The condition on which an alert is triggered: Hover over the ? icon to find a list of available conditions. Note that the list displays the conditions available specific to the type of alert currently being configured.
4. Alert severity: If there are many alerts generated, alerts with higher severity are displayed preferentially over alerts with lower severity.
5. Additional configuration options consisting of Summary Alert options. Click **Show Advanced Settings** to expand.
6. Close Modal: “Create” if adding a new alert and all configuration options specified. Or “Dismiss” if not adding a new alert.

Figure 373: Alert configuration modal advanced options



Configure Compliance Alerts

Types: Enforcement Policy | Live Analysis Policy

For *Enforced Application:*

condition > value...

Severity: Low | Medium | High | Critical | Immediate Action

Individual Alerts: Enable | Enable With Flow Details | Disable

Summary Alerts: None | Hourly | Daily

Summary Alerts

Summary Alerts are allowed for some applications and configuration options are dependent on the application.

- *Individual Alerts* generally refers to alerts which are generated over non-aggregated (or minimally aggregated) information and are likely to have a time range of one minute. Note that this does not necessarily mean the alerts are actually generated and sent at a minute interval; the individual alerts will still be generated at the *App Frequency* interval.
- *Summary Alerts* refers to alerts generated over metrics produced over an hour or to the summarization of less frequent alerts.

App	App Frequency1	Individual Alerts	Hourly Alerts	Daily Alerts
Compliance	Minute	Yes: at app frequency	Summary of Individual	Summary of Individual
Enforcement	Minute	Yes: at app frequency	Summary of Individual	Summary of Individual
Sensors	Minute	Yes: at app frequency	Summary of Individual	Summary of Individual

Note Event Time displayed on the UI of summary alerts represents the first occurrence of the same type alert over the past hour or a specified interval window.

Note on Summarization versus Snoozing

Summarization applies to the entire set of alerts generated according the alert configuration, while snoozing applies to a specific alert. This distinction is minor when the alert configuration is very specific, but is notable when the alert configuration is broad.

- For example, Compliance configuration is quite broad: an application workspace, and on which type of violation an alert should be generated. Thus, summarization would apply to all alerts triggered by a ‘escaped’ condition, while snoozing would apply to a very specfic consumer scope, provider scope, provider port, protocol, and the escaped condition.
- On the opposite end, a platform alert configured to alert on a path between source scope and destination scope with a hop count less than some amount, will generate a very specific alert.

Other distinctions

- Snoozing will only result in an alert being sent when a new alert is generated after the snooze interval has passed. There is no indication of how many suppressed alerts might have occurred during the snooze interval.
- A summary alert will be generated at the specified frequency, so long as any alerts were generated within that interval. Summary alerts provide a count of the number of alerts triggered within the window, along with aggregated or range metrics.

Secure Workload Alerts Notifier (TAN)

Note With release 3.3.1.x, TAN is moving to **Secure Workload Edge Appliance**.

Alert Notifiers provide capabilities to send alerts through various tools such as Amazon Kinesis, Email, Syslog and Slack in the currently selected scope. As scope owner or site admin, each notifier can be configured with required credentials and other information specific to the notifier application.

Configure Notifiers

To configure notifiers, alert-related connectors must be configured. The connectors can only be configured after a Secure Workload Edge Appliance is deployed. See Virtual Appliances for Connectors for details on how to deploy Secure Workload Edge appliance.

After the Secure Workload Edge appliance is set up, you can configure each notifier with its specific required input. Note that once Secure Workload Edge appliance is set up, you will be able to see dashed lines connecting Alert Types to Alerts publisher. This is due the fact that notifier is build upon the Alerts publisher.

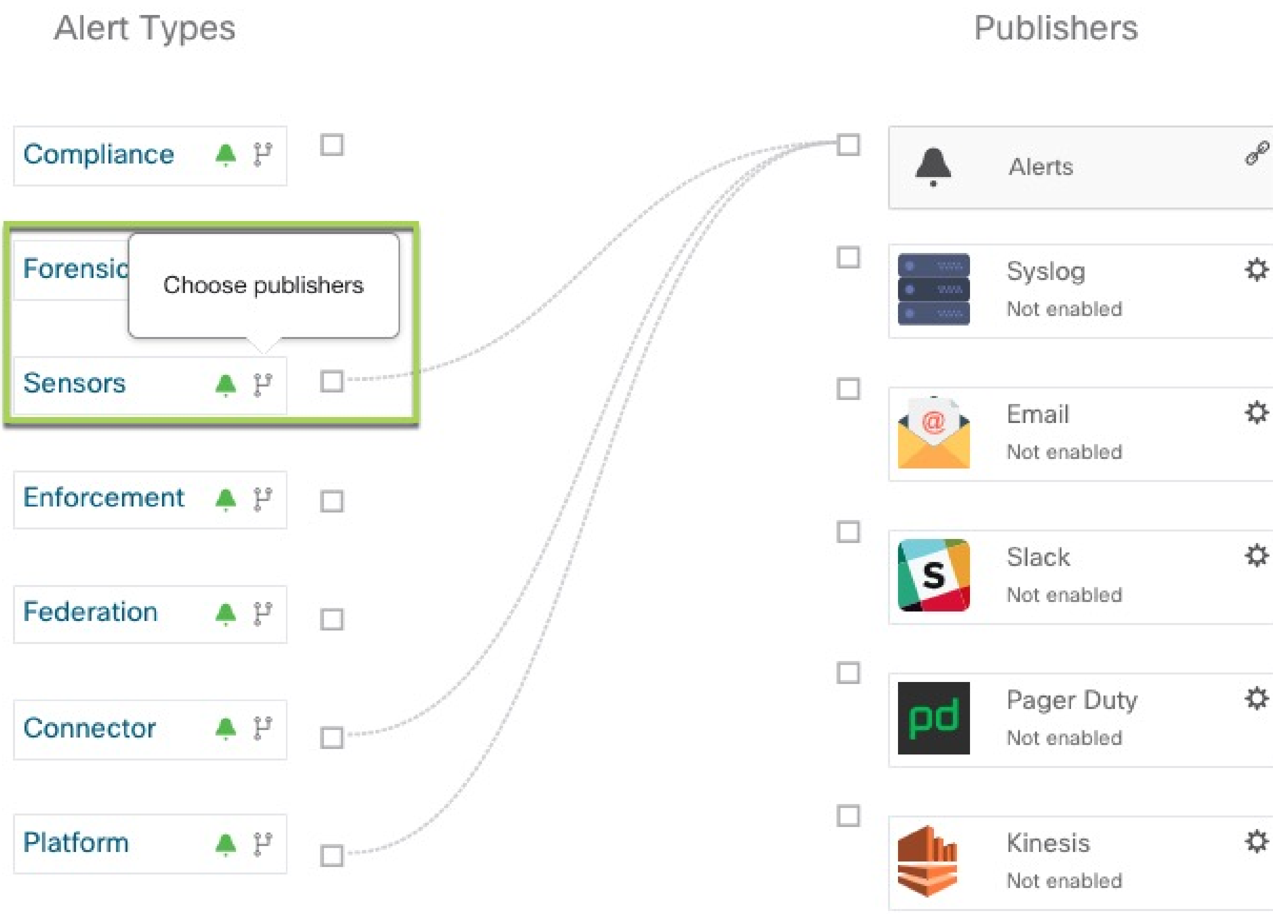
Refer to Connectors for Alert Notifications for details on how to configure each alert notifier.

App Frequency is approximately how often the app runs and generates alerts. For example, Compliance has a flexible run frequency, and may actually compute alerts over a couple minutes together.

Choose Alert Publishers

Scope owners and site admins can choose publishers to send alerts. Publishers includes Kafka (Data Tap) and notifiers.

Figure 374: Choose Alert Publishers



All avaliable publishers are displayed in the **Alerts - Configuration** window, including the Alerts and Active Notifiers. You can toggle the **Send** icon to choose the publishers for the alert type. Minimum Alert Severity refers to the severity level to which an alert must reach to be sent through the publishers.

Note TaaS clusters have a maximun number of alert that can be processed of up to 14000 alerts per minute batch. This could also be reduced by choosing external datataps.

External syslog tunneling moving to TAN

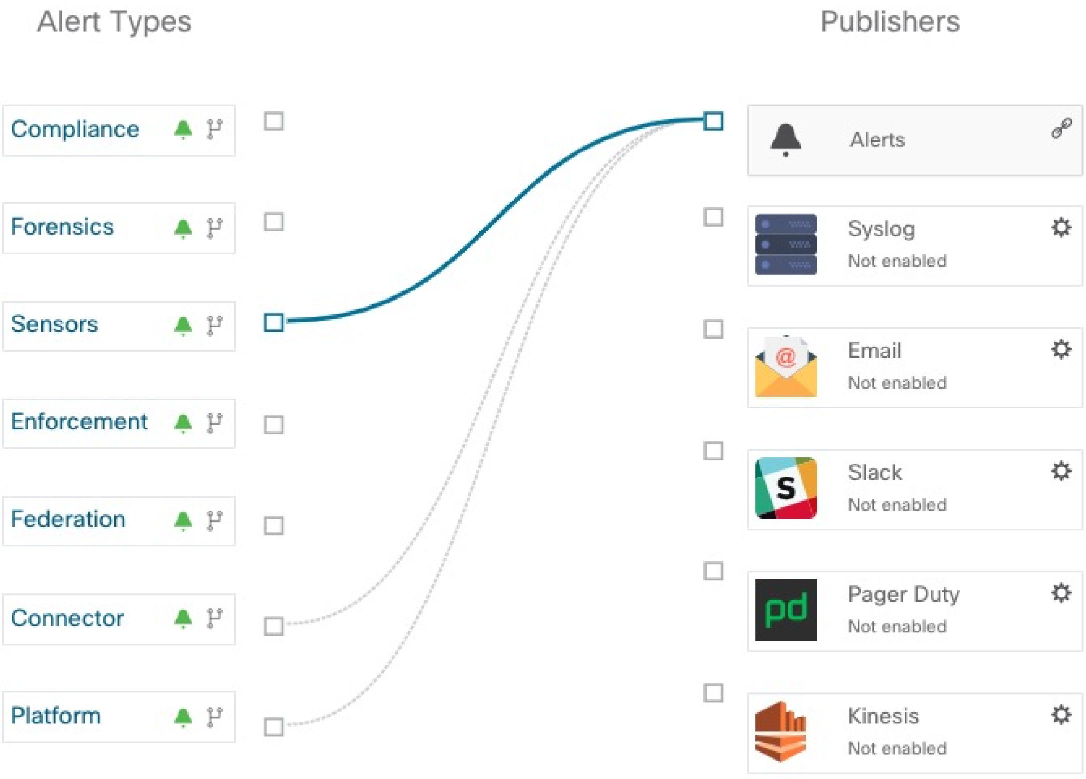
Note Starting 3.1.1.x release, the syslog tunneling feature will move to TAN. To configure syslog for getting platform level syslog events, user would need to configure TAN on Secure Workload Edge appliance on Default Rootscope. Once Secure Workload Edge appliance is configured on Default Rootscope, syslog server can be setup as shown below. To enable platform alerts, enable syslog notifications for Platform. This can be done by enabling Platform Syslog connection.

See Syslog Connector for details of how to configure syslog.

Connection Chart

The connection chart displays the connections between alert types and publishers. Once you choose a publisher for an alert type, a line will be established between that alert type and the publisher. Note that the line pointing to the Alerts publisher will always be dashed line since it represent an internal mechanism of how alerts notification build upon.

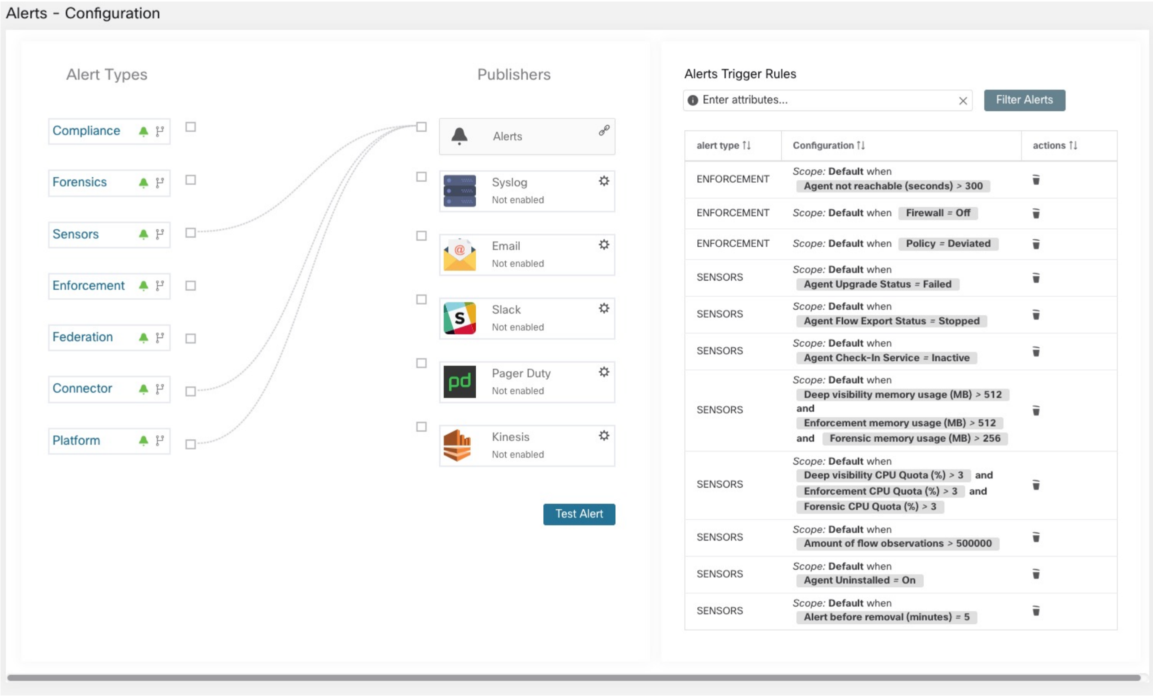
Figure 375: Connection chart



View Alerts Trigger Rules

A list of all Alerts Trigger Rules configured are displayed.

Figure 376: View Alerts Trigger Rules



Alerts Trigger Rules

alert type	Configuration	actions
ENFORCEMENT	*Scope:* **Default** when **Agent not reachable (seconds) > 300**	
ENFORCEMENT	*Scope:* **Default** when **Firewall = Off**	
ENFORCEMENT	*Scope:* **Default** when **Policy = Deviated**	
SENSORS	*Scope:* **Default** when **Agent Upgrade Status = Failed**	
SENSORS	*Scope:* **Default** when **Agent Flow Export Status = Stopped**	
SENSORS	*Scope:* **Default** when **Agent Check-In Service = Inactive**	
SENSORS	*Scope:* **Default** when **Deep visibility memory usage (MB) > 512** and **Enforcement memory usage (MB) > 512** and **Forensic memory usage (MB) > 256**	
SENSORS	*Scope:* **Default** when **Deep visibility CPU Quota (%) > 3** and **Enforcement CPU Quota (%) > 3** and **Forensic CPU Quota (%) > 3**	
SENSORS	*Scope:* **Default** when **Amount of flow observations > 500000**	
SENSORS	*Scope:* **Default** when **Agent Uninstalled = On**	
SENSORS	*Scope:* **Default** when **Alert before removal (minutes) = 5**	

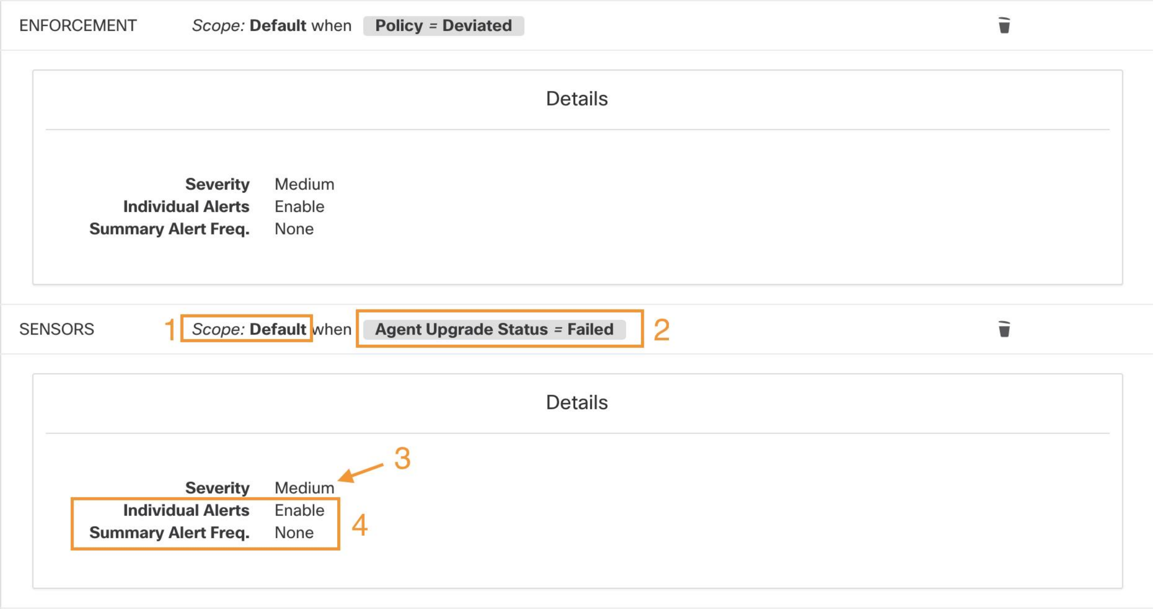
Alerts Trigger Rules window can be used to filter alerts trigger rules by alert type, alert frequency and alert trigger condition.

Note Alert trigger condition is an exact match condition.

Alerts Trigger Rules Details

Click on a row in the Alerts Trigger Rules table to expand and view the configuration details.

Figure 377: Expanded alert configuration



ENFORCEMENT Scope: Default when Policy = Deviated

Details

Severity Medium
Individual Alerts Enable
Summary Alert Freq. None

SENSORS Scope: Default when Agent Upgrade Status = Failed

Details

Severity Medium
Individual Alerts Enable
Summary Alert Freq. None

1. Subject: *what an alert is about.*
2. Trigger: *when an alert is generated.*
3. Severity: Decides which alerts are are displayed if there are many alerts generated at the same time.
4. Individual Alerts and Summary Alert Frequency: Decides whether individual and/or summary alerts are generated.

Generate Test Alerts

You can configure the sample alert to send out alerts based on the alert type and linked publisher in the alert configuration. The primary use is to verify the connectivity with the publisher.

Note

- Generating test alerts is not from the actual sources and is generated for test purpose only.
- Test alert can be generated for alert types which are linked to at least one publisher.

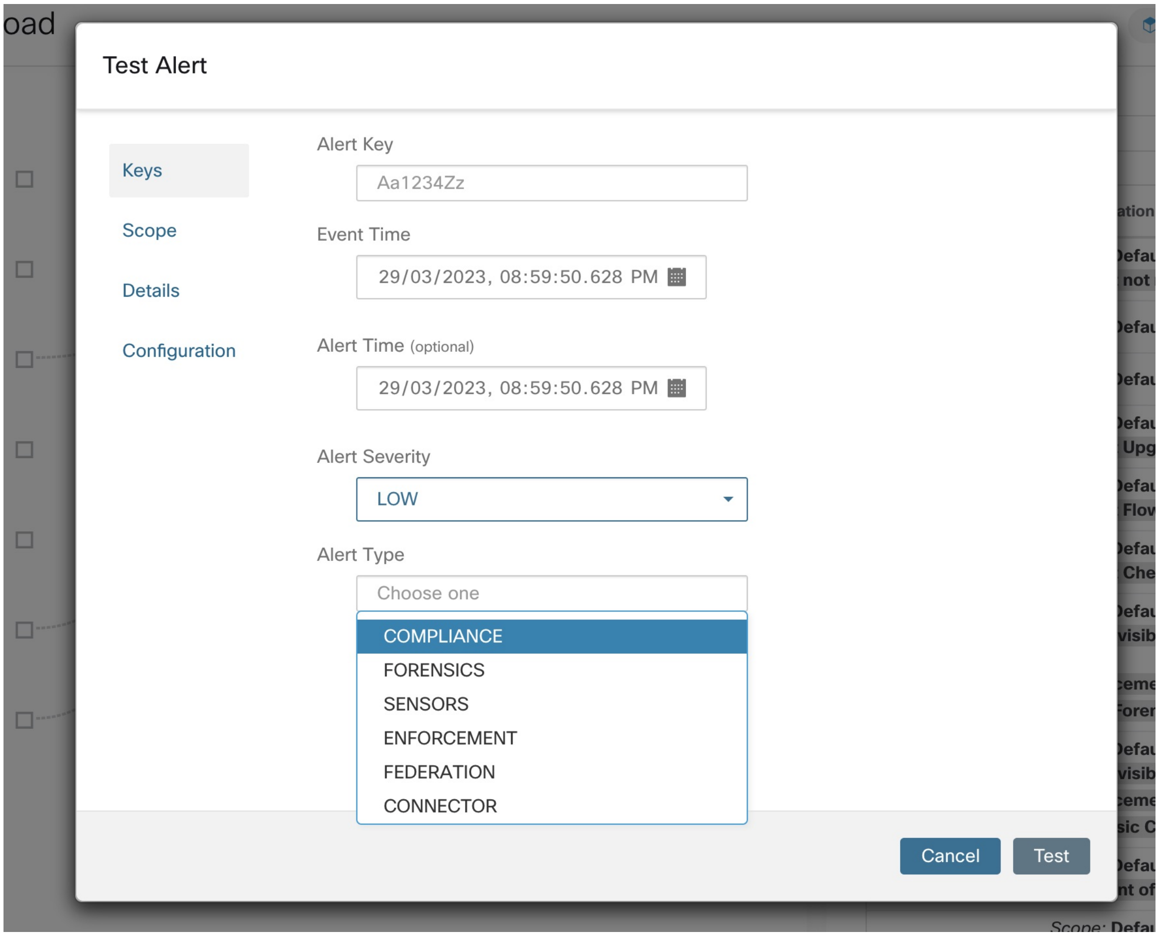
To generate a test alert follow the below steps.

Procedure

Step 1 In the navigation pane, click **Manage** > **Workloads** > **Alerts Config**.

Step 2 To configure a test alert, click **Test Alert** button.

Figure 378: Test Alert Configuration



Test Alert

Alert Key: Aa1234Zz

Event Time: 29/03/2023, 08:59:50.628 PM

Alert Time (optional): 29/03/2023, 08:59:50.628 PM

Alert Severity: LOW

Alert Type: Choose one

Step 3 Under the **Keys** tab, enter the value for Alert Key and choose the values for Event Time, Alert Time, Alert Severity and Alert Type.

Step 4 Under the **Scope** tab, the values of Scope ID and Tenant ID are auto generated based on the current scope.

Note If the Tenanat ID is same as Tenant ID VRF, then the system automatically checks the Tenant ID VRF check box.

Step 5 Under the **Details** tab, enter the values for Alert Text, Event Notes, Alert Details and Alert Configuration ID.

Note Alert Details can be a string value or data in JSON format.

Options for JSON content are:

a. Containing fields expected by that type of alert.

b. Any sample JSON data, if that alert type does not expect default json fields .

Sample JSON:

```
{"alert_name ":"sample","alert_category":{"severity": "dummy"}}
```

Step 6 Under the **Configuration** tab, choose the value for Individual Alert, Alert Frequency and Summary Alert Frequency.

For individual alert, choose *ENABLE* or *DISABLE* from the drop down.

Alert frequency is auto-selected with frequency as *INDIVIDUAL*.

Note It supports only individual alerts and does not consider summarization.

Summary alert is auto selected to *NONE*.

Step 7 To generate the test alert, click **TEST**.

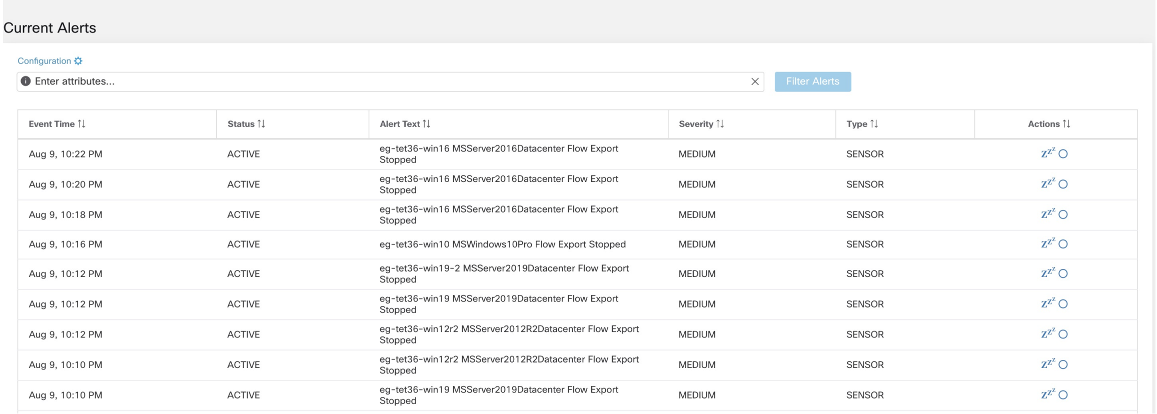
Note A test alert is generated and sent to the configured publisher.

Current Alerts

You can filter the alerts by type, status (active or snoozed), and severity (immediate_action, critical, high, medium, or low). By default, the listed alerts are filtered to display the active alerts that are sorted in descending order.

Warning Only alerts that contain the severity value of IMMEDIATE_ACTION, CRITICAL, LOW, MEDIUM, or HIGH are shown on the **Alerts** page. All alerts irrespective to the severity values are sent to the configured kafka broker.

Figure 379: Current Alerts Listing

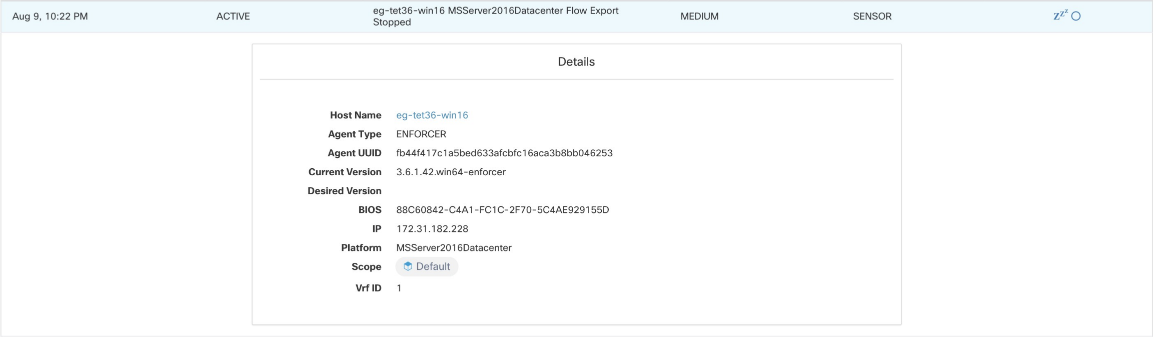


Event Time ↑↓	Status ↑↓	Alert Text ↑↓	Severity ↑↓	Type ↑↓	Actions ↑↓
Aug 9, 10:22 PM	ACTIVE	eg-tet36-win16 MSServer2016Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:20 PM	ACTIVE	eg-tet36-win16 MSServer2016Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:18 PM	ACTIVE	eg-tet36-win16 MSServer2016Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:16 PM	ACTIVE	eg-tet36-win10 MSWindows10Pro Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:12 PM	ACTIVE	eg-tet36-win19-2 MSServer2019Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:12 PM	ACTIVE	eg-tet36-win19 MSServer2019Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:12 PM	ACTIVE	eg-tet36-win12r2 MSServer2012R2Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:10 PM	ACTIVE	eg-tet36-win12r2 MSServer2012R2Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○
Aug 9, 10:10 PM	ACTIVE	eg-tet36-win19 MSServer2019Datacenter Flow Export Stopped	MEDIUM	SENSOR	zzz ○

View Additional Alert Details

Click the alert to view more details.

Figure 380: Alert Details



Aug 9, 10:22 PM ACTIVE eg-tet36-win16 MSServer2016Datacenter Flow Export Stopped MEDIUM SENSOR

Details

Host Name	eg-tet36-win16
Agent Type	ENFORCER
Agent UUID	fb44f417c1a5bed633afcbfc16aca3b8bb046253
Current Version	3.6.1.42.win64-enforcer
Desired Version	
BIOS	88C60842-C4A1-FC1C-2F70-5C4AE929155D
IP	172.31.182.228
Platform	MSServer2016Datacenter
Scope	Default
Vrf ID	1

Note

- Only 60 alerts per minute per root scope are displayed on the UI. A higher volume of alerts result in the summary alert on the UI.
- Preference is provided to Critical alerts, and then to those with High severity, followed by Medium severity, and finally Low severity.
- There is a maximum number of alerts that are displayed on the UI at any point in time; older alerts will be dropped as new alerts come in.

  See Limits.

Snooze Alerts

The Alerts App allows for alerts of the same *type* to be snoozed (suppressed) for a chosen amount of time. The *type of alert* is defined differently depending on the workspace that Alerts has currently been configured for. As an example for Alerts on Compliance, *type of alert* is defined as the four tuples: consumer scope, provider scope, protocol, and provider port.

Note Currently, user app created alerts cannot be snoozed or ignored (muted).

Snooze or Mute an Alert

To snooze an alert:

1. Under **Actions**, click the **Snooze** icon.
2. Choose an interval from the drop-down.
3. Click **Snooze**.

To mute an alert:

Instead of snoozing, you can use the mute option to stop receiving alerts of the selected type permanently. The muted alert types can be removed from the muted list to continue to receive the alerts.

1. Under **Actions**, click the **Mute** icon for the required alert type.

2. You no longer receive alerts of the selected type. To confirm, click **Yes**.

   To continue to receive these alerts, remove the alert type from the muted list. To find the list of muted alert types, choose **MUTED** from the **Status** drop-down menu (In previous releases of Secure Workload, enter **Status=MUTED** in the filter field).

Unsnooze or Unmute an Alert

1. Use the **Status** drop-down to filter **Snoozed** and **Muted** alerts.
   - Choose **Snoozed** (In previous releases of Secure Workload, enter **Status=SNOOZED** in the filter field).
   - Choose **Muted** (In previous releases of Secure Workload, enter **Status=MUTED** in the filter field).
2. Under **Actions**, click either the unsnooze or unmute icon, as required.
3. To confirm the action, click **Yes**.

Admiral Alerts

Admiral is an integrated alerting system, which replaces Bosun from earlier releases. Fore more information, see the Admiral Alerts section.

Alert Details

Common Alert Structure

All alerts follow an overall common structure, but each type of alert will vary in its alert details.

The common structure is as follows. This structure corresponds to the json message structure available through Kafka DataTaps.

Field	Format	About
root_scope_id	string	Scope Id corresponding to top scope in scope hierarchy.
key_id	string	id field used for determining 'similar' alerts. Identical key_id's can be snoozed.
type	string	Type of the alert. Fixed set of string values: COMPLIANCE, USERAPP, FORENSICS, ENFORCEMENT, SENSOR, PLATFORM, FEDERATION, CONNECTOR

Field	Format	About
event_time	long	timestamp of when the event triggered (or if event spanned a range, then the beginning of the range). This timestamp is in epoch milliseconds (UTC).
alert_time	long	Timestamp of when the alert was first attempted to be sent. This will be after the timerange of the event. This timestamp is in epoch milliseconds (UTC).
alert_text	string	Title of the alert.
alert_text_with_names	string	Same content as alert_text but with any id fields replaced by corresponding name. This field may not exist for all alerts.
severity	string	Fixed set of string values: LOW, MEDIUM, HIGH, CRITICAL, IMMEDIATE_ACTION.This is the severity of the alert. For some types of alerts these values are configurable.
alert_notes	string	Usually not set. May exist in some special cases for passing additional information through Kafka DataTap.
alert_conf_id	string	id of the alert configuration that triggered this alert. May not exist for all alerts.
alert_details	string	Structured data. String-i-fied json. See feature details for specific alert type, since the exact structure of this field varies based on the type of alert.
alert_details_json	json	Same content of alert_details, but not string-i-fied. Only present for compliance alerts, and only available through Kafka.
tenant_id	string	May contain vrf corresponding to root_scope_id. Or may contain 0 as default value. Or may not be present at all.

Field	Format	About
alert_id	string	Internal generated temporary id. Best ignored.

The fields within *alert_details* vary based on the type of alert. See each feature section for explanation and list of fields:

- Compliance: lab-compliance-alert-details
- Forensics: External Integration and Fields Displayed in Forensic Events
- Sensor: Sensor Alert Details
- Enforcement: Enforcement Alert Details
- Connector: Alert Details
- Federation: federation-alert-details
- Platform: Alert Details

General Alert Format by Notifier

Variation across notifier types. The following contains examples of how alerts display across various notifier types.

Kafka (DataTaps)

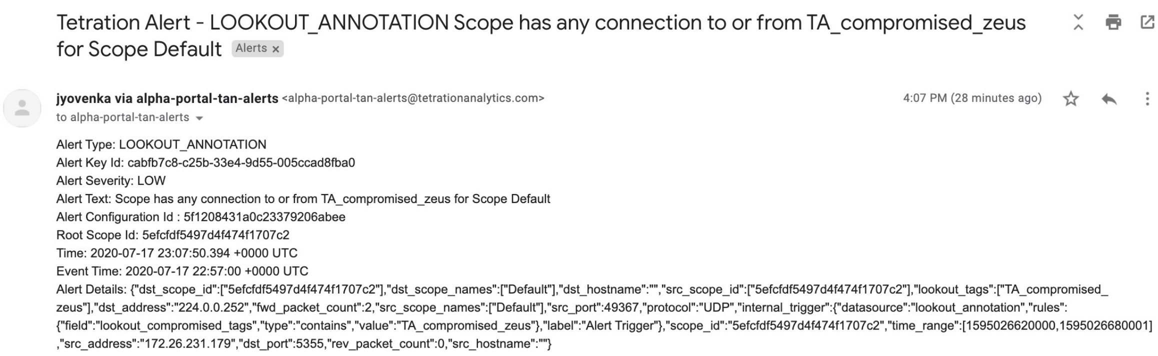
Kafka (DataTap) messages are in JSON format. Example below; see above alert_details for some additional examples.

```
  {
  "severity": "LOW",
  "tenant_id": 0,
  "alert_time": 1595207103337,
  "alert_text": "Lookout Annotated Flows contains TA_zeus for
<scope_id:5efcfdf5497d4f474f1707c2>",
  "key_id": "0a4a4208-f721-398c-b61c-c07af3be9413",
 "alert_id": "/Alerts/5efcfdf5497d4f474f1707c2/DataSource{location_type='TETRATION_PARQUET',
 location_name='lookout_annotation', location_grain='HOURLY',
root_scope_id='5efcfdf5497d4f474f1707c2'}/bd33f37af32a5ce71e888f95ccfe845305e61a12a7829ca5f2d72bf96237d403",

  "alert_text_with_names": "Lookout Annotated Flows contains TA_zeus for Scope Default",
  "root_scope_id": "5efcfdf5497d4f474f1707c2",
  "alert_conf_id": "5f10c7141a0c236b78148da1",
  "type": "LOOKOUT_ANNOTATION",
  "event_time": 1595204760000,
  "alert_details":
[illegible]

Trigger\"},\"scope_id\":\"5efcfdf5497d4f474f1707c2\",\"time_range\":[1595204760000,1595204820001],\"src_address\":\"172.26.230.124\",\"dst_port\":137,\"rev_packet_count\":0,\"src_hostname\":\"\"}"

  }
```

Email

Information about configuring Email alerts: Email Connector

Figure 381: Example of a Cisco Secure Workload alert when configured to send to email



Tetration Alert - LOOKOUT_ANNOTATION Scope has any connection to or from TA_compromised_zeus for Scope Default

jyovenka via alpha-portal-tan-alerts <alpha-portal-tan-alerts@tetrationanalytics.com>
to alpha-portal-tan-alerts

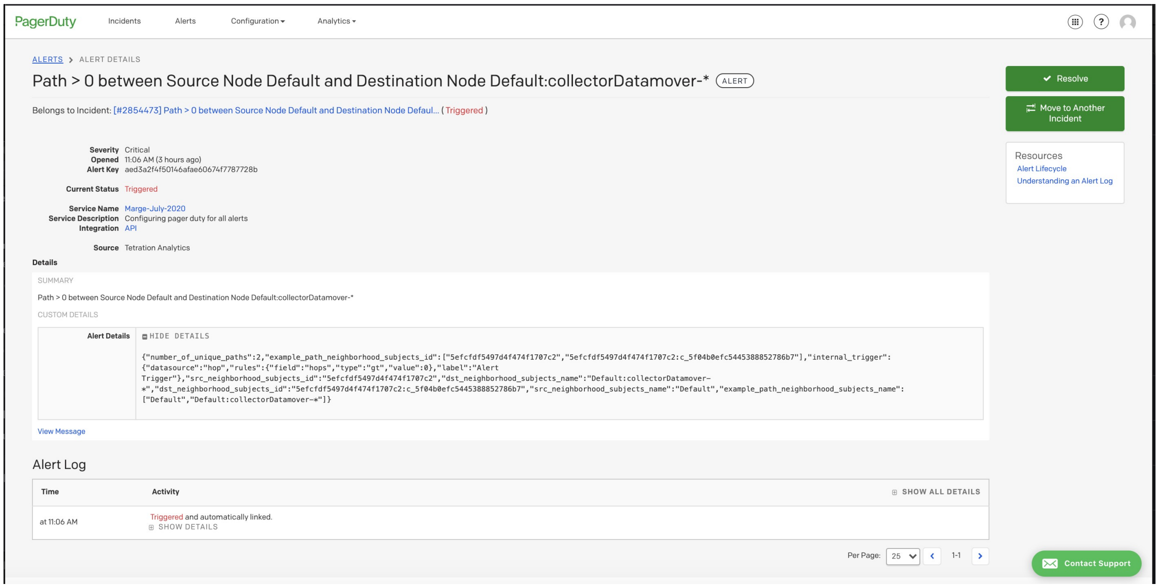
4:07 PM (28 minutes ago)

Alert Type: LOOKOUT_ANNOTATION
Alert Key Id: cabfb7c8-c25b-33e4-9d55-005ccad8fba0
Alert Severity: LOW
Alert Text: Scope has any connection to or from TA_compromised_zeus for Scope Default
Alert Configuration Id : 5f1208431a0c23379206abee
Root Scope Id: 5efcfdf5497d4f474f1707c2
Time: 2020-07-17 23:07:50.394 +0000 UTC
Event Time: 2020-07-17 22:57:00 +0000 UTC
Alert Details: {"dst_scope_id":["5efcfdf5497d4f474f1707c2"],"dst_scope_names":["Default"],"dst_hostname":"","src_scope_id":["5efcfdf5497d4f474f1707c2"],"lookout_tags":["TA_compromised_zeus"],"dst_address":"224.0.0.252","fwd_packet_count":2,"src_scope_names":["Default"],"src_port":49367,"protocol":"UDP","internal_trigger":{"datasource":"lookout_annotation","rules":{"field":"lookout_compromised_tags","type":"contains","value":"TA_compromised_zeus"},"label":"Alert Trigger"},"scope_id":"5efcfdf5497d4f474f1707c2","time_range":[1595026620000,1595026680001],"src_address":"172.26.231.179","dst_port":5355,"rev_packet_count":0,"src_hostname":""}

PagerDuty

Information about configuring PagerDuty alerts: PagerDuty Connector

Figure 382: Example of a Secure Workload alert in PagerDuty



Path > 0 between Source Node Default and Destination Node Default:collectorDatamover-* ALERT

Belongs to Incident: [#2854473] Path > 0 between Source Node Default and Destination Node Defaul... (Triggered)

Severity Critical
Opened 11:06 AM (3 hours ago)
Alert Key aed3a2f4f50146afae60674f7787728b

Current Status Triggered

Service Name Marge-July-2020
Service Description Configuring pager duty for all alerts
Integration API

Source Tetration Analytics

Details

SUMMARY

Path > 0 between Source Node Default and Destination Node Default:collectorDatamover-*

CUSTOM DETAILS

Alert Details HIDE DETAILS

```
{"number_of_unique_paths":2,"example_path_neighborhood_subjects_id":["5efcfdf5497d4f474f1707c2","5efcfdf5497d4f474f1707c2:c_5f04b0efc5445388852786b7"],"internal_trigger":
{"datasource":"hop","rules":{"field":"hops","type":"gt","value":0},"label":"Alert
Trigger"},"src_neighborhood_subjects_id":"5efcfdf5497d4f474f1707c2","dst_neighborhood_subjects_name":"Default:collectorDatamover-
*","dst_neighborhood_subjects_id":"5efcfdf5497d4f474f1707c2:c_5f04b0efc5445388852786b7","src_neighborhood_subjects_name":"Default","example_path_neighborhood_subjects_name":
["Default","Default:collectorDatamover-*"]}
```

View Message

Alert Log

Time	Activity
at 11:06 AM	Triggered and automatically linked. SHOW DETAILS

SHOW ALL DETAILS

Per Page: 25 1-1

Alerts sent to PagerDuty will be considered a re-trigger of the same alert based on the key_id.

Severity is mapped to PagerDuty severity as follows:

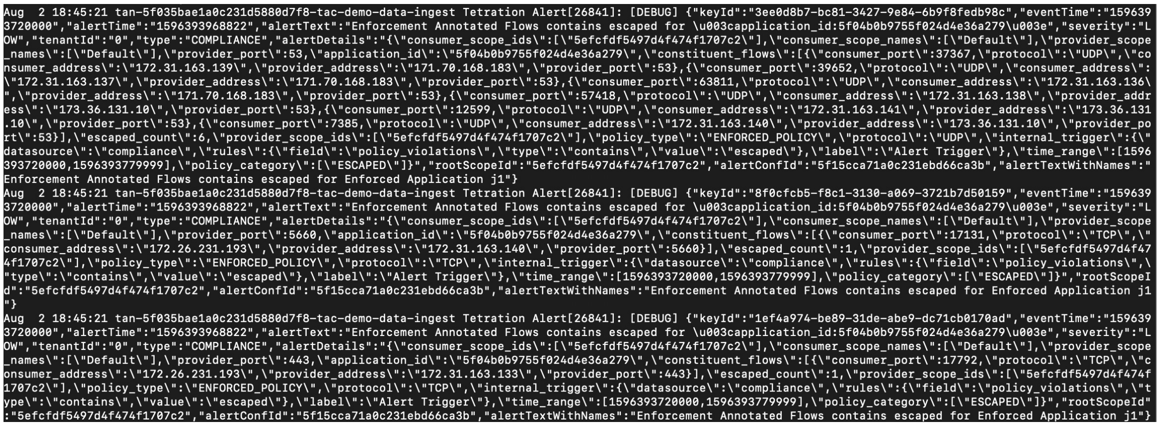
Secure Workload Severity	PagerDuty Severity
IMMEDIATE_ACTION	critical
CRITICAL	critical
HIGH	error

Secure Workload Severity	PagerDuty Severity
MEDIUM	warning
LOW	info

Syslog

Information about configuring Syslog alerts, and adjusting severity mapping: Syslog Connector

Figure 383: Example of several Secure Workload alerts sent to syslog

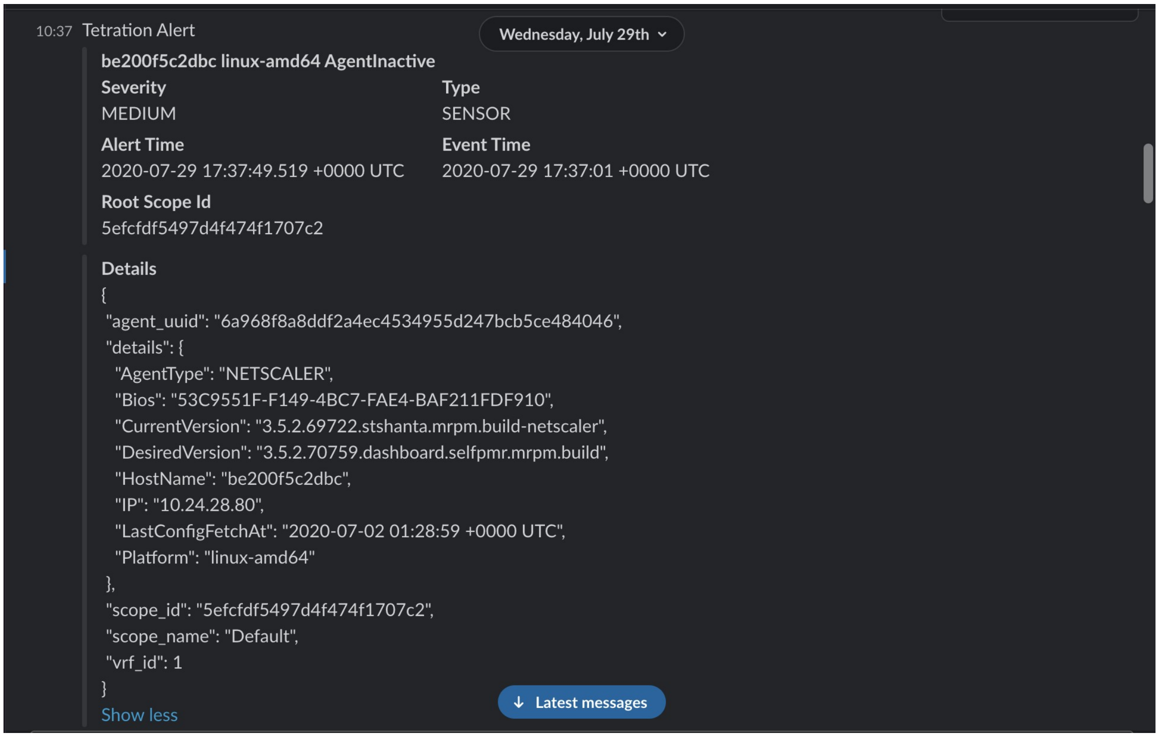


```
Aug  2 18:45:21 tan-5f035bae1a0c231d5880d7f8-tac-demo-data-ingest Tetration Alert[26841]: [DEBUG] {"keyId":"3ee0d8b7-bc81-3427-9e84-6b9f8fedb98c","eventTime":"159639
3720000","alertTime":"1596393968822","alertText":"Enforcement Annotated Flows contains escaped for \u003capplication_id:5f04b0b9755f024d4e36a279\u003e","severity":"L
OW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"consumer_scope_ids\":[\"5efcfdf5497d4f474f1707c2\"],\"consumer_scope_names\":[\"Default\"],\"provider_scope
_names\":[\"Default\"],\"provider_port\":53,\"application_id\":\"5f04b0b9755f024d4e36a279\",\"constituent_flows\":[{\"consumer_port\":37367,\"protocol\":\"UDP\",\"co
nsumer_address\":\"172.31.163.139\",\"provider_address\":\"171.70.168.183\",\"provider_port\":53},{\"consumer_port\":39652,\"protocol\":\"UDP\",\"consumer_address\":
\"172.31.163.137\",\"provider_address\":\"171.70.168.183\",\"provider_port\":53},{\"consumer_port\":63811,\"protocol\":\"UDP\",\"consumer_address\":\"172.31.163.136\
",\"provider_address\":\"171.70.168.183\",\"provider_port\":53},{\"consumer_port\":57418,\"protocol\":\"UDP\",\"consumer_address\":\"172.31.163.138\",\"provider_addr
ess\":\"173.36.131.10\",\"provider_port\":53},{\"consumer_port\":12599,\"protocol\":\"UDP\",\"consumer_address\":\"172.31.163.141\",\"provider_address\":\"173.36.131
.10\",\"provider_port\":53},{\"consumer_port\":7385,\"protocol\":\"UDP\",\"consumer_address\":\"172.31.163.140\",\"provider_address\":\"173.36.131.10\",\"provider_po
rt\":53}],\"escaped_count\":6,\"provider_scope_ids\":[\"5efcfdf5497d4f474f1707c2\"],\"policy_type\":\"ENFORCED_POLICY\",\"protocol\":\"UDP\",\"internal_trigger\":{\"
datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"time_range\":[1596
393720000,1596393779999],\"policy_category\":[\"ESCAPED\"]}","rootScopeId":"5efcfdf5497d4f474f1707c2","alertConfId":"5f15cca71a0c231ebd66ca3b","alertTextWithNames":"
Enforcement Annotated Flows contains escaped for Enforced Application j1"}
Aug  2 18:45:21 tan-5f035bae1a0c231d5880d7f8-tac-demo-data-ingest Tetration Alert[26841]: [DEBUG] {"keyId":"8f0cfcb5-f8c1-3130-a069-3721b7d50159","eventTime":"159639
3720000","alertTime":"1596393968822","alertText":"Enforcement Annotated Flows contains escaped for \u003capplication_id:5f04b0b9755f024d4e36a279\u003e","severity":"L
OW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"consumer_scope_ids\":[\"5efcfdf5497d4f474f1707c2\"],\"consumer_scope_names\":[\"Default\"],\"provider_scope
_names\":[\"Default\"],\"provider_port\":5660,\"application_id\":\"5f04b0b9755f024d4e36a279\",\"constituent_flows\":[{\"consumer_port\":17131,\"protocol\":\"TCP\",\"
consumer_address\":\"172.26.231.193\",\"provider_address\":\"172.31.163.140\",\"provider_port\":5660}],\"escaped_count\":1,\"provider_scope_ids\":[\"5efcfdf5497d4f47
4f1707c2\"],\"policy_type\":\"ENFORCED_POLICY\",\"protocol\":\"TCP\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\
"type\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"time_range\":[1596393720000,1596393779999],\"policy_category\":[\"ESCAPED\"]}","rootScopeI
d":"5efcfdf5497d4f474f1707c2","alertConfId":"5f15cca71a0c231ebd66ca3b","alertTextWithNames":"Enforcement Annotated Flows contains escaped for Enforced Application j1
"}
Aug  2 18:45:21 tan-5f035bae1a0c231d5880d7f8-tac-demo-data-ingest Tetration Alert[26841]: [DEBUG] {"keyId":"1ef4a974-be89-31de-abe9-dc71cb0170ad","eventTime":"159639
3720000","alertTime":"1596393968822","alertText":"Enforcement Annotated Flows contains escaped for \u003capplication_id:5f04b0b9755f024d4e36a279\u003e","severity":"L
OW","tenantId":"0","type":"COMPLIANCE","alertDetails":"{\"consumer_scope_ids\":[\"5efcfdf5497d4f474f1707c2\"],\"consumer_scope_names\":[\"Default\"],\"provider_scope
_names\":[\"Default\"],\"provider_port\":443,\"application_id\":\"5f04b0b9755f024d4e36a279\",\"constituent_flows\":[{\"consumer_port\":17792,\"protocol\":\"TCP\",\"c
onsumer_address\":\"172.26.231.193\",\"provider_address\":\"172.31.163.133\",\"provider_port\":443}],\"escaped_count\":1,\"provider_scope_ids\":[\"5efcfdf5497d4f474f
1707c2\"],\"policy_type\":\"ENFORCED_POLICY\",\"protocol\":\"TCP\",\"internal_trigger\":{\"datasource\":\"compliance\",\"rules\":{\"field\":\"policy_violations\",\"t
ype\":\"contains\",\"value\":\"escaped\"},\"label\":\"Alert Trigger\"},\"time_range\":[1596393720000,1596393779999],\"policy_category\":[\"ESCAPED\"]}","rootScopeId"
:"5efcfdf5497d4f474f1707c2","alertConfId":"5f15cca71a0c231ebd66ca3b","alertTextWithNames":"Enforcement Annotated Flows contains escaped for Enforced Application j1"}
```

Slack

Information about configuring Slack alerts: Slack Connector

Figure 384: Example of a Secure Workload alert sent to slack channel



10:37 Tetration Alert

be200f5c2dbc linux-amd64 AgentInactive

Severity
MEDIUM

Type
SENSOR

Alert Time
2020-07-29 17:37:49.519 +0000 UTC

Event Time
2020-07-29 17:37:01 +0000 UTC

Root Scope Id
5efcfdf5497d4f474f1707c2

Details

```
{
 "agent_uuid": "6a968f8a8ddf2a4ec4534955d247bcb5ce484046",
 "details": {
   "AgentType": "NETSCALER",
   "Bios": "53C9551F-F149-4BC7-FAE4-BAF211FDF910",
   "CurrentVersion": "3.5.2.69722.stshanta.mrpm.build-netscaler",
   "DesiredVersion": "3.5.2.70759.dashboard.selfpmr.mrpm.build",
   "HostName": "be200f5c2dbc",
   "IP": "10.24.28.80",
   "LastConfigFetchAt": "2020-07-02 01:28:59 +0000 UTC",
   "Platform": "linux-amd64"
 },
 "scope_id": "5efcfdf5497d4f474f1707c2",
 "scope_name": "Default",
 "vrf_id": 1
}
```

Kinesis

Information about configuring Kinesis alerts: Kinesis Connector

Kinesis alerts are similar to Kafka alerts, as these are both message queues.

CHAPTER 10

Threat Intelligence

To manage threat intelligence, in the left navigation pane, click **Manage** > **Service Settings** > **Threat Intelligence**.

The **Threat Intelligence** feature provides the most up-to-date datasets for the Secure Workload pipeline that identifies and quarantines threats by inspecting the datacenter workloads against externally known malware command and control addresses, security flaws in processes and geographical location.

The Threat Intelligence dashboard displays the updated status of threat intelligence datasets. These datasets are updated automatically.

Warning The Threat Intelligence feature requires a connection to Cisco Secure Workload servers to automatically update. Your enterprise outbound HTTP request may require:

- Allow the following domain from the enterprise firewall outbound rules: `uas.tetrationcloud.com`
- Configure your Outbound HTTP Connection.

In environments without an outbound connection, upload the datasets directly. See the **Manual Uploads** section.

Table 31: Datasets

Dataset	Description
NVD CVEs	Security related software flaws, CVSS base score, vulnerable product configuration, and weakness categorization
MaxMind Geo	Identification of the location and other characteristics of source IPs
NIST RDS	NIST Reference Data Set of digital signatures of known, traceable software applications
Team Cymru	Insight on 3,000+ botnet command and control IPs
Hash Verdict	Verdict of Secure Workload on process hashes (only available with the Automatic Updates section).

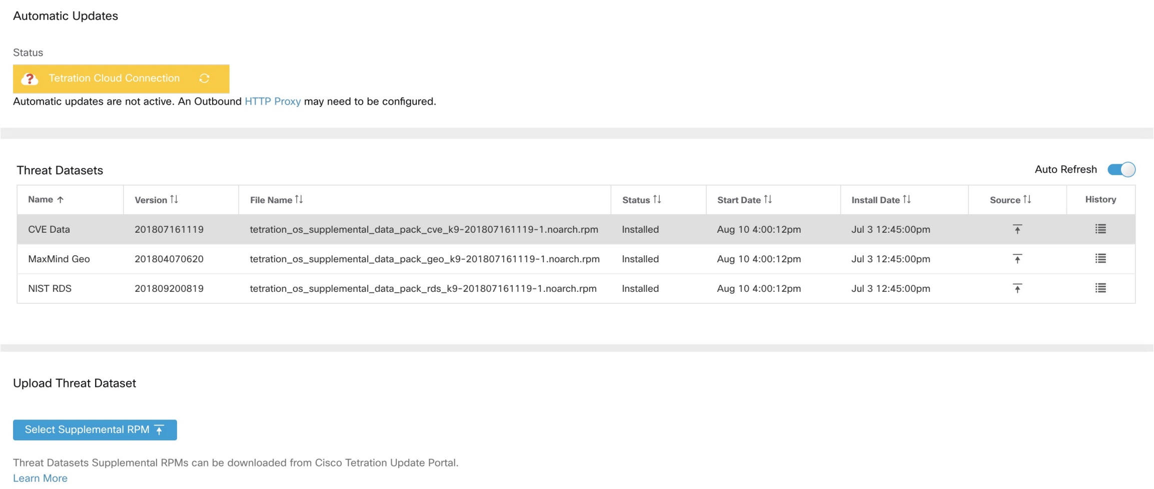
Note In case the MaxMind Geo dataset is manually uploaded in an earlier release, you must reupload the corresponding RPM to view the location and related information on the Flow Visibility page.

- Automatic Updates, on page 660
- Manual Uploads, on page 660

Automatic Updates

The threat dataset updates are triggered from the appliance to synchronize with the global dataset that is hosted on the Internet at uas.tetrationcloud.com, everyday between 3-4 a.m. UTC. The global dataset is refreshed weekly on Fridays or Mondays. The Threat Intelligence dashboard lists the datasets and the date on which the dataset is last updated.

Figure 385: Dashboard



Automatic Updates

Status

Tetration Cloud Connection

Automatic updates are not active. An Outbound HTTP Proxy may need to be configured.

Threat Datasets

Auto Refresh

Name ↑	Version ↑↓	File Name ↑↓	Status ↑↓	Start Date ↑↓	Install Date ↑↓	Source ↑↓	History
CVE Data	201807161119	tetration_os_supplemental_data_pack_cve_k9-201807161119-1.noarch.rpm	Installed	Aug 10 4:00:12pm	Jul 3 12:45:00pm	⤒	☰
MaxMind Geo	201804070620	tetration_os_supplemental_data_pack_geo_k9-201807161119-1.noarch.rpm	Installed	Aug 10 4:00:12pm	Jul 3 12:45:00pm	⤒	☰
NIST RDS	201809200819	tetration_os_supplemental_data_pack_rds_k9-201807161119-1.noarch.rpm	Installed	Aug 10 4:00:12pm	Jul 3 12:45:00pm	⤒	☰

Upload Threat Dataset

Select Supplemental RPM

Threat Datasets Supplemental RPMs can be downloaded from Cisco Tetration Update Portal.
Learn More

Manual Uploads

Attention **Scheduling Manual Uploads**—Dataset RPM files are published to Secure Workload Update Portal weekly. It is recommended to install the latest releases periodically by configuring a schedule for an administrator.

Downloading Updated Datasets

The datasets can be downloaded from Secure Workload Update Portal.

Uploading Datasets Manually

To upload dataset RPM files:

Before you begin

Log in as a **Site Administrator** or **Customer Support**.

Procedure

Step 1 In the left navigation pane, click **Manage** > **Service Settings** > **Threat Intelligence**.

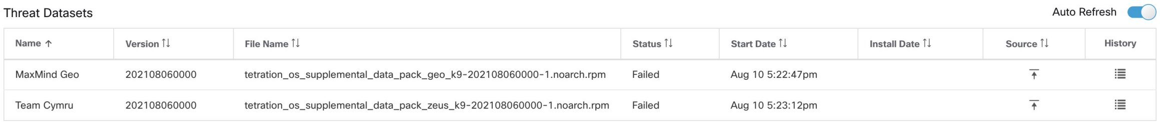
Step 2 Under the **Upload Threat Dataset** section, click **Select Supplemental RPM**.

Step 3 Upload the RPM file downloaded from Secure Workload Update Portal.

Step 4 Click **Upload**.

The RPM upload process is initiated and the status is displayed on a progress bar. After the upload, the RPM file is processed and installed in the background. The table is updated after the installation is complete.

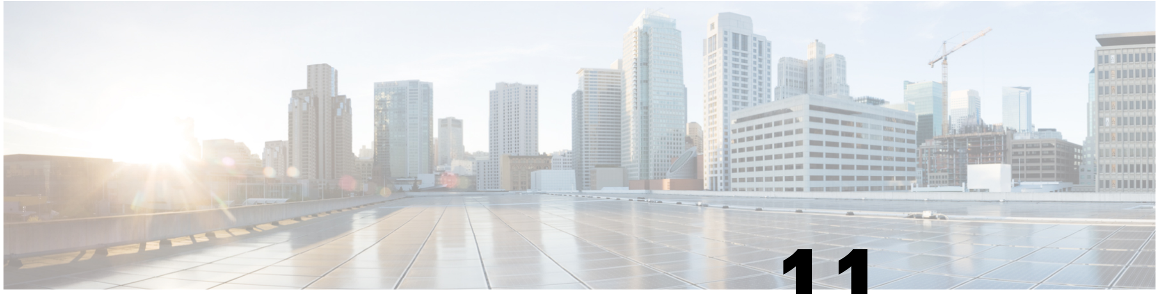
Figure 386: Threat Datasets



Threat Datasets

Auto Refresh

Name ↑	Version ⇅	File Name ⇅	Status ⇅	Start Date ⇅	Install Date ⇅	Source ⇅	History
MaxMind Geo	202108060000	tetration_os_supplemental_data_pack_geo_k9-202108060000-1.noarch.rpm	Failed	Aug 10 5:22:47pm		⤒	☰
Team Cymru	202108060000	tetration_os_supplemental_data_pack_zeus_k9-202108060000-1.noarch.rpm	Failed	Aug 10 5:23:12pm		⤒	☰



CHAPTER 11

Monitoring

The **Monitoring** options available to you vary depending on your role.

Agent Monitoring

The page displays the count of all monitored agents in a cluster based on the currently selected root scope.

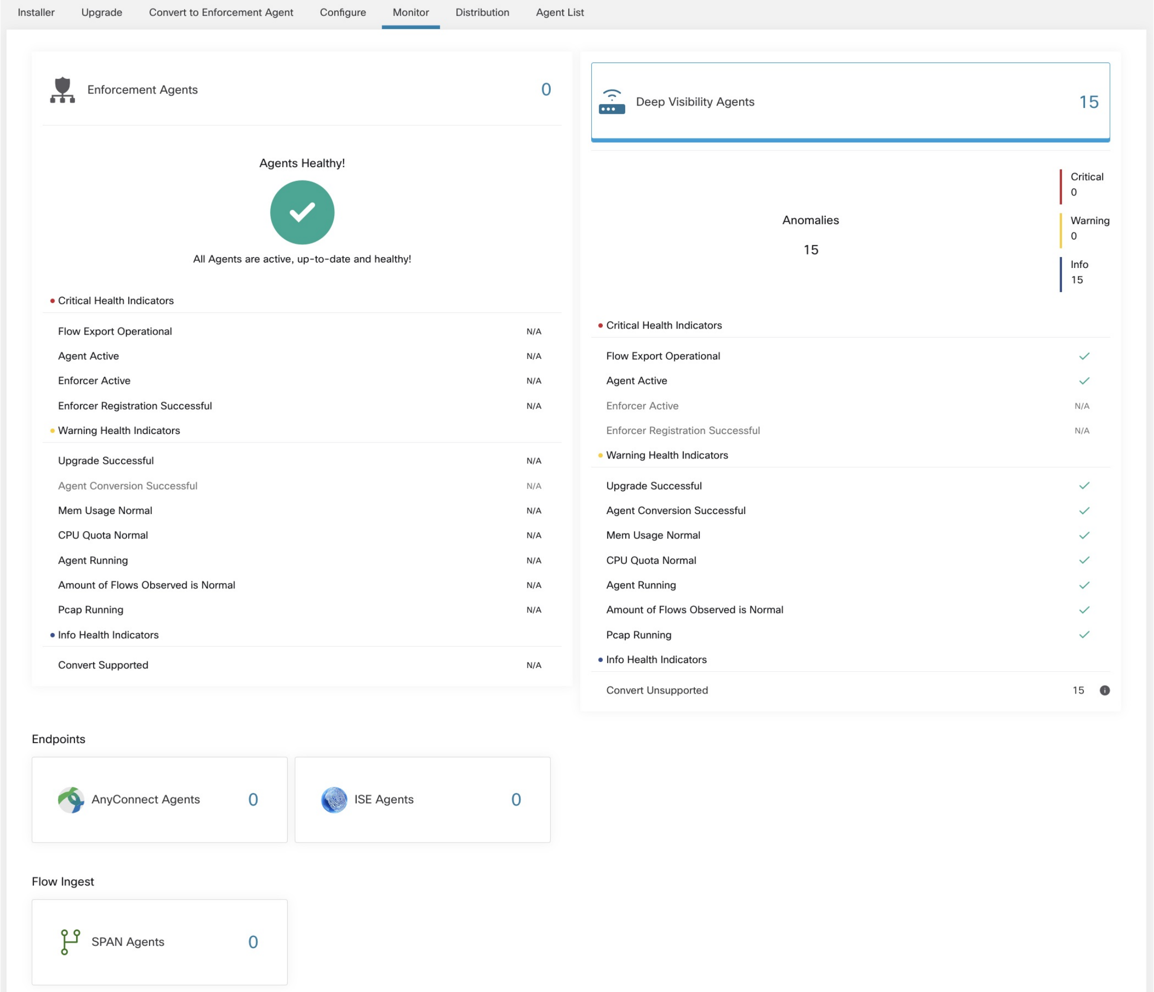
Note Total Inventory count is the summation of all inventory observed on the network after applying collection rules.

Agent Monitoring Type

To monitor agents, click **Manage** > **Agents** in the left navigation bar, then click the **Monitor** tab.

This page is only available for users that have **Site Admin** and **Customer Support** roles. **Scope owners** can see Inventory, Deep Visibility Agents, and Enforcement Agents.

Figure 387: Total Number of Installed Agents



Installer | Upgrade | Convert to Enforcement Agent | Configure | Monitor | Distribution | Agent List

Enforcement Agents 0

Agents Healthy!

All Agents are active, up-to-date and healthy!

● Critical Health Indicators	
Flow Export Operational	N/A
Agent Active	N/A
Enforcer Active	N/A
Enforcer Registration Successful	N/A
● Warning Health Indicators	
Upgrade Successful	N/A
Agent Conversion Successful	N/A
Mem Usage Normal	N/A
CPU Quota Normal	N/A
Agent Running	N/A
Amount of Flows Observed is Normal	N/A
Pcap Running	N/A
● Info Health Indicators	
Convert Supported	N/A

Deep Visibility Agents 15

Anomalies

15

Critical
0

Warning
0

Info
15

● Critical Health Indicators	
Flow Export Operational	✓
Agent Active	✓
Enforcer Active	N/A
Enforcer Registration Successful	N/A
● Warning Health Indicators	
Upgrade Successful	✓
Agent Conversion Successful	✓
Mem Usage Normal	✓
CPU Quota Normal	✓
Agent Running	✓
Amount of Flows Observed is Normal	✓
Pcap Running	✓
● Info Health Indicators	
Convert Unsupported	15

Endpoints

AnyConnect Agents 0

ISE Agents 0

Flow Ingest

SPAN Agents 0

The following table shows the differences between each agent type.

Agent Type	Description
Deep Visibility	Provides highest fidelity in terms of time series flow data, processes running on a host. Most Linux and Windows platforms are supported. See sw_agents_deployment-label
Enforcement	Provides all capabilities available in Deep Visibility Agents. In addition, Enforcement agents are capable of setting firewall rules on the installed host.

AnyConnect	Provides time series flow data on endpoints running AnyConnect Secure Mobility Agent with Network Visibility Module (NVM) without requiring any Cisco Secure Workload agent installation. IPFIX records generated by NVM are sent to Secure Workload AnyConnect Proxy connector. Windows, Mac, and certain smartphone platforms are supported.
ISE	Provides metadata about endpoints registered with Cisco ISE. Through ISE pxGrid, ISE connector collects the metadata, registers the ISE endpoints on Secure Workload as ISE agents pushes labels based on the attributes fetched from ISE appliance and LDAP attributes for the users logged in to the endpoints.

The following table provides a brief summary of various appliance agents provided by Cisco Secure Workload.

Appliance Agents	Description
SPAN	Provides the flow analysis without requiring any per-host agent installation. It runs in the Secure Workload ERSPAN VM appliance. It consumes ERSPAN packets sourced by any Cisco switch.

Note Appliance agents such as NetFlow, NetScaler, F5, AWS, and AnyConnect Proxy are now supported as connectors. For more information on connectors, see What are Connectors.

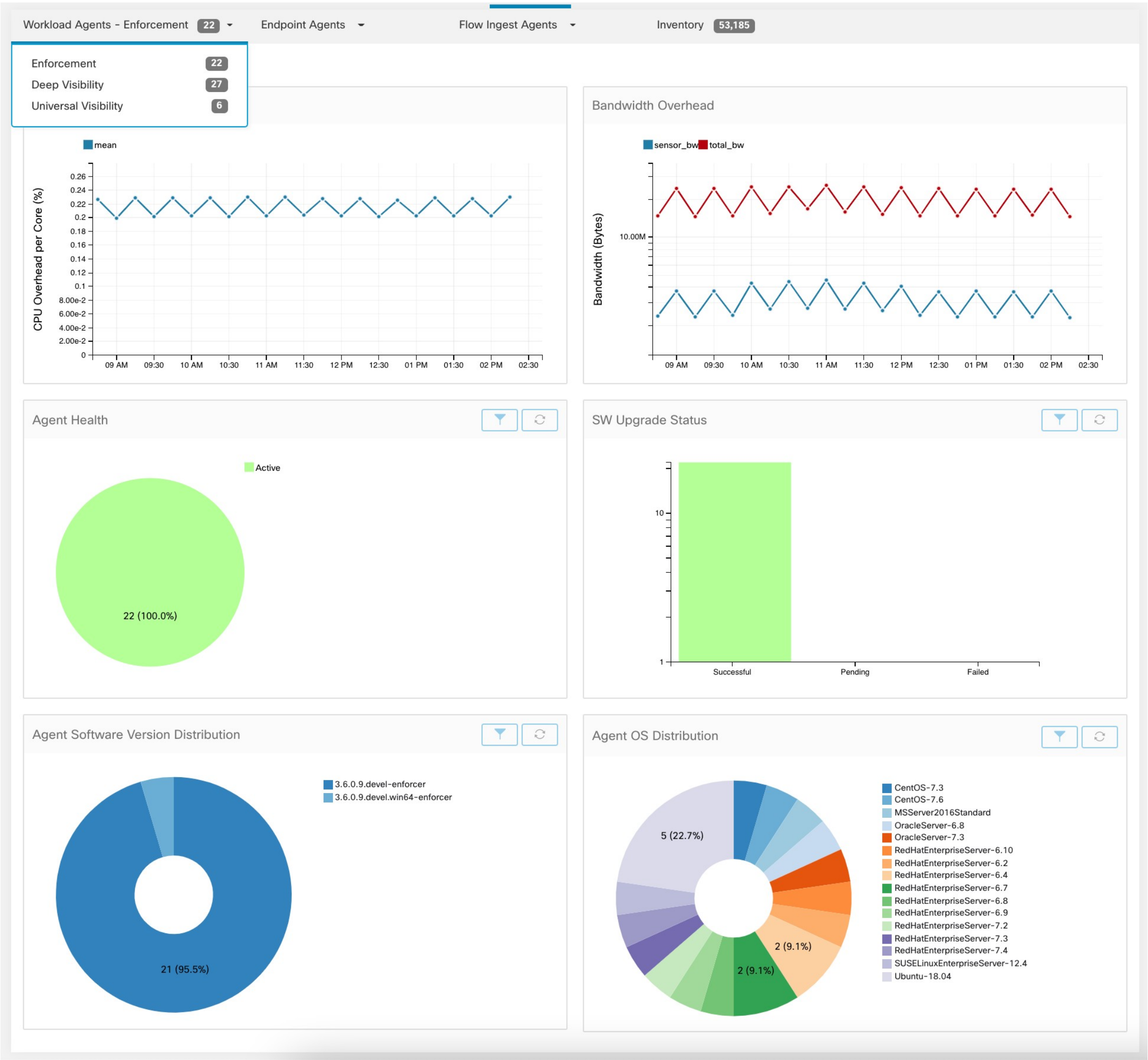
Any non-zero agent type button allows further drill-down into the distribution of each agent type.

Agent Status and Statistics

To view the charts described in this topic, choose **Manage** > **Agents**, then click the **Distribution** tab.

The following charts are available for both Deep Visibility and Enforcement Agent types.

Figure 388: Agents Distribution



For each agent type, this page provides an overview and the health of registered agents including overall CPU overhead, bandwidth overhead, missed packets, OS/version distribution and agent upgrade status.

CPU Overhead Chart

The CPU Overhead chart provides an aggregated view of CPU overhead per core from all agents. Per-agent CPU Overhead is provided as part of the Workload Profile. This chart is only available for Deep Visibility and Enforcement Agent Types.

Bandwidth Overhead Chart

The Bandwidth Overhead chart provides aggregated stats of total bandwidth and bandwidth used by agents. Per-agent bandwidth overhead is provided as part of the Workload Profile. This chart is only available for Deep Visibility and Enforcement Agent Types.

Agent Health Chart

The Agent Health chart provides the number of active/inactive agents. Active agents are the one schecking in with config server for upgrade on regular intervals. The checking interval is 30 minutes. If we see that an agent has missed more than two check-in periods from a agent, it would be declared as inactive agent.

Software Agent Updates to Latest Revision Chart

Every time an agent checks in with the config server, the agent would also provide its current RPM version. If an agent is configured to a specific version and is not able to update after 2 check-in periods, the agent would be declared as not able to upgrade to the latest version.

Agent Packet Missed Chart

In rare occasions when the traffic volume traversing a host is greater than the rate at which the agent is able to inspect, some packets are skipped from being analyzed. The number of missed packets and the corresponding agent name are displayed in this chart.

Agent Software Version/OS Distribution Charts

These charts show the agent version distribution and parent OS platform of all agents registered with the Secure Workload cluster.

Enforcement Status

To view enforcement status, click **Defend** > **Enforcement Status** in the navigation bar at the left side of the window.

This page is available for site admin/customer support users and scope owners to get an overview of the current status of all the enforcement agents, including the cloud connectors that are enforcing a policy.

If any of the charts shows red or orange, see the applicable topic:

Table 32: Enforcement Status Charts

Chart	Result	Take Action
Agent Enforcement Enabled	**Not Enabled**	Make sure enforcement is enabled in the agent configuration. See Create an Agent Configuration Profile, on page 66.
Agent Policy Config	**Stale Policies**	This situation is generally temporary and typically doesn't require any action. It occurs because a Secure Workload deployment based on labels updates inventory and policies dynamically. However, if this situation persists for any individual workloads, contact Cisco TAC.
Agent Concrete Policies	**Skipped**	This indicates that policies weren't pushed to some agents.

Tip

- To view status for individual scopes or for the entire tenant, use the **Filter by Scope** option at the top-left side of the page.
- If the charts indicate a problem, identify which workloads have the problem by clicking the relevant part of a chart.

  The table displays the affected workloads.

  Alternatively, to see filtering options, click the (i) button in the **Filter** box below the charts.
- To view a wealth of additional details, click the IP address link in the filtered list of workloads to display the Workload Profile page.

The following table describes the fields shown in the enforcement status table.

Field	**Description**
Host Name	Host name of the workload.
Address	IP addresses of all the interfaces on the workload.
Enforcement Enabled	Indicates whether enforcement is enabled or not on the agent.
Concrete Policies in Sync	This indicates whether the desired version of concrete policies are currently enforced on the agent.
Concrete Policies	If this value shows **Skipped** for any host, this means the limit on policies is reached for the agent on that host. (See Limits Related to Policies, on page 950.)
Policy Count	The number of concrete policies on the agent.
Status	The status of the latest policy config enforcement. If the status is **CONFIG_SUCCESS**, it indicates that current version is enforced without any issue.

Enforcement Status for Cloud Connectors

If you have set up AWS or Azure cloud connectors:

All interfaces enforcement status are displayed on the enforcement status page. If the policies are applied successfully, the policies are in sync else the corresponding error messages are displayed.

Policy count in the enforcement status page is Secure Workload accounting but not AWS or Azure rule accounting.

(AWS only) The hostname field on this page is derived from public DNS. If the public DNS is not enabled on the given VPC, the hostname field is empty.

Pausing Policy Updates

See Pause Policy Updates, on page 549.

CHAPTER 12

Security Dashboard

Security Dashboard presents actionable security scores by bringing together multiple signals available in Secure Workload. It helps in understanding the current security position and improving it.

Security Dashboard acts as a springboard to many richer drill-downs within Secure Workload such as flow search, inventory search, automatic policy discovery, and forensics.

View the Security Dashboard

To view the Security Dashboard, in the left navigation pane, click **Overview**.

Security Score

Security Score is a number from 0 through 100, indicating the security position in a category. A score of 100 is the best score and a score of 0 is the worst. Scores closer to 100 are better.

The Security Score computation considers vulnerabilities in installed software packages, consistency of process hashes, open ports on different interfaces, forensic and network anomaly events, and compliance or noncompliance to policies.

Security Score Categories

There are six different score categories. Most security aspects of a workload are taken into account to come up with these categories.

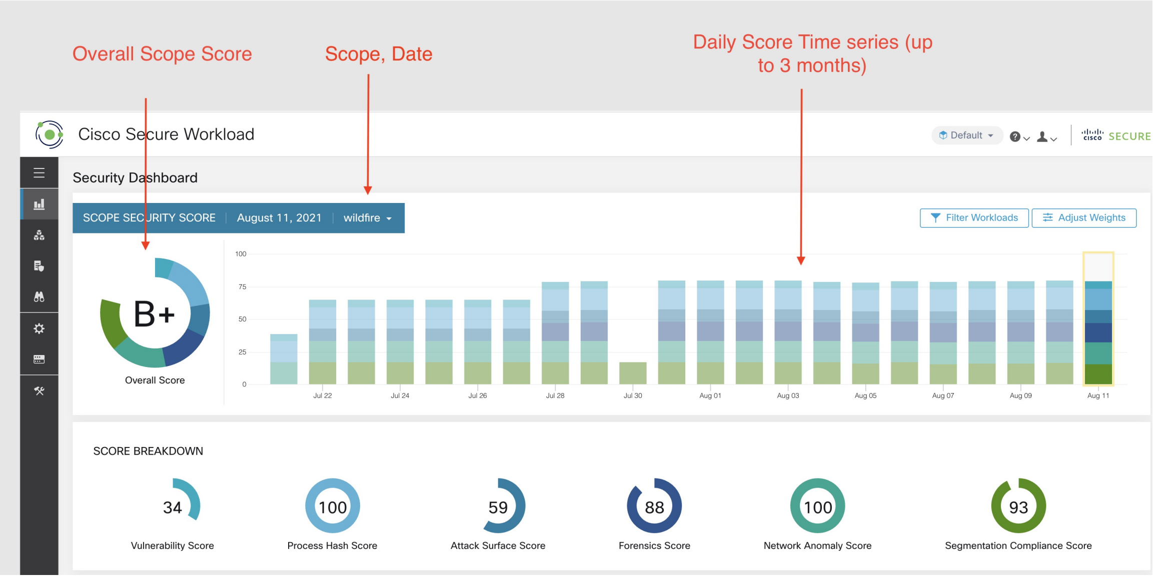
- **Vulnerability Score**: Vulnerabilities in the installed packages on a workload are used for scoring.
- **Process Hash Score**: Process hash consistency (and anomaly) along with Benign and Flagged process hashes is used for scoring.
- **Attack Surface Score**: Process may have one or more ports open on multiple interfaces to make services available. Unused open ports are used for scoring.
- **Forensics Score**: Severity of forensic events on a workload is used for scoring.
- **Network Anomaly Score**: Severity of network anomaly events on a workload is used for scoring.
- **Segmentation Compliance Score**: Compliance (permitted) and violations (escaped) to automatically discovered policies is used for scoring.

High-Level View

Security dashboard has scope level scores for the selected scope. There is an overall score with time series and score breakdown. Score details for the six score categories for the selected scope are displayed.

Scope Level Score Details

Scope Level Score details are on top of the dashboard.

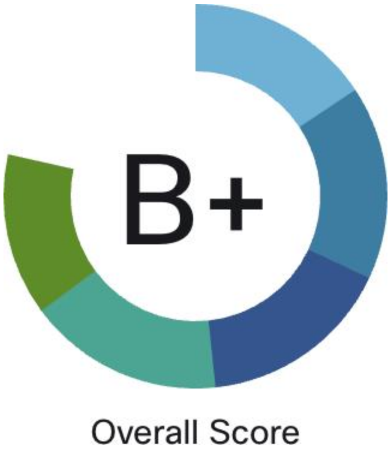


The following details are displayed:

- **Overall Scope Score**: Overall score for the selected scope.
- **Daily Score Time series**: Stacked time series that can go up to 3 months.
- **Score Breakdown**: Breakdown of category scores for the selected day on time series.

Overall Score

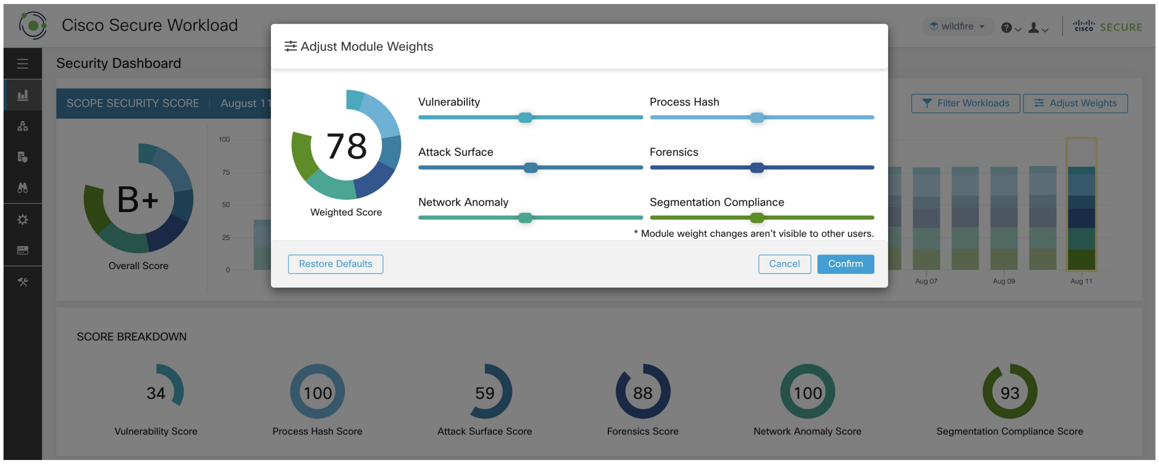
The overall score is represented as a letter from **A+, A, … , F**, with **A+** considered as the best score and **F** to be the worst. It is displayed as a donut chart with each slice (color-coded) representing a score category.



Overall score is the weighted average of the six score categories. By default, all weights are equal. If a score is **N/A**, it is considered as 0 in the overall score calculation.

$$\text{Overall score} = \frac{\sum W_{category} \times Score_{category}}{\sum W_{category}}$$

Weights can be adjusted using slides in the **Adjust Weights** module. Each user can set their own weight adjustments, which help in aligning scores with your priorities.

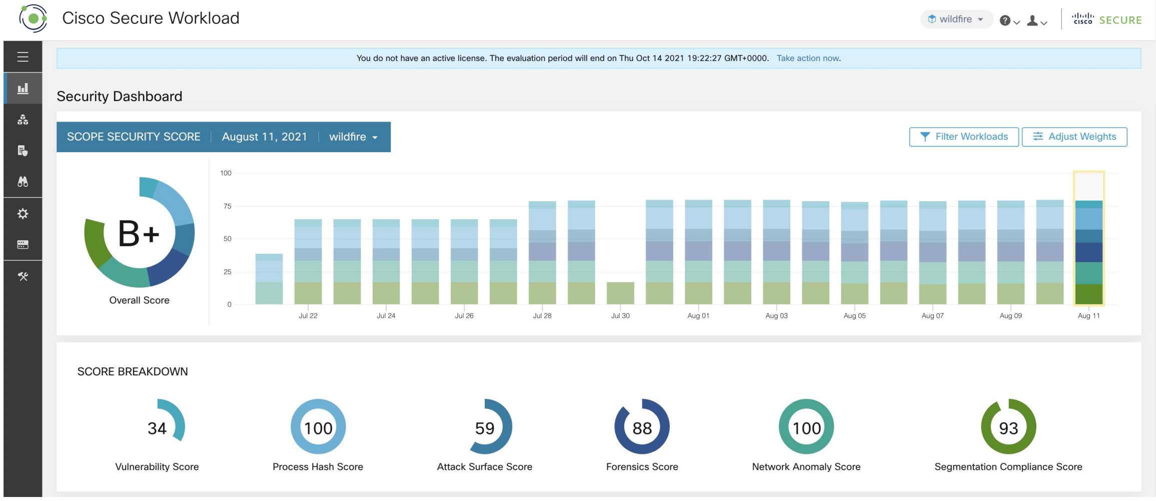


* Module weight changes aren't visible to other users.

Important: If a score is **N/A**, it is considered as **0** in the overall score calculation.

Daily Time Series

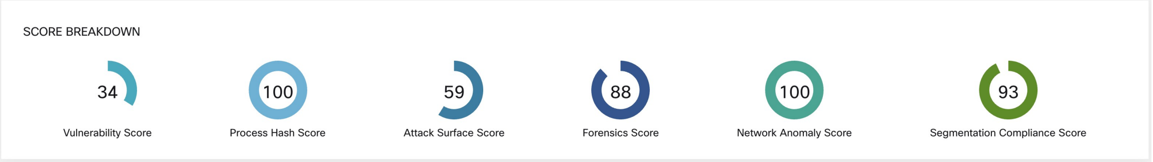
Stacked time series that can go up to three months. It helps in tracking security position over a long period. Each stack represents an overall score for a day. Each segment in the stack is a category that is represented by different color. You can click on day to get the score breakdown for the day.



You do not have an active license. The evaluation period will end on Thu Oct 14 2021 19:22:27 GMT+0000. Take action now.

Score Breakdown

The Score Breakdown displays the score for all the six categories for the day that is selected on the time series. Score **N/A** indicates that score is not available. It will be counted as 0 for the overall score calculation.



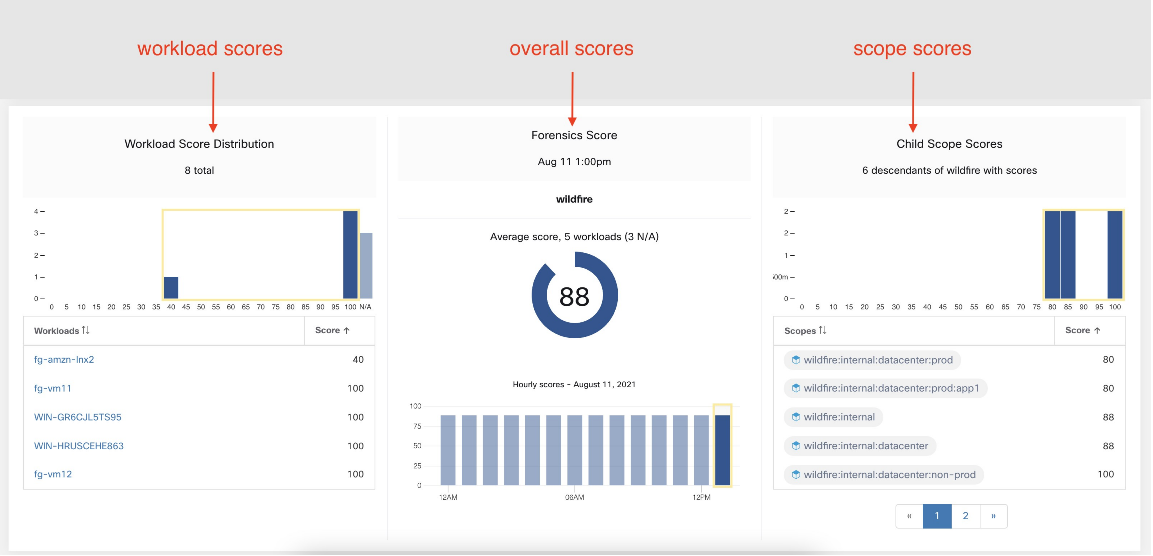
SCORE BREAKDOWN

Vulnerability Score	34
Process Hash Score	100
Attack Surface Score	59
Forensics Score	88
Network Anomaly Score	100
Segmentation Compliance Score	93

Important If a score is **N/A**, it is considered as **0** for overall score calculation.

Score Details

Each of the six categories follows the following template. It has workload score distribution, hourly time series, and child scope score distribution.



Workload Score Distribution

8 total

Workloads ⇅	Score ↑
fg-amzn-lnx2	40
fg-vm11	100
WIN-GR6CJL5TS95	100
WIN-HRUSCEHE863	100
fg-vm12	100

Forensics Score

Aug 11 1:00pm

wildfire

Average score, 5 workloads (3 N/A)

88

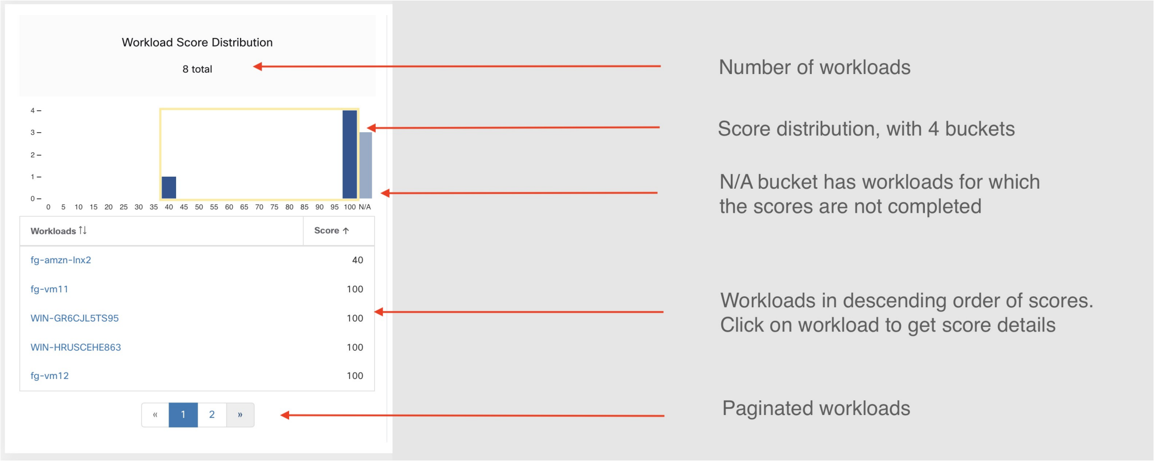
Hourly scores - August 11, 2021

Child Scope Scores

6 descendants of wildfire with scores

Scopes ⇅	Score ↑
wildfire:internal:datacenter:prod	80
wildfire:internal:datacenter:prod:app1	80
wildfire:internal	88
wildfire:internal:datacenter	88
wildfire:internal:datacenter:non-prod	100

Workload score distribution provides insight into score contribution from workloads under the selected scope. It helps to bubble up lowest-scoring workloads to expedite corrective actions.



Workload Score Distribution

8 total

4
3
2
1
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 N/A

Workloads ⇅	Score ↑
fg-amzn-lnx2	40
fg-vm11	100
WIN-GR6CJL5TS95	100
WIN-HRUSCEHE863	100
fg-vm12	100

Number of workloads

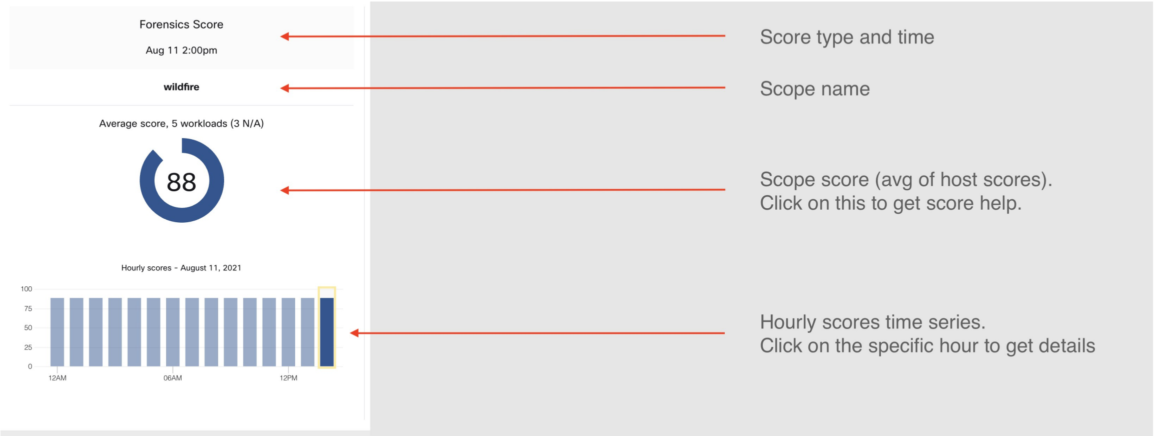
Score distribution, with 4 buckets

N/A bucket has workloads for which the scores are not completed

Workloads in descending order of scores. Click on workload to get score details

Paginated workloads

Hourly time series helps in getting the hourly score over the course of a selected day. Selecting an hour in the hourly time series updates the workload score distribution and descendent scope distribution to show the selected hour.



Forensics Score

Aug 11 2:00pm

wildfire

Average score, 5 workloads (3 N/A)

88

Hourly scores - August 11, 2021

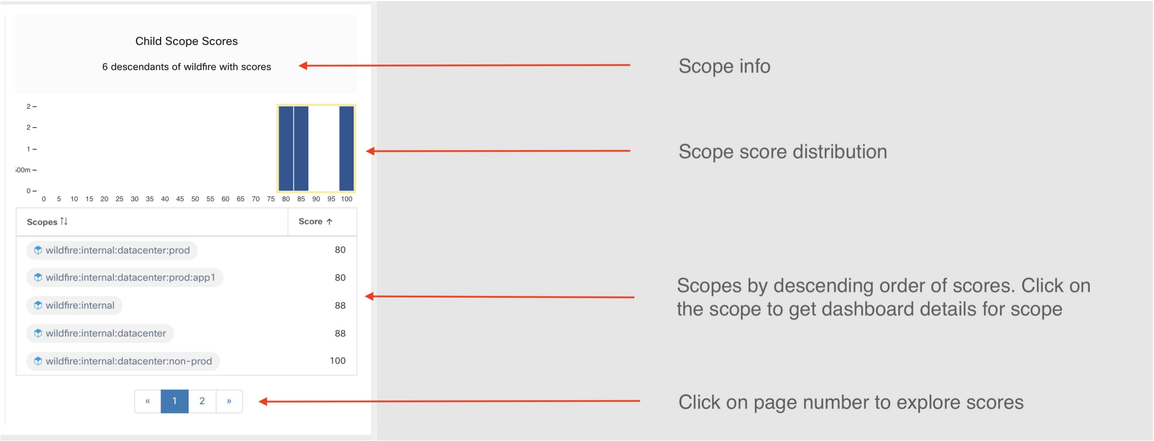
Score type and time

Scope name

Scope score (avg of host scores). Click on this to get score help.

Hourly scores time series. Click on the specific hour to get details

Descendent scope distribution provides insight into the score contribution of child scopes of the selected scope.



Child Scope Scores

6 descendants of wildfire with scores

Scopes ⇅	Score ↑
wildfire:internal:datacenter:prod	80
wildfire:internal:datacenter:prod:app1	80
wildfire:internal	88
wildfire:internal:datacenter	88
wildfire:internal:datacenter:non-prod	100

Scope info

Scope score distribution

Scopes by descending order of scores. Click on the scope to get dashboard details for scope

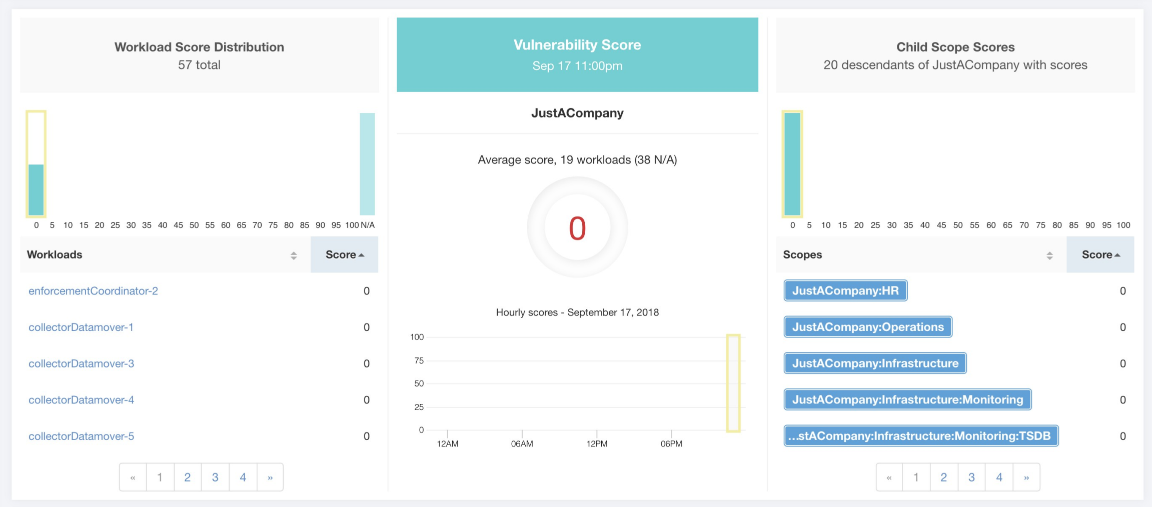
Click on page number to explore scores

Details of each score category are explained in this section.

Vulnerability Security Score

Vulnerabilities in software packages installed on workloads are used for computing Vulnerability Security Score.

Figure 389: Vulnerability Security Score Details



Workload Score Distribution
57 total

Workloads	Score
enforcementCoordinator-2	0
collectorDatamover-1	0
collectorDatamover-3	0
collectorDatamover-4	0
collectorDatamover-5	0

« 1 2 3 4 »

Vulnerability Score
Sep 17 11:00pm

JustACompany

Average score, 19 workloads (38 N/A)

0

Hourly scores - September 17, 2018

Child Scope Scores
20 descendants of JustACompany with scores

Scopes	Score
JustACompany:HR	0
JustACompany:Operations	0
JustACompany:Infrastructure	0
JustACompany:Infrastructure:Monitoring	0
...stACompany:Infrastructure:Monitoring:TSDB	0

« 1 2 3 4 »

Lower score indicates:

- One or more installed software packages have serious vulnerabilities.
- Apply patch or upgrade to reduce the chances of exposures or exploits

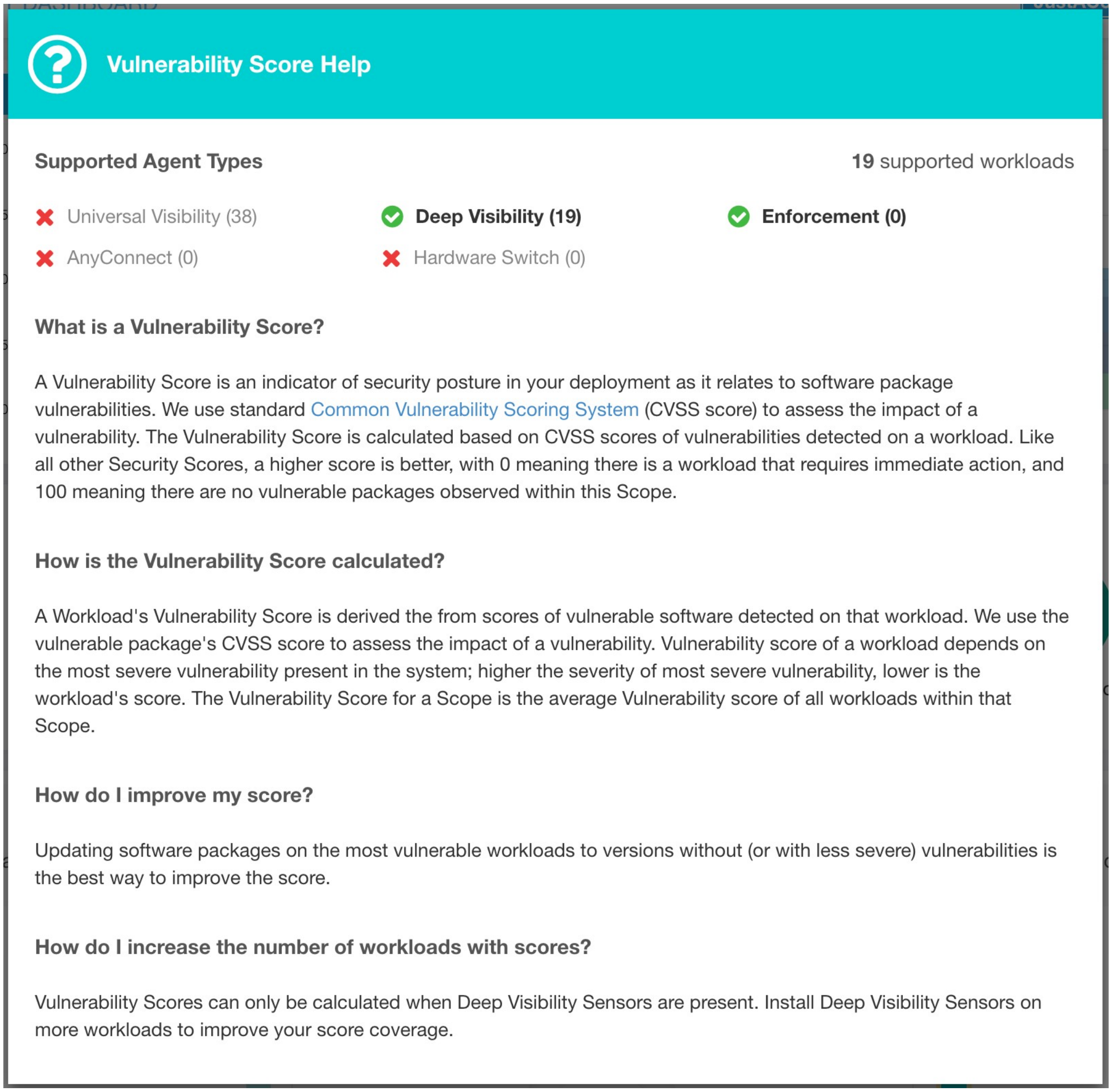
Software packages on workloads could potentially be associated with known vulnerabilities (CVE). CVSS (Common Vulnerability Scoring System) is used for assessing the impact of a CVE. CVSS score range is 0–10, with 10 being the most severe.

CVE can have CVSS v2 and CVSS v3 score. To compute Vulnerability score, CVSS v3 is considered if available, else CVSS v2 is considered.

Vulnerability score for a workload is derived from scores of vulnerable software that is detected on that workload. The Workload Vulnerability Score is calculated based on the CVSS scores, the vendor data, and may be adjusted by our security research team when data is missing or inaccurate (common for new vulnerabilities). This data is updated every 24 hours when the threat feed is configured. Higher the severity of the most severe vulnerability, lower is the score.

Scope score is average of workload scores in the scope. Improve the score by identifying workload or scopes with vulnerable software packages, and patch or upgrade with safer packages.

Figure 390: Help for Vulnerability Security Score



Vulnerability Score Help

Supported Agent Types

19 supported workloads

✗ Universal Visibility (38)	✓ **Deep Visibility (19)**	✓ **Enforcement (0)**
✗ AnyConnect (0)	✗ Hardware Switch (0)	

What is a Vulnerability Score?

A Vulnerability Score is an indicator of security posture in your deployment as it relates to software package vulnerabilities. We use standard Common Vulnerability Scoring System (CVSS score) to assess the impact of a vulnerability. The Vulnerability Score is calculated based on CVSS scores of vulnerabilities detected on a workload. Like all other Security Scores, a higher score is better, with 0 meaning there is a workload that requires immediate action, and 100 meaning there are no vulnerable packages observed within this Scope.

How is the Vulnerability Score calculated?

A Workload's Vulnerability Score is derived the from scores of vulnerable software detected on that workload. We use the vulnerable package's CVSS score to assess the impact of a vulnerability. Vulnerability score of a workload depends on the most severe vulnerability present in the system; higher the severity of most severe vulnerability, lower is the workload's score. The Vulnerability Score for a Scope is the average Vulnerability score of all workloads within that Scope.

How do I improve my score?

Updating software packages on the most vulnerable workloads to versions without (or with less severe) vulnerabilities is the best way to improve the score.

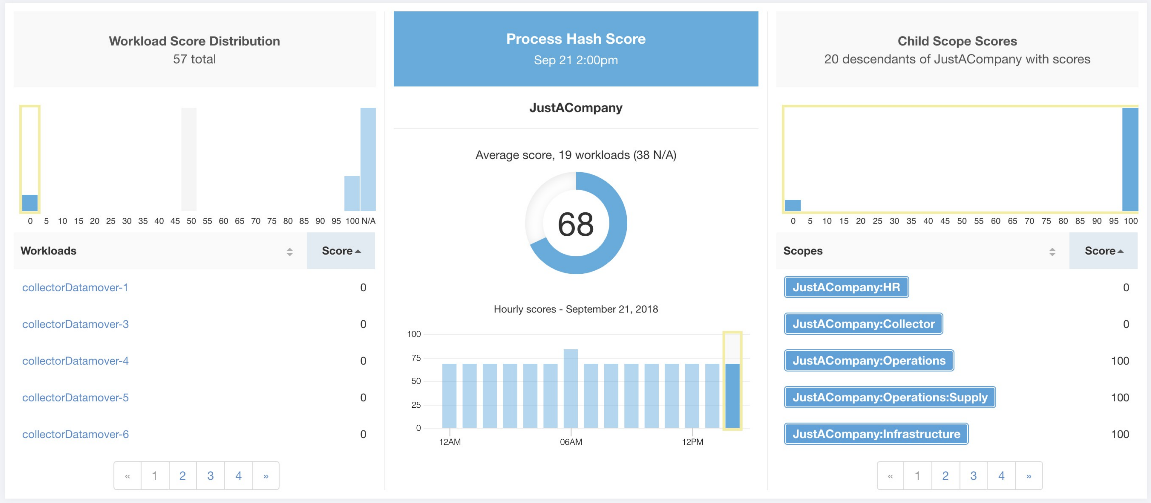
How do I increase the number of workloads with scores?

Vulnerability Scores can only be calculated when Deep Visibility Sensors are present. Install Deep Visibility Sensors on more workloads to improve your score coverage.

Process Hash Score

Process hash score is an assessment of process binary hash (file hash) consistency across workloads. For example: A web server farm running Apache that is cloned from the same setup config is expected to have same hash for httpd binaries on all servers. A mismatch is an anomaly.

Figure 391: Process Hash Score Details



Workload Score Distribution
57 total

Workloads	Score
collectorDatamover-1	0
collectorDatamover-3	0
collectorDatamover-4	0
collectorDatamover-5	0
collectorDatamover-6	0

Process Hash Score
Sep 21 2:00pm

JustACompany

Average score, 19 workloads (38 N/A)

68

Hourly scores - September 21, 2018

Child Scope Scores
20 descendants of JustACompany with scores

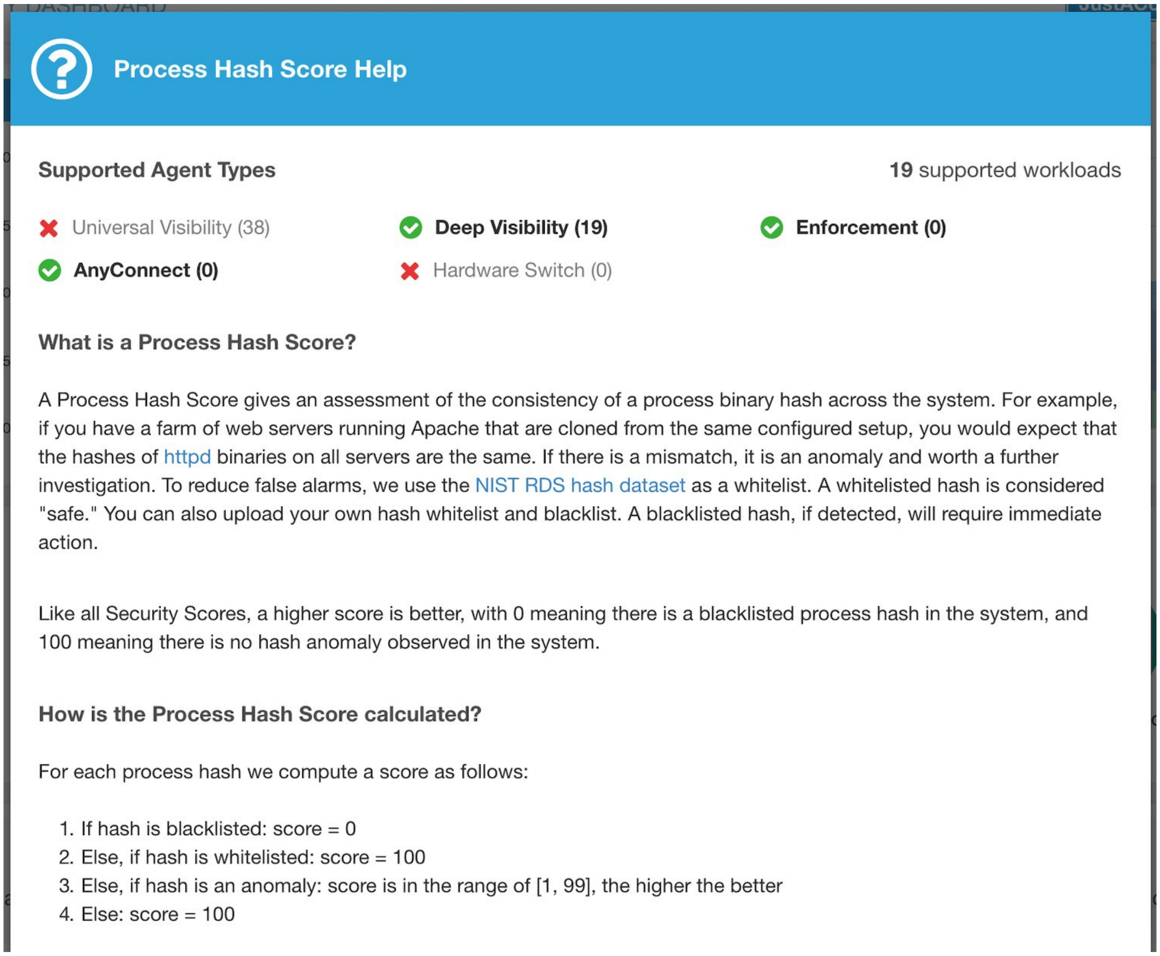
Scopes	Score
JustACompany:HR	0
JustACompany:Collector	0
JustACompany:Operations	100
JustACompany:Operations:Supply	100
JustACompany:Infrastructure	100

Lower score indicates, at least one or both of:

- One or more process hashes are flagged.
- One or more process hashes are anomalous.

Refer to Process Hash Anomaly Detection for more details.

Figure 392: Help for Process Hash Score



Process Hash Score Help

Supported Agent Types

19 supported workloads

✗ Universal Visibility (38)

✓ **Deep Visibility (19)**

✓ **Enforcement (0)**

✓ **AnyConnect (0)**

✗ Hardware Switch (0)

What is a Process Hash Score?

A Process Hash Score gives an assessment of the consistency of a process binary hash across the system. For example, if you have a farm of web servers running Apache that are cloned from the same configured setup, you would expect that the hashes of httpd binaries on all servers are the same. If there is a mismatch, it is an anomaly and worth a further investigation. To reduce false alarms, we use the NIST RDS hash dataset as a whitelist. A whitelisted hash is considered "safe." You can also upload your own hash whitelist and blacklist. A blacklisted hash, if detected, will require immediate action.

Like all Security Scores, a higher score is better, with 0 meaning there is a blacklisted process hash in the system, and 100 meaning there is no hash anomaly observed in the system.

How is the Process Hash Score calculated?

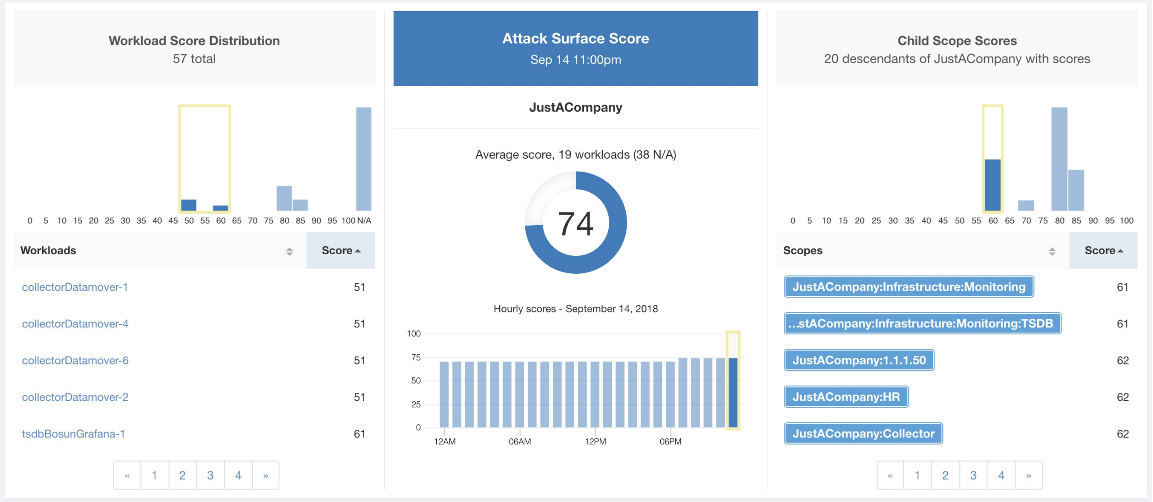
For each process hash we compute a score as follows:

1. If hash is blacklisted: score = 0
2. Else, if hash is whitelisted: score = 100
3. Else, if hash is an anomaly: score is in the range of [1, 99], the higher the better
4. Else: score = 100

Attack Surface Score

Attack Surface Score highlights potential attack surface in a workload. Open unused ports (open ports without traffic) contribute to lowering this score.

Figure 393: Attack Surface Score Details



Workload Score Distribution
57 total

Workloads	Score
collectorDatamover-1	51
collectorDatamover-4	51
collectorDatamover-6	51
collectorDatamover-2	51
tsdbBosunGrafana-1	61

Attack Surface Score
Sep 14 11:00pm

JustACompany

Average score, 19 workloads (38 N/A)

74

Hourly scores - September 14, 2018

Child Scope Scores
20 descendants of JustACompany with scores

Scopes	Score
JustACompany:Infrastructure:Monitoring	61
...stACompany:Infrastructure:Monitoring:TSDB	61
JustACompany:1.1.1.50	62
JustACompany:HR	62
JustACompany:Collector	62

A lower score indicates:

- Many open ports without any traffic in the last 2 weeks
- Well-known attack ports may be open and unused in last 2 weeks.
- One or more open ports are attached with packages that have serious vulnerabilities.

The attack surface score is a function of unused open ports relative to total ports, with a smoothing factor. Open ports without any traffic over the past 2 weeks are considered “unused open ports”. An extra penalty is applied to unused open ports which are well-known ports that are used in attacks (for example, 21, 22, 8080 and so on).

Figure 394: Attack Surface Score Formula

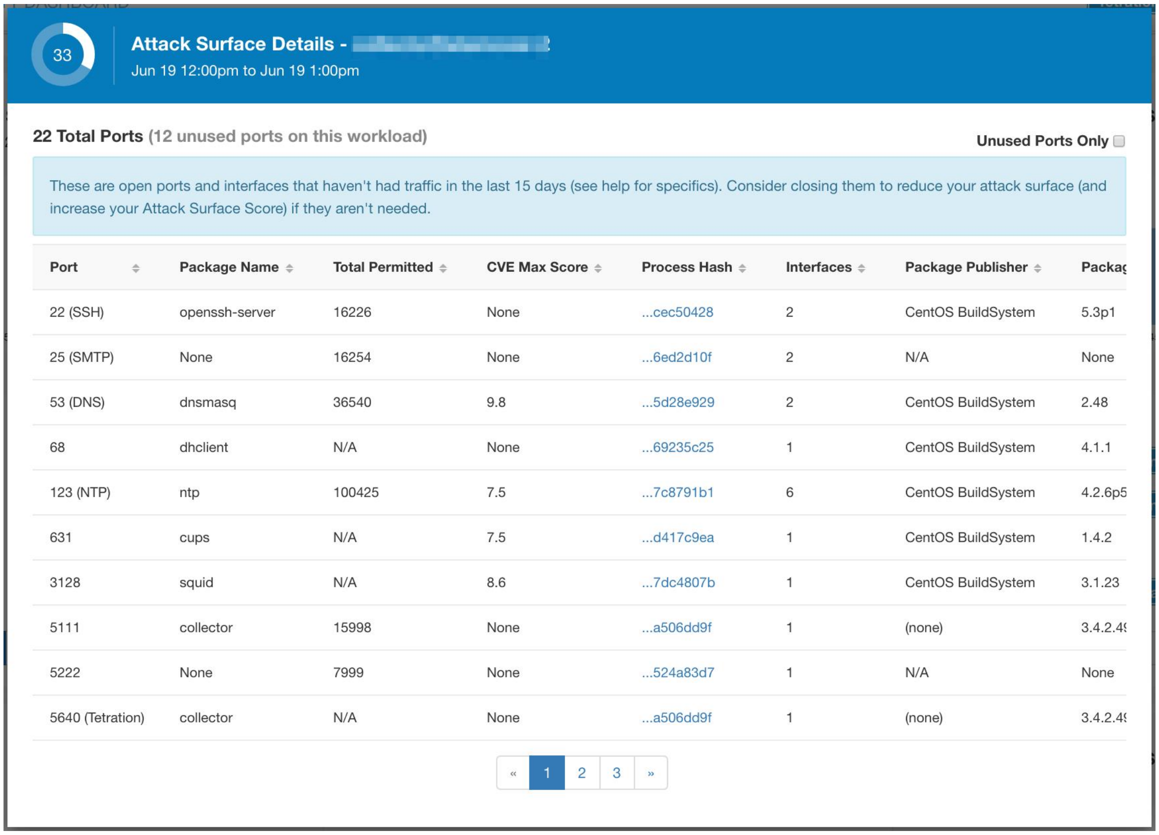
$$Attack\ surface\ score = \frac{\alpha + \sum used\ open\ ports}{\alpha + \sum open\ ports + (\rho * \sum unused\ common\ attack\ ports\ ) + f_v(vulnerablity\ pkgs)}$$

$$f_v = \max\left(\left\{cve_{score} = \begin{cases} CVSS_{V3}, & v3\ exist \\ CVSS_{V2}, & v3\ not\ exist \end{cases}\right\}\right)$$

Laplace smoothing is used with a penalty factor based on heuristic data. Score is computed daily with the past 2 weeks of data.

Tenant score is average of workload scores in the scope. Improve the score by identifying workload or scopes with unused open ports, and closing the unused ports.

When a workload link is clicked an attack surface modal is opened with details on all available ports and interfaces within the context of that workload.



33

Attack Surface Details - [redacted]

Jun 19 12:00pm to Jun 19 1:00pm

22 Total Ports (12 unused ports on this workload)

Unused Ports Only □

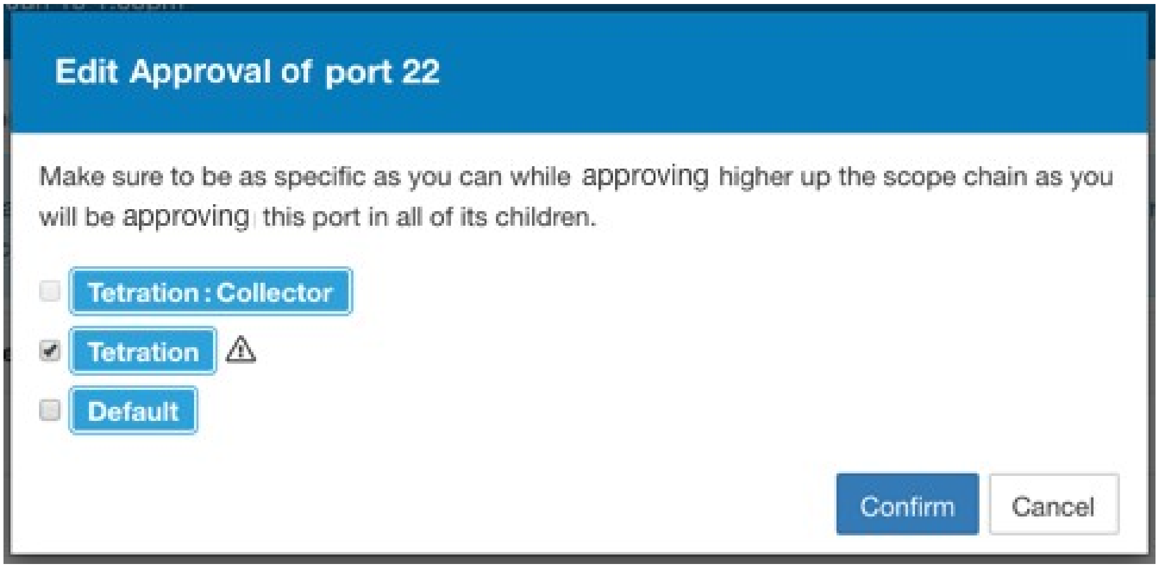
These are open ports and interfaces that haven't had traffic in the last 15 days (see help for specifics). Consider closing them to reduce your attack surface (and increase your Attack Surface Score) if they aren't needed.

Port	Package Name	Total Permitted	CVE Max Score	Process Hash	Interfaces	Package Publisher	Packag
22 (SSH)	openssh-server	16226	None	...cec50428	2	CentOS BuildSystem	5.3p1
25 (SMTP)	None	16254	None	...6ed2d10f	2	N/A	None
53 (DNS)	dnsmasq	36540	9.8	...5d28e929	2	CentOS BuildSystem	2.48
68	dhclient	N/A	None	...69235c25	1	CentOS BuildSystem	4.1.1
123 (NTP)	ntp	100425	7.5	...7c8791b1	6	CentOS BuildSystem	4.2.6p5
631	cups	N/A	7.5	...d417c9ea	1	CentOS BuildSystem	1.4.2
3128	squid	N/A	8.6	...7dc4807b	1	CentOS BuildSystem	3.1.23
5111	collector	15998	None	...a506dd9f	1	(none)	3.4.2.4
5222	None	7999	None	...524a83d7	1	N/A	None
5640 (Tetration)	collector	N/A	None	...a506dd9f	1	(none)	3.4.2.4

Features:

- Unused Ports Only: checkbox that when toggled filters out the ports that are used and only shows you the unused ports that are associated with the workload.
- Columns: Approved, port, package name, total permitted, CVE Max Score, Process Hash, Interfaces, Package Publisher, Package Version, Total Escaped, Total Rejected, Commonly Hacked Port, Links.
- Interfaces: If you click on any one of the line items in the Attack Surface table you can view the interfaces that are associated with each port inside a modal.
- Approved: checkbox that when toggled, allows you to intentionally set an “unused port” as “approved” on any one of the scopes on the scope chain that that workload has access to. Note: if a port is approved on a scope and that port is not explicitly approved on any of the children (if that scope has children), then the scope checkboxes are disabled as it is implied that any child scope that the parent scope has access to already is approved in that chain.

Approval Modal:



Edit Approval of port 22

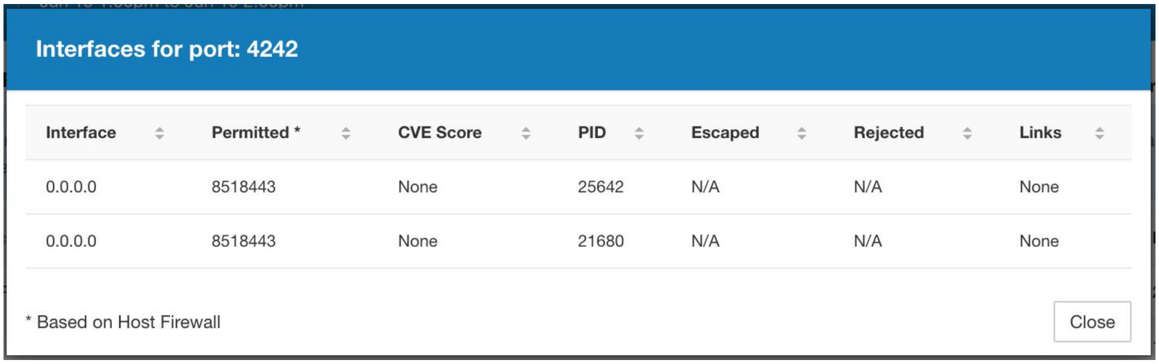
Make sure to be as specific as you can while approving higher up the scope chain as you will be approving this port in all of its children.

☐ Tetration : Collector

☑ Tetration ⚠

☐ Default

Interfaces Modal:

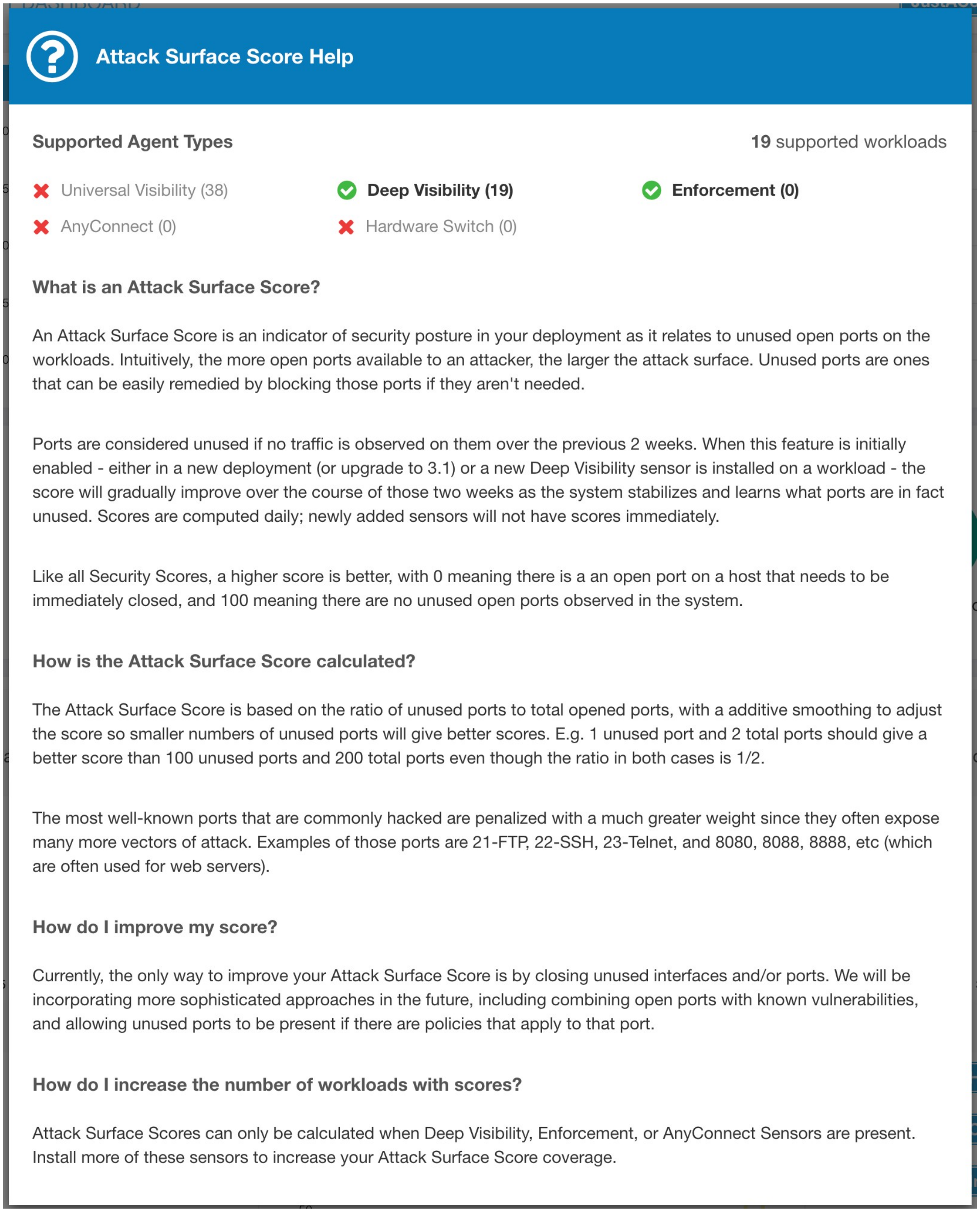


Interfaces for port: 4242

Interface	Permitted *	CVE Score	PID	Escaped	Rejected	Links
0.0.0.0	8518443	None	25642	N/A	N/A	None
0.0.0.0	8518443	None	21680	N/A	N/A	None

* Based on Host Firewall

Figure 395: Help for Attack Surface Score



Attack Surface Score Help

Supported Agent Types

19 supported workloads

✗ Universal Visibility (38) ✓ **Deep Visibility (19)** ✓ **Enforcement (0)**

✗ AnyConnect (0) ✗ Hardware Switch (0)

What is an Attack Surface Score?

An Attack Surface Score is an indicator of security posture in your deployment as it relates to unused open ports on the workloads. Intuitively, the more open ports available to an attacker, the larger the attack surface. Unused ports are ones that can be easily remedied by blocking those ports if they aren't needed.

Ports are considered unused if no traffic is observed on them over the previous 2 weeks. When this feature is initially enabled - either in a new deployment (or upgrade to 3.1) or a new Deep Visibility sensor is installed on a workload - the score will gradually improve over the course of those two weeks as the system stabilizes and learns what ports are in fact unused. Scores are computed daily; newly added sensors will not have scores immediately.

Like all Security Scores, a higher score is better, with 0 meaning there is a an open port on a host that needs to be immediately closed, and 100 meaning there are no unused open ports observed in the system.

How is the Attack Surface Score calculated?

The Attack Surface Score is based on the ratio of unused ports to total opened ports, with a additive smoothing to adjust the score so smaller numbers of unused ports will give better scores. E.g. 1 unused port and 2 total ports should give a better score than 100 unused ports and 200 total ports even though the ratio in both cases is 1/2.

The most well-known ports that are commonly hacked are penalized with a much greater weight since they often expose many more vectors of attack. Examples of those ports are 21-FTP, 22-SSH, 23-Telnet, and 8080, 8088, 8888, etc (which are often used for web servers).

How do I improve my score?

Currently, the only way to improve your Attack Surface Score is by closing unused interfaces and/or ports. We will be incorporating more sophisticated approaches in the future, including combining open ports with known vulnerabilities, and allowing unused ports to be present if there are policies that apply to that port.

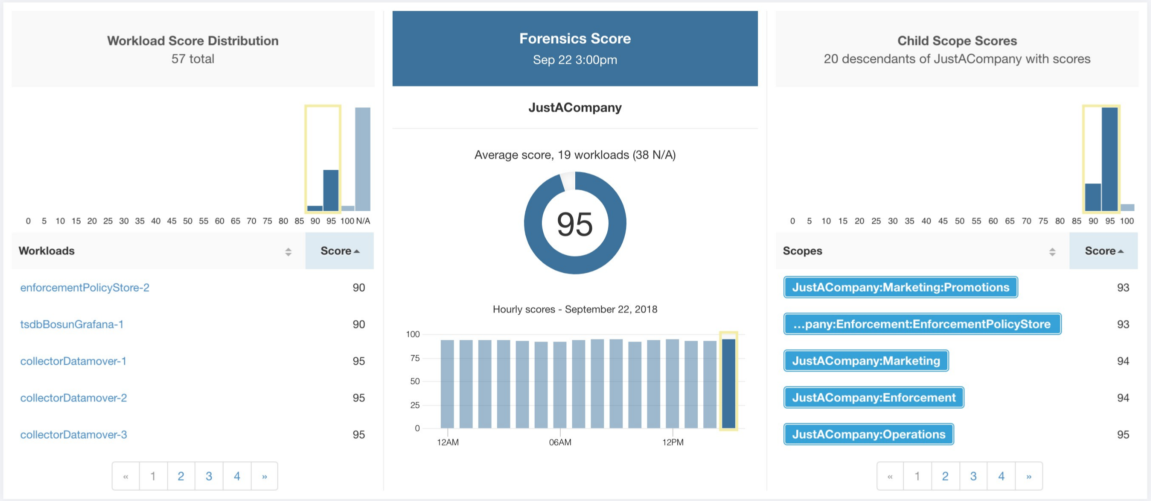
How do I increase the number of workloads with scores?

Attack Surface Scores can only be calculated when Deep Visibility, Enforcement, or AnyConnect Sensors are present. Install more of these sensors to increase your Attack Surface Score coverage.

Forensics Score

Severity of forensics events on workloads is used for computing the scores.

Figure 396: Forensics Score Details


Workload Score Distribution
57 total
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 N/A
Forensics Score
Sep 22 3:00pm
JustACompany
Average score, 19 workloads (38 N/A)
95
Hourly scores - September 22, 2018
100
75
50
25
0
12AM
06AM
12PM
Child Scope Scores
20 descendants of JustACompany with scores
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
« 1 2 3 4 »

Workloads	Score
enforcementPolicyStore-2	90
tsdbBosunGrafana-1	90
collectorDatamover-1	95
collectorDatamover-2	95
collectorDatamover-3	95

Scopes	Score
JustACompany:Marketing:Promotions	93
...pany:Enforcement:EnforcementPolicyStore	93
JustACompany:Marketing	94
JustACompany:Enforcement	94
JustACompany:Operations	95

Lower score indicates:

- One or more forensics events were observed on the workload.
- Or one/more forensics rules are noisy and/or incorrect.

To improve the score:

- Fix the issue if any to reduce the chances of exposures/exploits.
- Tweak forensics rules to reduce noise and false alarms.

Forensics score for a workload is inverse function of total impact score of forensics events. Higher is the total impact score of forensics events, lower is the forensics score.

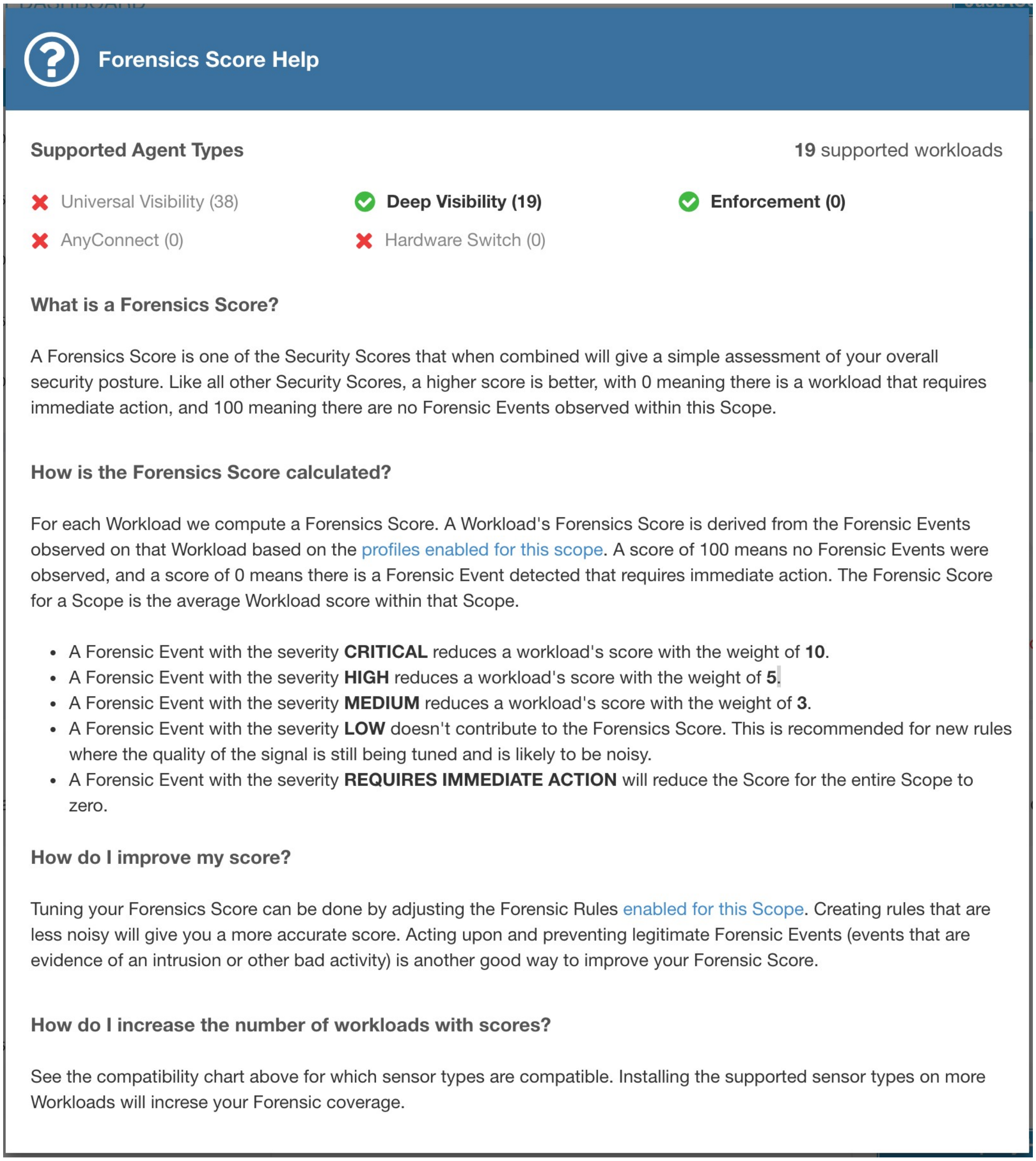
Severity	Impact Score
IMMEDIATE_ACTION	100
CRITICAL	10
HIGH	5
CRITICAL	3

Figure 397: Forensics Score Formula

$$forensics\ score = max\left(0,(100\ -\ \sum forensics\ event\ impact\ score)\right)$$

Refer to Forensics for more details.

Figure 398: Help for Forensics Score



Forensics Score Help

Supported Agent Types

19 supported workloads

✗ Universal Visibility (38)	✓ **Deep Visibility (19)**	✓ **Enforcement (0)**
✗ AnyConnect (0)	✗ Hardware Switch (0)	

What is a Forensics Score?

A Forensics Score is one of the Security Scores that when combined will give a simple assessment of your overall security posture. Like all other Security Scores, a higher score is better, with 0 meaning there is a workload that requires immediate action, and 100 meaning there are no Forensic Events observed within this Scope.

How is the Forensics Score calculated?

For each Workload we compute a Forensics Score. A Workload's Forensics Score is derived from the Forensic Events observed on that Workload based on the profiles enabled for this scope. A score of 100 means no Forensic Events were observed, and a score of 0 means there is a Forensic Event detected that requires immediate action. The Forensic Score for a Scope is the average Workload score within that Scope.

- A Forensic Event with the severity **CRITICAL** reduces a workload's score with the weight of **10**.
- A Forensic Event with the severity **HIGH** reduces a workload's score with the weight of **5**.
- A Forensic Event with the severity **MEDIUM** reduces a workload's score with the weight of **3**.
- A Forensic Event with the severity **LOW** doesn't contribute to the Forensics Score. This is recommended for new rules where the quality of the signal is still being tuned and is likely to be noisy.
- A Forensic Event with the severity **REQUIRES IMMEDIATE ACTION** will reduce the Score for the entire Scope to zero.

How do I improve my score?

Tuning your Forensics Score can be done by adjusting the Forensic Rules enabled for this Scope. Creating rules that are less noisy will give you a more accurate score. Acting upon and preventing legitimate Forensic Events (events that are evidence of an intrusion or other bad activity) is another good way to improve your Forensic Score.

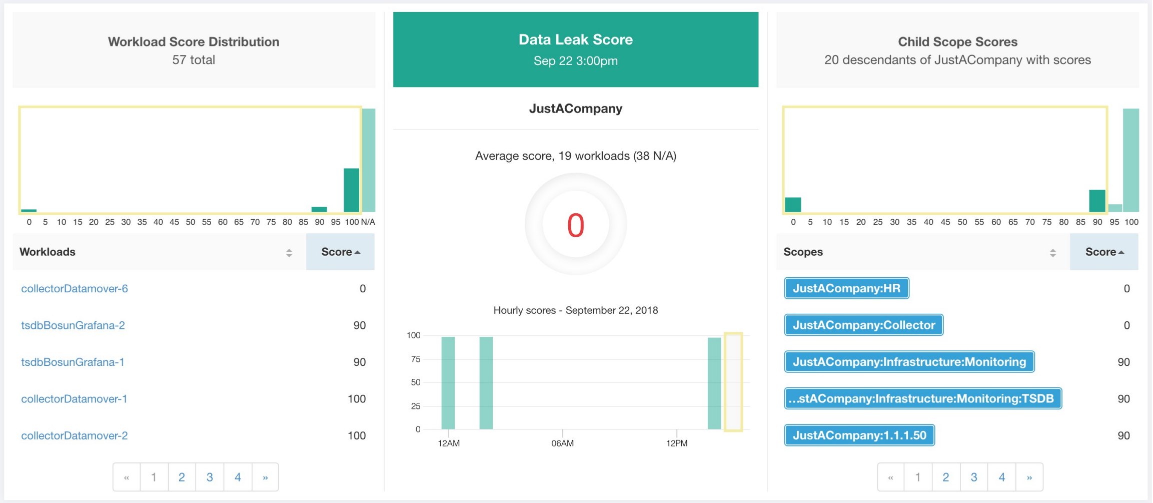
How do I increase the number of workloads with scores?

See the compatibility chart above for which sensor types are compatible. Installing the supported sensor types on more Workloads will increse your Forensic coverage.

Network Anomaly Score

Severity of Network Anomaly events on workloads is used for computing the scores.

Figure 399: Data Leak Score Details



Workload Score Distribution
57 total

Workloads	Score
collectorDatamover-6	0
tsdbBosunGrafana-2	90
tsdbBosunGrafana-1	90
collectorDatamover-1	100
collectorDatamover-2	100

« 1 2 3 4 »

Data Leak Score
Sep 22 3:00pm

JustACompany

Average score, 19 workloads (38 N/A)

0

Hourly scores - September 22, 2018

Child Scope Scores
20 descendants of JustACompany with scores

Scopes	Score
JustACompany:HR	0
JustACompany:Collector	0
JustACompany:Infrastructure:Monitoring	90
...stACompany:Infrastructure:Monitoring:TSDB	90
JustACompany:1.1.1.50	90

« 1 2 3 4 »

Lower score indicates:

- Unusually high amount of data is being transferred out of workloads.
- Or Network Anomaly forensic rule is incorrect or noisy.

To improve the score:

- Fix the issue if any to reduce the chances of data exfiltration.
- Adjust Network Anomaly rules to reduce noise and false alarms.

Network Anomaly score for a workload is inverse function of total severity score of Network Anomaly events. Higher is the total severity score, lower is the Network Anomaly score.

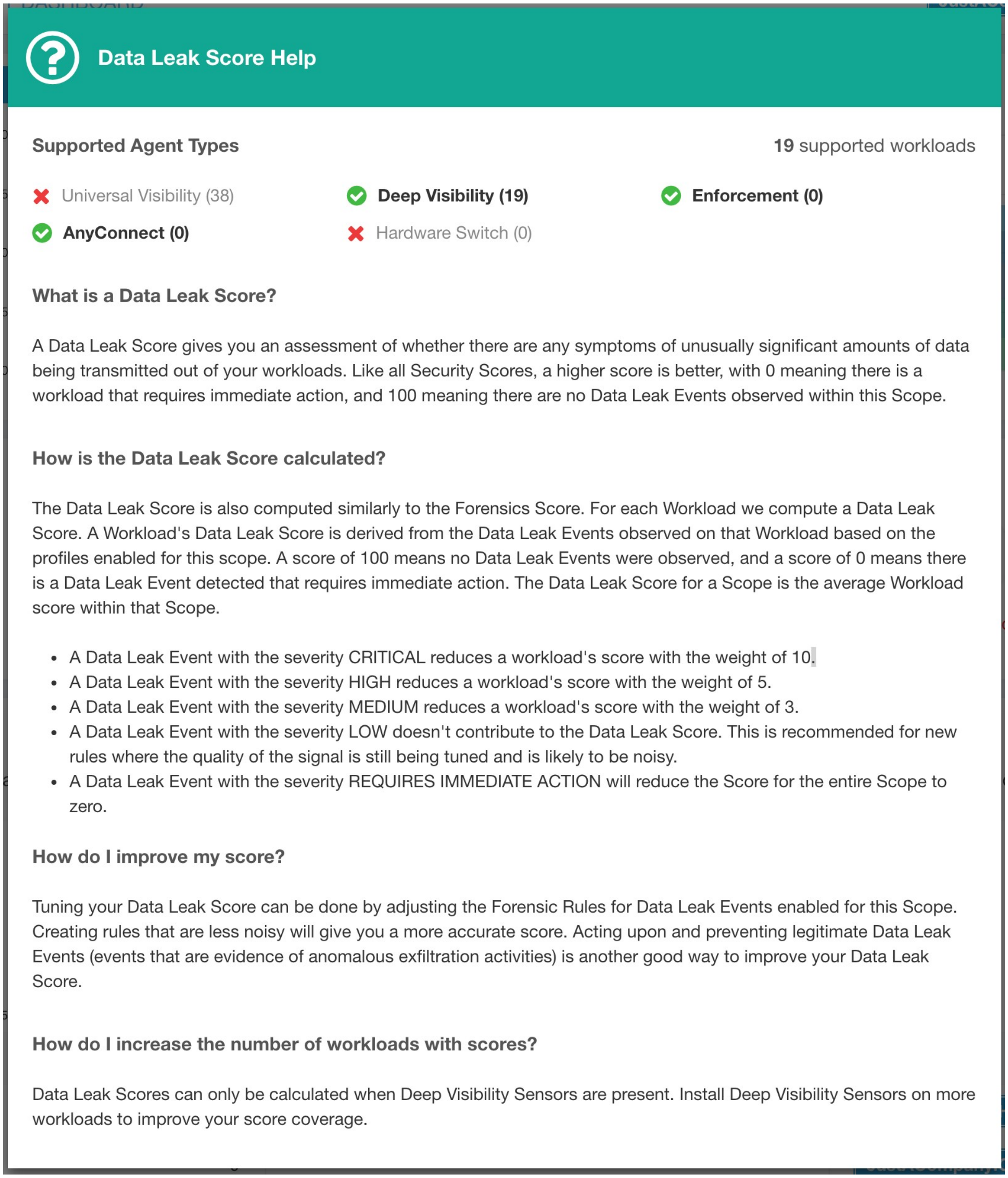
Severity	Score
IMMEDIATE_ACTION	100
CRITICAL	10
HIGH	5
CRITICAL	3

Figure 400: Data Leak Score Formula

$$data\ leak\ score = max\left(0, \left(100 - \sum data\ leak\ event\ severity\ score\right)\right)$$

Refer to PCR-Based Network Anomaly Detection for more details.

Figure 401: Help for Data Leak Score



Data Leak Score Help

Supported Agent Types

19 supported workloads

✗ Universal Visibility (38)
✓ **Deep Visibility (19)**
✓ **Enforcement (0)**
✓ **AnyConnect (0)**
✗ Hardware Switch (0)

What is a Data Leak Score?

A Data Leak Score gives you an assessment of whether there are any symptoms of unusually significant amounts of data being transmitted out of your workloads. Like all Security Scores, a higher score is better, with 0 meaning there is a workload that requires immediate action, and 100 meaning there are no Data Leak Events observed within this Scope.

How is the Data Leak Score calculated?

The Data Leak Score is also computed similarly to the Forensics Score. For each Workload we compute a Data Leak Score. A Workload's Data Leak Score is derived from the Data Leak Events observed on that Workload based on the profiles enabled for this scope. A score of 100 means no Data Leak Events were observed, and a score of 0 means there is a Data Leak Event detected that requires immediate action. The Data Leak Score for a Scope is the average Workload score within that Scope.

- A Data Leak Event with the severity CRITICAL reduces a workload's score with the weight of 10.
- A Data Leak Event with the severity HIGH reduces a workload's score with the weight of 5.
- A Data Leak Event with the severity MEDIUM reduces a workload's score with the weight of 3.
- A Data Leak Event with the severity LOW doesn't contribute to the Data Leak Score. This is recommended for new rules where the quality of the signal is still being tuned and is likely to be noisy.
- A Data Leak Event with the severity REQUIRES IMMEDIATE ACTION will reduce the Score for the entire Scope to zero.

How do I improve my score?

Tuning your Data Leak Score can be done by adjusting the Forensic Rules for Data Leak Events enabled for this Scope. Creating rules that are less noisy will give you a more accurate score. Acting upon and preventing legitimate Data Leak Events (events that are evidence of anomalous exfiltration activities) is another good way to improve your Data Leak Score.

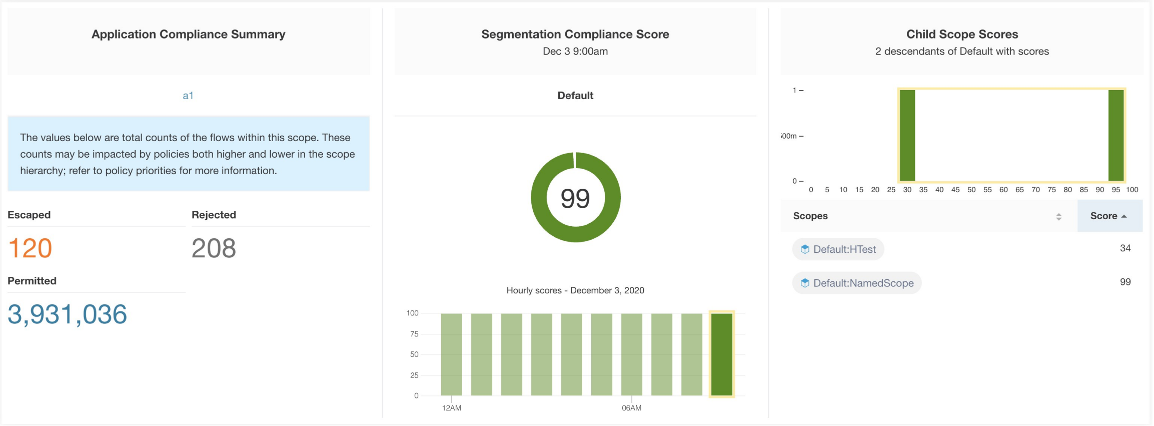
How do I increase the number of workloads with scores?

Data Leak Scores can only be calculated when Deep Visibility Sensors are present. Install Deep Visibility Sensors on more workloads to improve your score coverage.

Segmentation Compliance Score

Segmentation Compliance Score presents a top-level view of policy violations and emphasizes which scopes and workspaces have the most violations.

Figure 402: Segmentation Compliance Score Details



Application Compliance Summary

a1

The values below are total counts of the flows within this scope. These counts may be impacted by policies both higher and lower in the scope hierarchy; refer to policy priorities for more information.

Escaped	Rejected
120	208

Permitted

3,931,036

Segmentation Compliance Score

Dec 3 9:00am

Default

99

Hourly scores - December 3, 2020

Child Scope Scores

2 descendants of Default with scores

Scopes	Score ▲
Default:HTest	34
Default:NamedScope	99

Note Escaped/Rejected/Permitted count that is displayed on security dashboard for root scope does not add up to all the counts respectively displayed for all child scopes. Escaped/Rejected/Permitted count is an evaluation on the policy and not just on source or destination.

Lower score indicates:

- Significant number of escaped flows (policy violations) relative to permitted
- Score is 0 when more escaped flows than permitted.

Segmentation Compliance Score is computed for scopes with an enforced primary workspace. For scopes without enforced workspaces, the score will be computed as the average of descendant scope scores with enforced policies.

Score is computed by using the ratio between escaped and permitted.

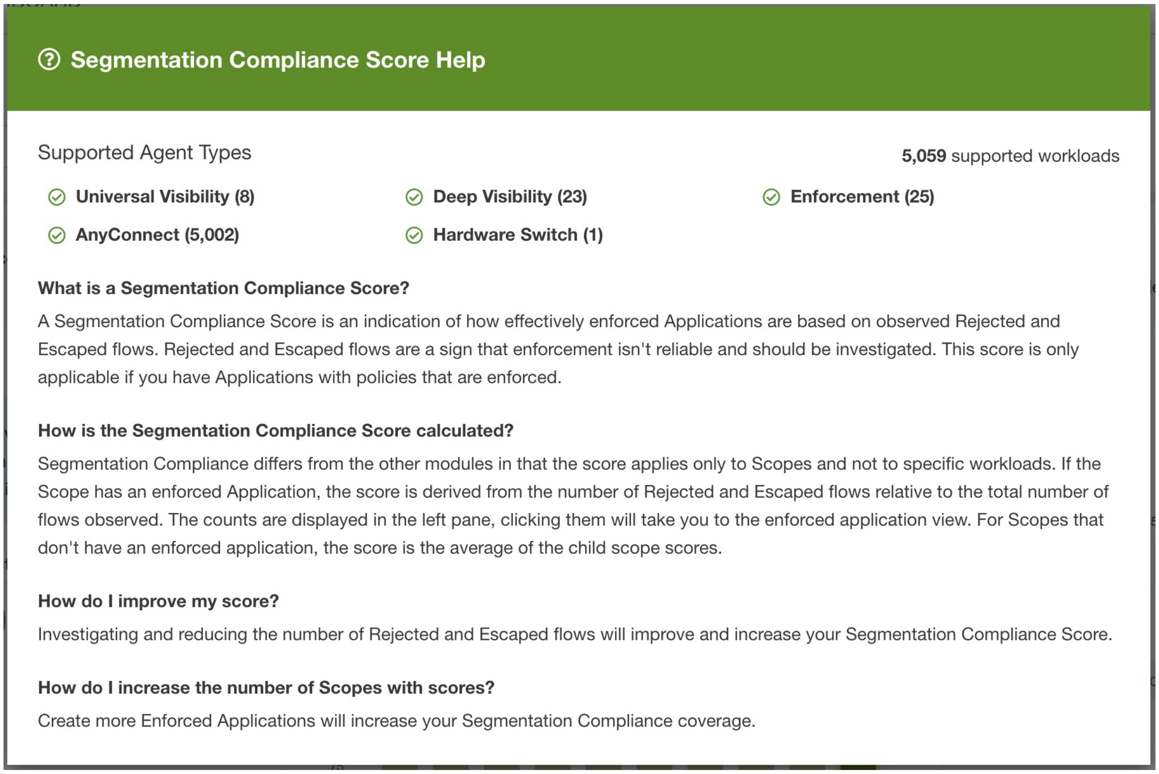
Figure 403: Segmentation Compliance Score Formula

$$compliance\ score = \left\lfloor 100 - \frac{100 \times escaped}{permitted} \right\rfloor$$

Improve score by reducing number of policy violations

- Verify policies correctly cover desired behavior.
- Verify that policies are correctly being enforced.

Figure 404: Help for Segmentation Compliance Score Details



Segmentation Compliance Score Help

Supported Agent Types

5,059 supported workloads

✓ **Universal Visibility (8)** ✓ **Deep Visibility (23)** ✓ **Enforcement (25)**

✓ **AnyConnect (5,002)** ✓ **Hardware Switch (1)**

What is a Segmentation Compliance Score?

A Segmentation Compliance Score is an indication of how effectively enforced Applications are based on observed Rejected and Escaped flows. Rejected and Escaped flows are a sign that enforcement isn't reliable and should be investigated. This score is only applicable if you have Applications with policies that are enforced.

How is the Segmentation Compliance Score calculated?

Segmentation Compliance differs from the other modules in that the score applies only to Scopes and not to specific workloads. If the Scope has an enforced Application, the score is derived from the number of Rejected and Escaped flows relative to the total number of flows observed. The counts are displayed in the left pane, clicking them will take you to the enforced application view. For Scopes that don't have an enforced application, the score is the average of the child scope scores.

How do I improve my score?

Investigating and reducing the number of Rejected and Escaped flows will improve and increase your Segmentation Compliance Score.

How do I increase the number of Scopes with scores?

Create more Enforced Applications will increase your Segmentation Compliance coverage.

CHAPTER 13

Vulnerability Dashboard

Vulnerability Dashboard enables end users to focus their effort on critical vulnerabilities and workloads that need most attention. You can select relevant scope at the top of this page and select the scoring system for vulnerabilities they want to view (Common Vulnerability Scoring System v2 or v3). The new page highlights the distribution of vulnerabilities in the chosen scope and displays vulnerabilities by different attributes, for example, complexity of exploits, can the vulnerabilities be exploited over the network or does attacker need local access to the workload. Furthermore, there are statistics to quickly filter out vulnerabilities that are remotely exploitable and have lowest complexity to exploit.

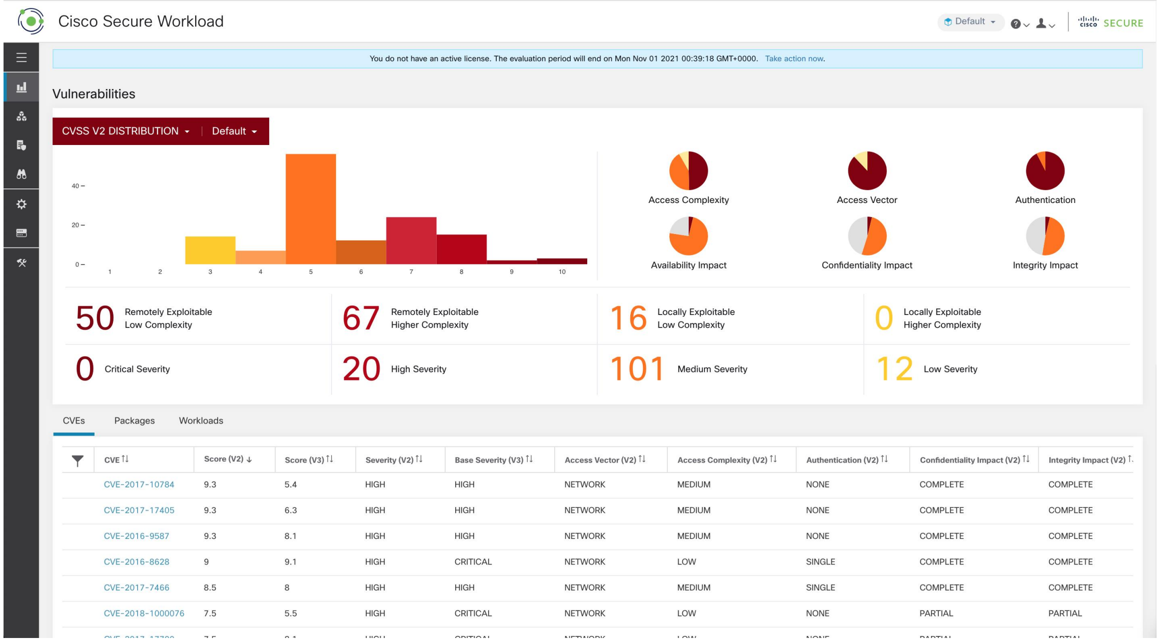
There are three tabs that are available on this page – all of them adjust/filter based on user's clicks on the widgets at the top of the page:

- CVEs tab highlights the vulnerabilities to focus on in the chosen scope.
- Packages tab shows the end users the packages that must be patched.
- Workloads tab lists the workloads that need most attention in terms of patching in the chosen scope.

Clicking on any row in the above tabs display more information about that row, for example, clicking on package row in the packages tab show which workloads that package/version is installed on and the associated vulnerabilities for that package. Similarly, clicking on the row in workloads tab shows packages that are installed on the chosen workload along with the associated vulnerabilities.

This page is intended to help the users identify workloads to focus on first and which packages to patch first.

Figure 405: Vulnerability Dashboard



You do not have an active license. The evaluation period will end on Mon Nov 01 2021 00:39:18 GMT+0000. Take action now.

50 Remotely Exploitable Low Complexity

67 Remotely Exploitable Higher Complexity

16 Locally Exploitable Low Complexity

0 Locally Exploitable Higher Complexity

0 Critical Severity

20 High Severity

101 Medium Severity

12 Low Severity

CVE	Score (V2)	Score (V3)	Severity (V2)	Base Severity (V3)	Access Vector (V2)	Access Complexity (V2)	Authentication (V2)	Confidentiality Impact (V2)	Integrity Impact (V2)
CVE-2017-10784	9.3	5.4	HIGH	HIGH	NETWORK	MEDIUM	NONE	COMPLETE	COMPLETE
CVE-2017-17405	9.3	6.3	HIGH	HIGH	NETWORK	MEDIUM	NONE	COMPLETE	COMPLETE
CVE-2016-9587	9.3	8.1	HIGH	HIGH	NETWORK	MEDIUM	NONE	COMPLETE	COMPLETE
CVE-2016-8628	9	9.1	HIGH	CRITICAL	NETWORK	LOW	SINGLE	COMPLETE	COMPLETE
CVE-2017-7466	8.5	8	HIGH	HIGH	NETWORK	MEDIUM	SINGLE	COMPLETE	COMPLETE
CVE-2018-1000076	7.5	5.5	HIGH	CRITICAL	NETWORK	LOW	NONE	PARTIAL	PARTIAL

- View the Vulnerability Dashboard, on page 690
- CVEs Tab, on page 690
- Packages Tab, on page 691
- Workloads Tab, on page 692

View the Vulnerability Dashboard

To view the Vulnerability Dashboard, in the left navigation pane, click **Investigate** > **Vulnerabilities**.

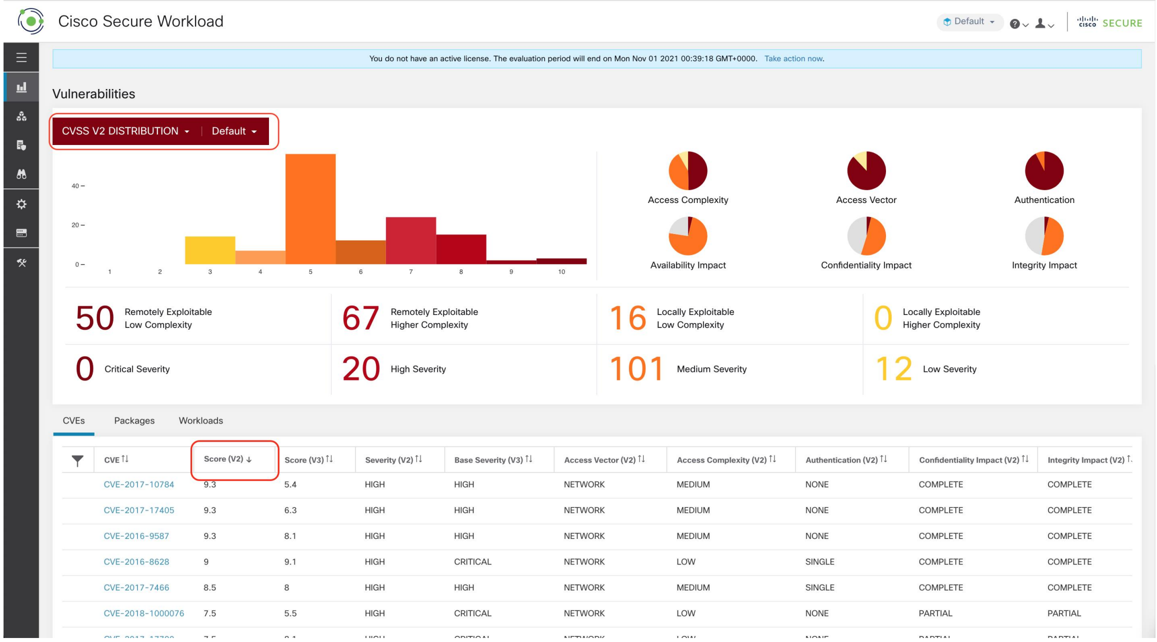
CVEs Tab

Based on the scope that is selected at the top of the page and the scoring system (v2 or v3), CVE tab highlights the vulnerabilities (sorted by the scores) on workloads in the selected scopes that need attention.

For each CVE, besides basic impact metrics, exploit information based on our threat intelligence is displayed:

- Exploit Count: number of times CVE was seen exploited in the wild in the last year.
- Last Exploited: last time CVE was seen exploited in the wild by our threat intelligence.

Figure 406: CVEs Tab Listing Vulnerabilities in Specified Scope



You do not have an active license. The evaluation period will end on Mon Nov 01 2021 00:39:18 GMT+0000. Take action now.

50 Remotely Exploitable Low Complexity

67 Remotely Exploitable Higher Complexity

16 Locally Exploitable Low Complexity

0 Locally Exploitable Higher Complexity

0 Critical Severity

20 High Severity

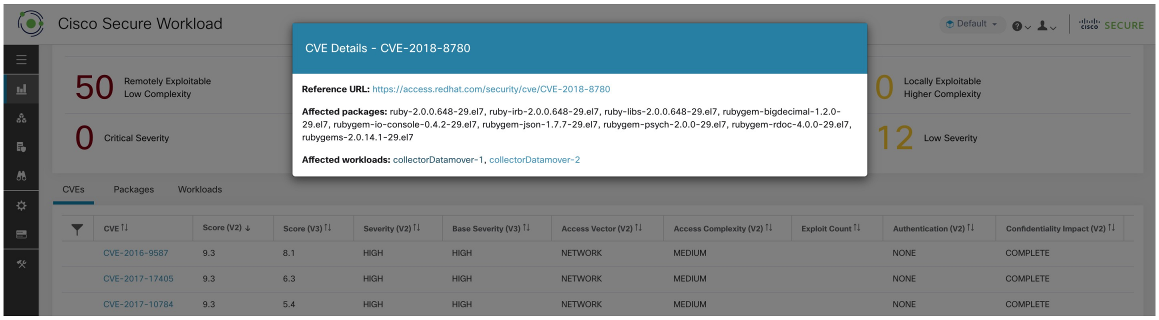
101 Medium Severity

12 Low Severity

CVE	Score (V2)	Score (V3)	Severity (V2)	Base Severity (V3)	Access Vector (V2)	Access Complexity (V2)	Authentication (V2)	Confidentiality Impact (V2)	Integrity Impact (V2)
CVE-2017-10784	9.3	5.4	HIGH	HIGH	NETWORK	MEDIUM	NONE	COMPLETE	COMPLETE
CVE-2017-17405	9.3	6.3	HIGH	HIGH	NETWORK	MEDIUM	NONE	COMPLETE	COMPLETE
CVE-2016-9587	9.3	8.1	HIGH	HIGH	NETWORK	MEDIUM	NONE	COMPLETE	COMPLETE
CVE-2016-8628	9	9.1	HIGH	CRITICAL	NETWORK	LOW	SINGLE	COMPLETE	COMPLETE
CVE-2017-7466	8.5	8	HIGH	HIGH	NETWORK	MEDIUM	SINGLE	COMPLETE	COMPLETE
CVE-2018-1000076	7.5	5.5	HIGH	CRITICAL	NETWORK	LOW	NONE	PARTIAL	PARTIAL

Clicking on any row in the CVEs table gives more details about that vulnerability and which workloads that it affects.

Figure 407: Details for a CVE



CVE Details - CVE-2018-8780

Reference URL: https://access.redhat.com/security/cve/CVE-2018-8780

Affected packages: ruby-2.0.0.648-29.el7, ruby-irb-2.0.0.648-29.el7, ruby-libs-2.0.0.648-29.el7, rubygem-bigdecimal-1.2.0-29.el7, rubygem-io-console-0.4.2-29.el7, rubygem-json-1.7.7-29.el7, rubygem-psych-2.0.0-29.el7, rubygem-rdoc-4.0.0-29.el7, rubygems-2.0.14.1-29.el7

Affected workloads: collectorDatamover-1, collectorDatamover-2

50 Remotely Exploitable Low Complexity

0 Locally Exploitable Higher Complexity

0 Critical Severity

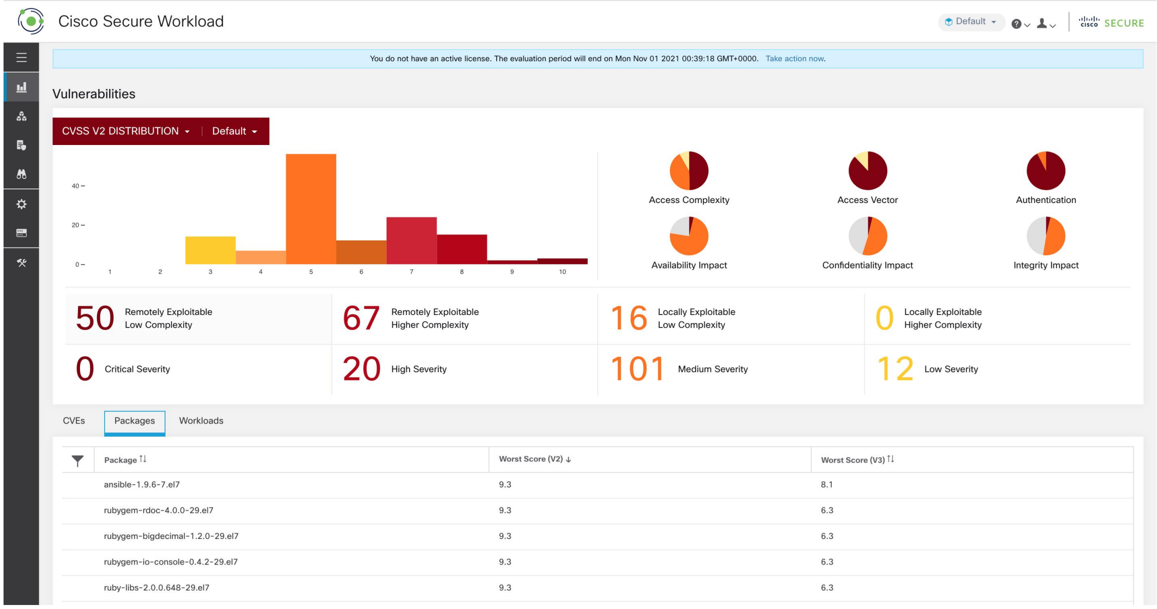
12 Low Severity

CVE	Score (V2)	Score (V3)	Severity (V2)	Base Severity (V3)	Access Vector (V2)	Access Complexity (V2)	Exploit Count	Authentication (V2)	Confidentiality Impact (V2)
CVE-2016-9587	9.3	8.1	HIGH	HIGH	NETWORK	MEDIUM		NONE	COMPLETE
CVE-2017-17405	9.3	6.3	HIGH	HIGH	NETWORK	MEDIUM		NONE	COMPLETE
CVE-2017-10784	9.3	5.4	HIGH	HIGH	NETWORK	MEDIUM		NONE	COMPLETE

Packages Tab

Packages tab lists the software packages that users must pay attention to and potentially upgrade to reduce their attack surface.

Figure 408: Packages Tab Listing Vulnerable Software in Specified Scope



You do not have an active license. The evaluation period will end on Mon Nov 01 2021 00:39:18 GMT+0000. Take action now.

Vulnerabilities

50 Remotely Exploitable Low Complexity

67 Remotely Exploitable Higher Complexity

16 Locally Exploitable Low Complexity

0 Locally Exploitable Higher Complexity

0 Critical Severity

20 High Severity

101 Medium Severity

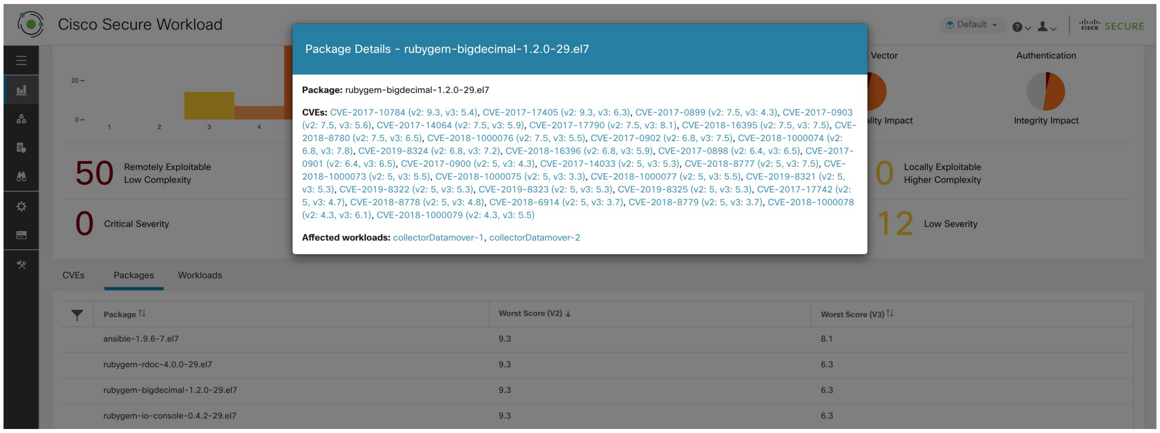
12 Low Severity

CVEs | Packages | Workloads

Package ↑↓	Worst Score (V2) ↓	Worst Score (V3) ↑↓
ansible-1.9.6-7.el7	9.3	8.1
rubygem-rdoc-4.0.0-29.el7	9.3	6.3
rubygem-bigdecimal-1.2.0-29.el7	9.3	6.3
rubygem-io-console-0.4.2-29.el7	9.3	6.3
ruby-libs-2.0.0.648-29.el7	9.3	6.3

Clicking on any row in the packages table gives more details about which workloads that package is installed as well as the known CVEs for that package.

Figure 409: Details of Vulnerabilities and Affected Workloads for a Package



Package Details - rubygem-bigdecimal-1.2.0-29.el7

Package: rubygem-bigdecimal-1.2.0-29.el7

CVEs: CVE-2017-10784 (v2: 9.3, v3: 5.4), CVE-2017-17405 (v2: 9.3, v3: 6.3), CVE-2017-0899 (v2: 7.5, v3: 4.3), CVE-2017-0903 (v2: 7.5, v3: 5.6), CVE-2017-14064 (v2: 7.5, v3: 5.9), CVE-2017-17790 (v2: 7.5, v3: 8.1), CVE-2018-16395 (v2: 7.5, v3: 7.5), CVE-2018-8780 (v2: 7.5, v3: 6.5), CVE-2018-1000076 (v2: 7.5, v3: 5.5), CVE-2017-0902 (v2: 6.8, v3: 7.5), CVE-2018-1000074 (v2: 6.8, v3: 7.8), CVE-2019-8324 (v2: 6.8, v3: 7.2), CVE-2018-16396 (v2: 6.8, v3: 5.9), CVE-2017-0898 (v2: 6.4, v3: 6.5), CVE-2017-0901 (v2: 6.4, v3: 6.5), CVE-2017-0900 (v2: 5, v3: 4.3), CVE-2017-14033 (v2: 5, v3: 5.3), CVE-2018-8777 (v2: 5, v3: 7.5), CVE-2018-1000073 (v2: 5, v3: 5.5), CVE-2018-1000075 (v2: 5, v3: 3.3), CVE-2018-1000077 (v2: 5, v3: 5.5), CVE-2019-8321 (v2: 5, v3: 5.3), CVE-2019-8322 (v2: 5, v3: 5.3), CVE-2019-8323 (v2: 5, v3: 5.3), CVE-2019-8325 (v2: 5, v3: 5.3), CVE-2017-17742 (v2: 5, v3: 4.7), CVE-2018-8778 (v2: 5, v3: 4.8), CVE-2018-6914 (v2: 5, v3: 3.7), CVE-2018-8779 (v2: 5, v3: 3.7), CVE-2018-1000078 (v2: 4.3, v3: 6.1), CVE-2018-1000079 (v2: 4.3, v3: 5.5)

Affected workloads: collectorDatamover-1, collectorDatamover-2

50 Remotely Exploitable Low Complexity

0 Locally Exploitable Higher Complexity

0 Critical Severity

12 Low Severity

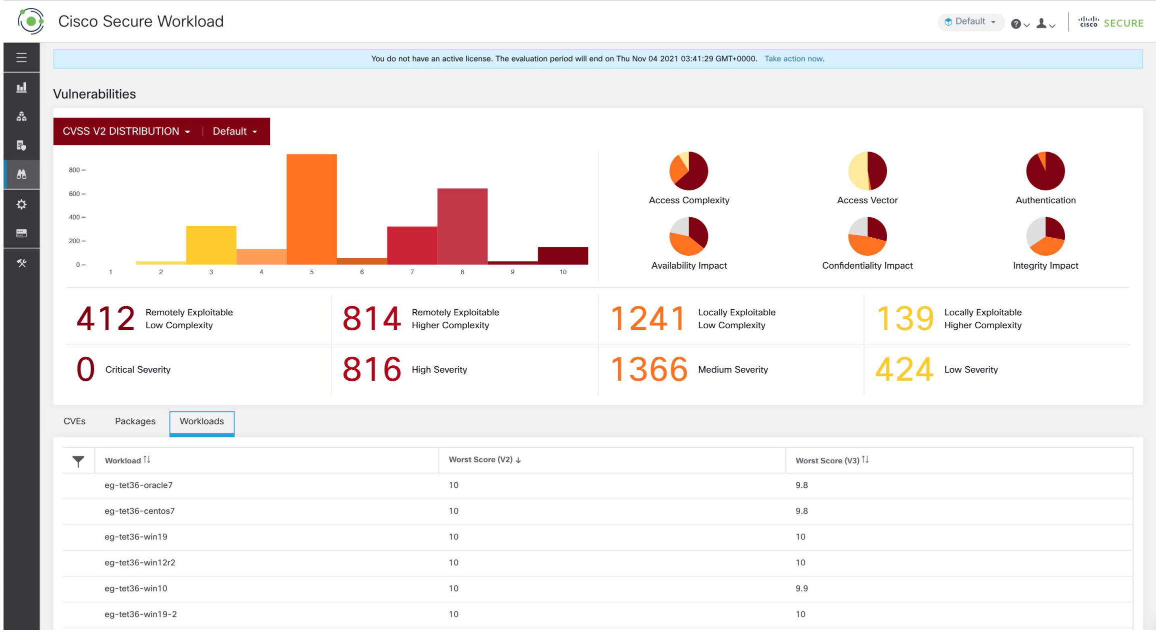
CVEs | Packages | Workloads

Package ↑↓	Worst Score (V2) ↓	Worst Score (V3) ↑↓
ansible-1.9.6-7.el7	9.3	8.1
rubygem-rdoc-4.0.0-29.el7	9.3	6.3
rubygem-bigdecimal-1.2.0-29.el7	9.3	6.3
rubygem-io-console-0.4.2-29.el7	9.3	6.3

Workloads Tab

Workloads tab lists the workloads that need attention in terms of software updates or patches.

Figure 410: Workloads Tab Listing Vulnerable Workloads in Specified Scope



You do not have an active license. The evaluation period will end on Thu Nov 04 2021 03:41:29 GMT+0000. Take action now.

Vulnerabilities

412 Remotely Exploitable Low Complexity

814 Remotely Exploitable Higher Complexity

1241 Locally Exploitable Low Complexity

139 Locally Exploitable Higher Complexity

0 Critical Severity

816 High Severity

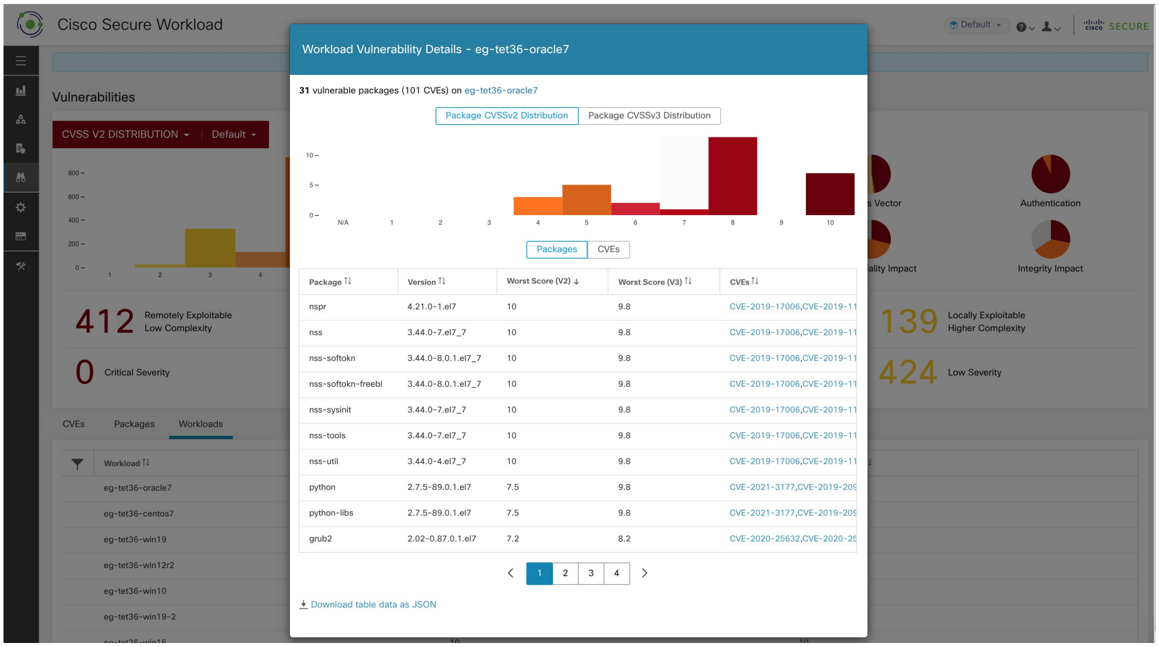
1366 Medium Severity

424 Low Severity

Workload	Worst Score (V2)	Worst Score (V3)
eg-tet36-oracle7	10	9.8
eg-tet36-centos7	10	9.8
eg-tet36-win19	10	10
eg-tet36-win12r2	10	10
eg-tet36-win10	10	9.9
eg-tet36-win19-2	10	10

Clicking on any row in the workloads table provides the list of packages with vulnerabilities on that workload.

Figure 411: Details of Vulnerabilities for a Workload



Workload Vulnerability Details - eg-tet36-oracle7

31 vulnerable packages (101 CVEs) on eg-tet36-oracle7

Package	Version	Worst Score (V2)	Worst Score (V3)	CVEs
nspr	4.21.0-1.el7	10	9.8	CVE-2019-17006,CVE-2019-11
nss	3.44.0-7.el7_7	10	9.8	CVE-2019-17006,CVE-2019-11
nss-softokn	3.44.0-8.0.1.el7_7	10	9.8	CVE-2019-17006,CVE-2019-11
nss-softokn-freebl	3.44.0-8.0.1.el7_7	10	9.8	CVE-2019-17006,CVE-2019-11
nss-sysinit	3.44.0-7.el7_7	10	9.8	CVE-2019-17006,CVE-2019-11
nss-tools	3.44.0-7.el7_7	10	9.8	CVE-2019-17006,CVE-2019-11
nss-util	3.44.0-4.el7_7	10	9.8	CVE-2019-17006,CVE-2019-11
python	2.7.5-89.0.1.el7	7.5	9.8	CVE-2021-3177,CVE-2019-20
python-libs	2.7.5-89.0.1.el7	7.5	9.8	CVE-2021-3177,CVE-2019-20
grub2	2.02-0.87.0.1.el7	7.2	8.2	CVE-2020-25632,CVE-2020-2

Download table data as JSON

All of the above tables are downloadable using the Download links at the bottom of the tables.

CHAPTER 14

Reporting Dashboard

Reporting Dashboard

Reporting dashboard, which is designed for Executives, Network Administrators, and Security Analysts, provides visual representations of critical workflow status, troubleshooting capabilities, and report creation functionalities. On the navigation pane, click **Reporting> Reporting Dashboard** to access the dashboard.

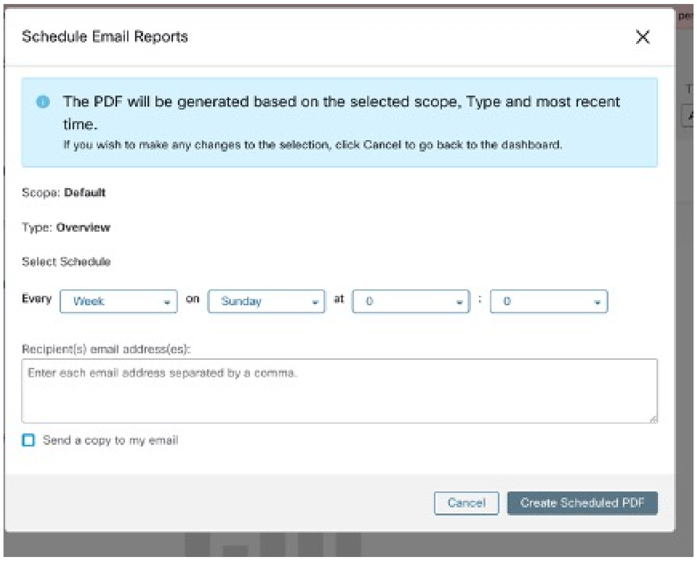
The sections below provide an overview of the reports, how to schedule and email the reports.

Schedule Email Reports

To generate a report, choose from either of the options:

- **Download**: After you generate a report, you can download and save a copy of the report for future reference.
- **Email**: If you choose the option to email reports, an email will be triggered to recipients with the attached report.
- **Schedule**: You have two options to choose from to schedule a report.
    - Daily
    - Weekly

      To schedule a report, enter the schedule details to trigger the report. Select Weekly or Daily, enetr the day and time, and the email addresses of the recipients. Click **Create Scheduled PDF** to save the details.



Schedule Email Reports ×

The PDF will be generated based on the selected scope, Type and most recent time.
If you wish to make any changes to the selection, click Cancel to go back to the dashboard.

Scope: **Default**

Type: **Overview**

Select Schedule

Every Week on Sunday at 0 : 0

Recipient(s) email address(es):

Enter each email address separated by a comma.

□ Send a copy to my email

Note If the report scheduling fails, check the schedule for any incorrect email address or incorrectly entered date and time.

To access the report schedules that were generated earlier, choose **Generated Reports** > **Schedules**. If the report scheduling fails, check the schedule for any incorrect email address or incorrect date, time.

Note The maximum number of schedules that you can store in the scheduling dashboard is five.

Overview

The overview section provides real-time insights into the network flow information, security policies, system performances, and security threats. It enables security analysts and network administrators to make informed decisions and take measures to protect their data resources.

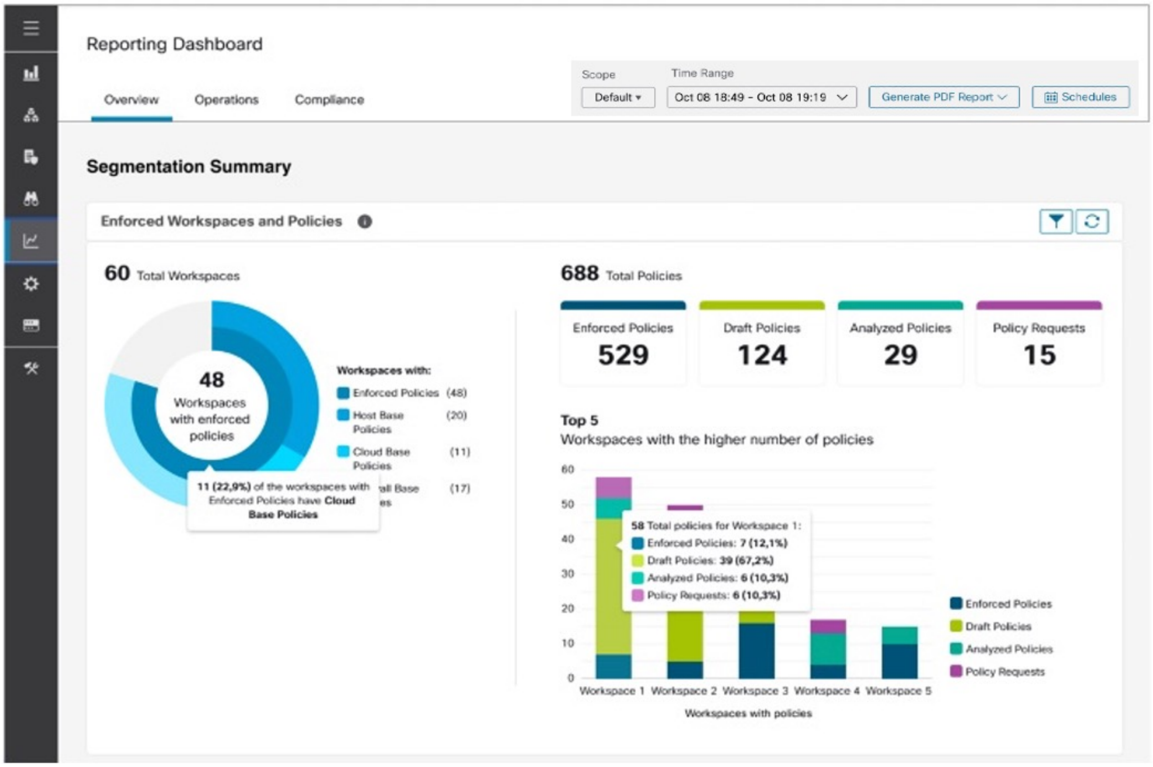
Segmentation Summary

Workspaces are the building blocks to discover, apply, and manage policies and enforcement within the cluster. You can define segmentation memberships by selecting the appropriate scope.

Segmentation summary captures the configuration details for every workspace, all policy-related activities, such as defining, analyzing, and enforcing policies for a particular scope in the workspace or workspaces that are associated with that scope.

The graph displays a summary of the various policies that are associated with the workspaces.

Figure 412: Segmentation Summary



Segmentation Summary

Enforced Workspaces and Policies

60 Total Workspaces

48 Workspaces with enforced policies

Workspaces with:	
Enforced Policies	(48)
Host Base Policies	(20)
Cloud Base Policies	(11)
…all Base …es	(17)

11 (22,9%) of the workspaces with Enforced Policies have **Cloud Base Policies**

688 Total Policies

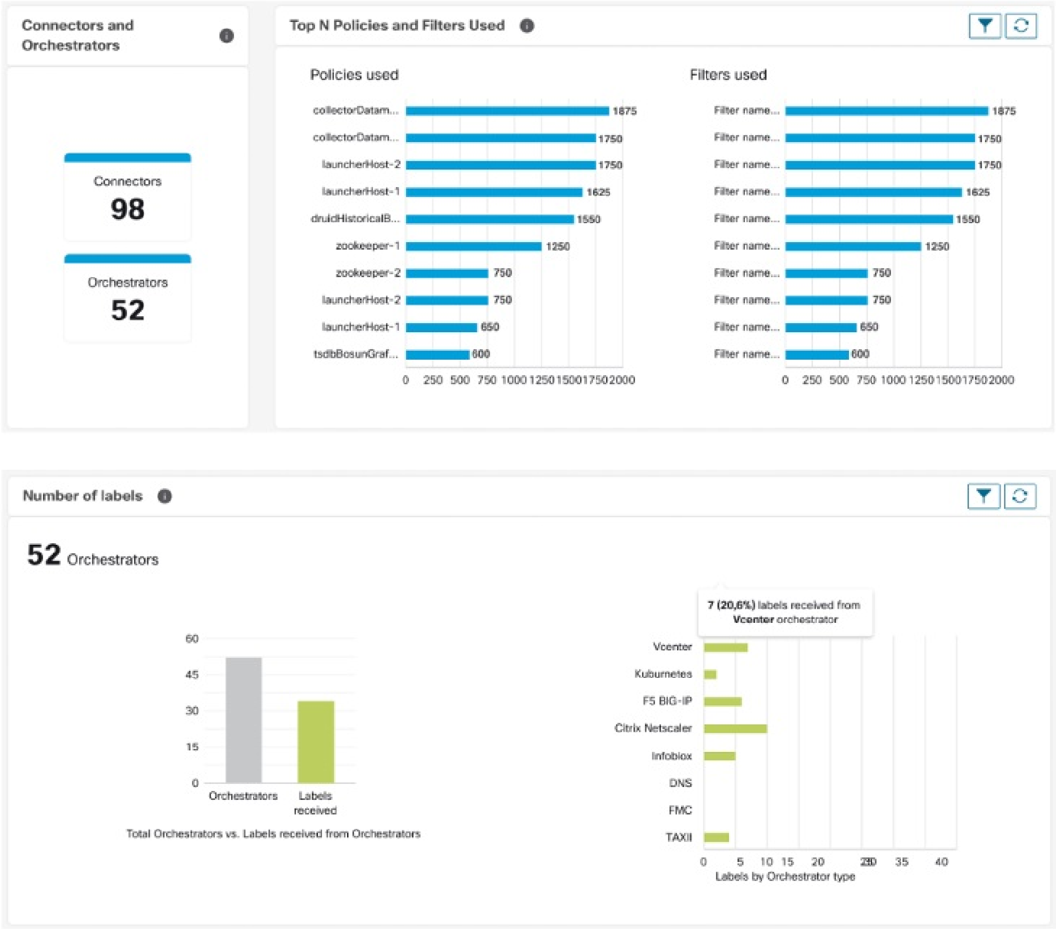
Enforced Policies	Draft Policies	Analyzed Policies	Policy Requests
529	124	29	15

Top 5

Workspaces with the higher number of policies

58 Total policies for Workspace 1:
- Enforced Policies: **7 (12,1%)**
- Draft Policies: **39 (67,2%)**
- Analyzed Policies: **6 (10,3%)**
- Policy Requests: **6 (10,3%)**

Figure 413: Connectors and Orchestrators

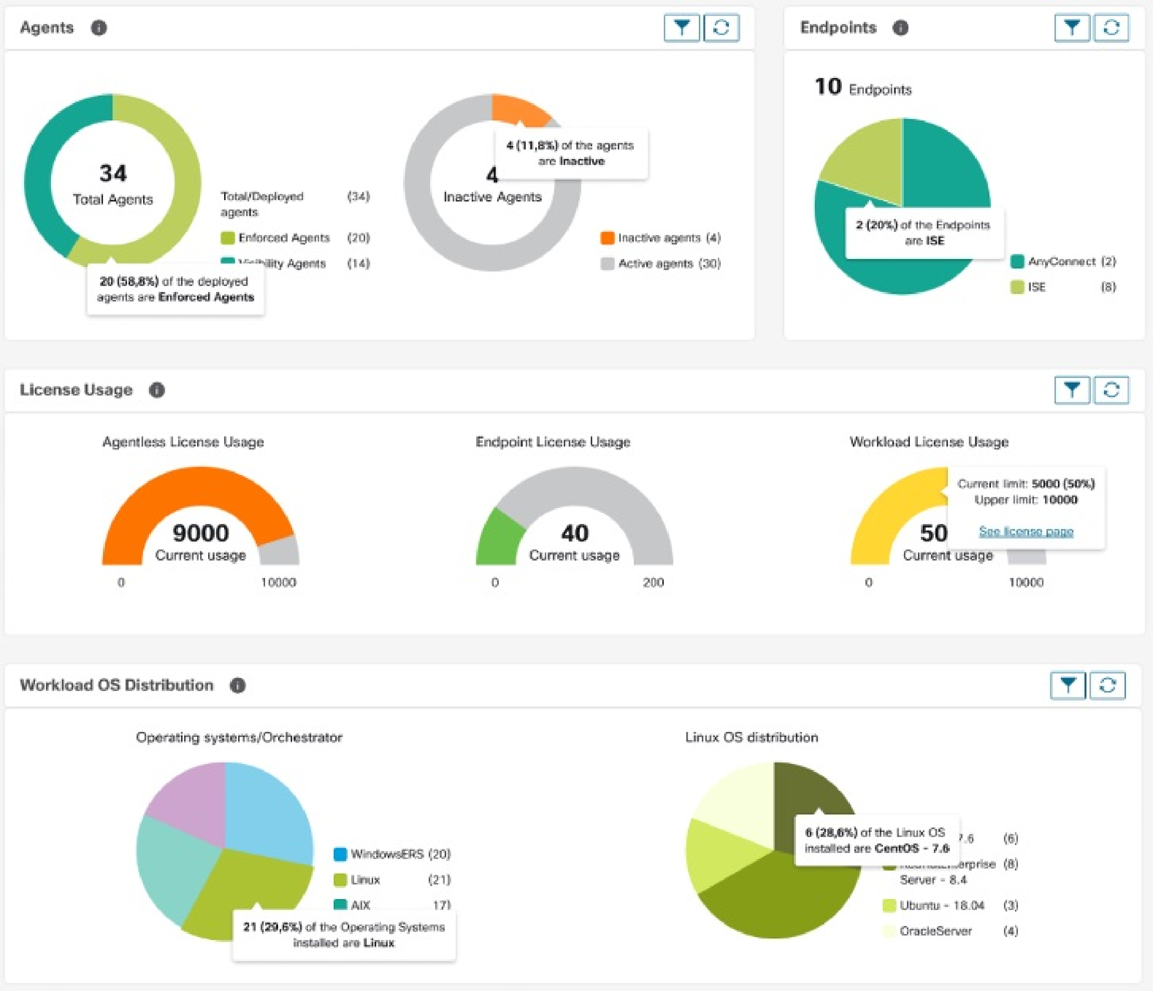


Workload Summary

The Workload summary provides the following details about the agents that are deployed on one or more servers and endpoints in the infrastructure:

- Agents monitor and collect network flow information.
- Agents enforce security policies with firewall rules on the installed hosts.
- Agents communicate the status of the workload.
- Agents receive updates on the security policies.

Figure 414: Workload Summary



20 (58,8%) of the deployed agents are Enforced Agents

4 (11,8%) of the agents are Inactive

2 (20%) of the Endpoints are ISE

Current limit: 5000 (50%)
Upper limit: 10000

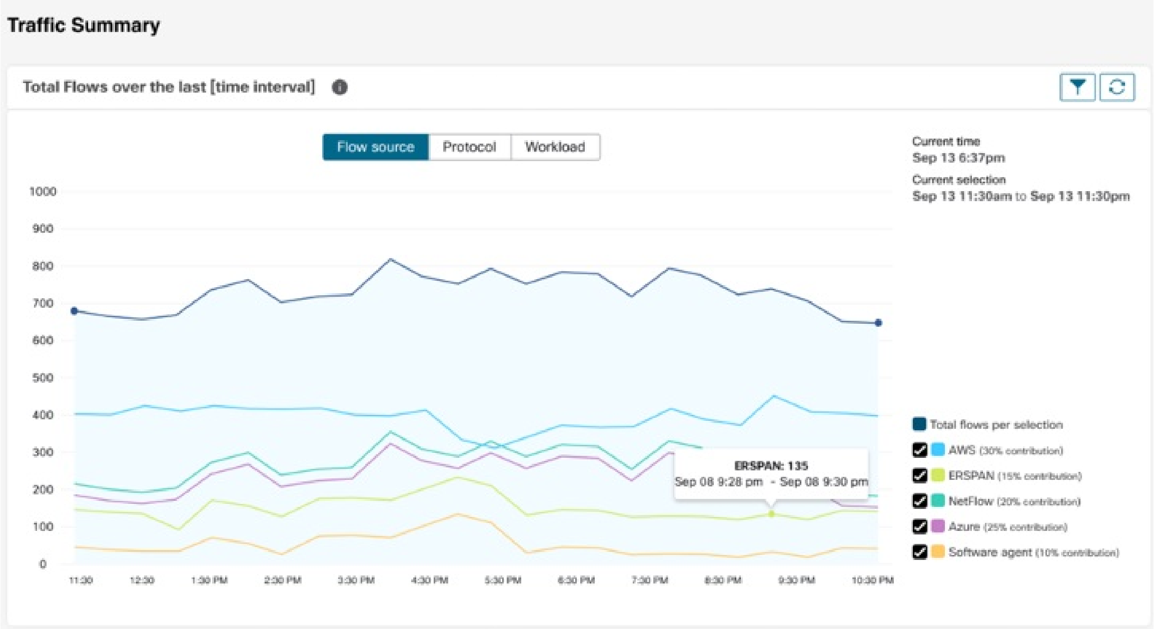
21 (29,6%) of the Operating Systems installed are Linux

6 (28,6%) of the Linux OS installed are CentOS - 7.6

Traffic Summary

Traffic summary captures the flow observations of each flow. Each observation in the flow source tracks the number of packets, bytes, and other metrics for the flows.

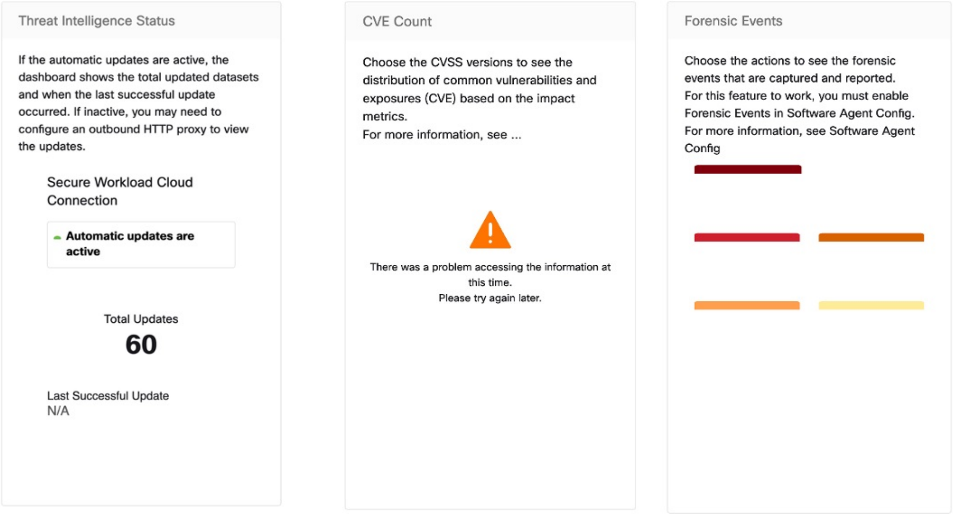
Figure 415: Traffic Summary



Security Summary

Security Summary provides Threat Intelligence Status (last time when the threat intelligence status updates were received are shown), count of CVEs, and distribution of Forensic events.

Figure 416: Security Summary



Threat Intelligence Status

If the automatic updates are active, the dashboard shows the total updated datasets and when the last successful update occurred. If inactive, you may need to configure an outbound HTTP proxy to view the updates.

Secure Workload Cloud Connection

Automatic updates are active

Total Updates

60

Last Successful Update

N/A

CVE Count

Choose the CVSS versions to see the distribution of common vulnerabilities and exposures (CVE) based on the impact metrics.

For more information, see ...

There was a problem accessing the information at this time.

Please try again later.

Forensic Events

Choose the actions to see the forensic events that are captured and reported.

For this feature to work, you must enable Forensic Events in Software Agent Config.

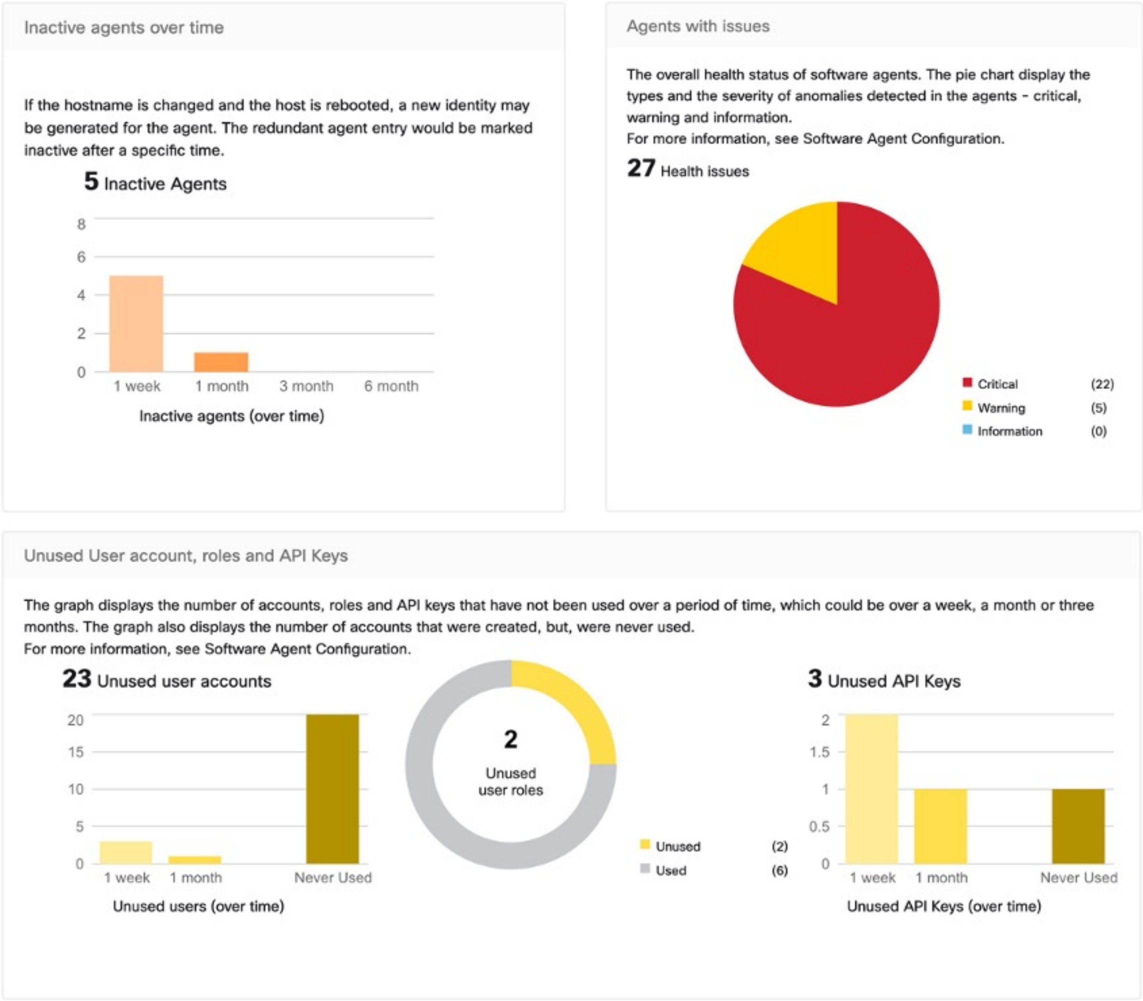
For more information, see Software Agent Config

Operation

Workload Summary

Workload summary provides a view of the total agents that are deployed on one or more servers and endpoints in the network. The agents monitor and collect network flow information, enforce security policies with firewall rules on the installed hosts, communicate the status of the workload, and receive updates on the security policies.

Figure 417: Workload Summary



Inactive agents over time

If the hostname is changed and the host is rebooted, a new identity may be generated for the agent. The redundant agent entry would be marked inactive after a specific time.

Agents with issues

The overall health status of software agents. The pie chart display the types and the severity of anomalies detected in the agents - critical, warning and information.
For more information, see Software Agent Configuration.

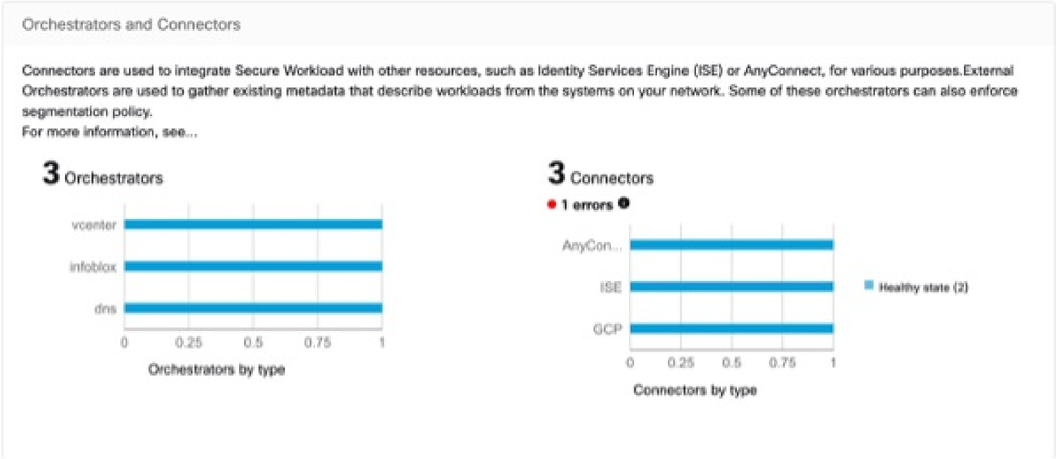
Unused User account, roles and API Keys

The graph displays the number of accounts, roles and API keys that have not been used over a period of time, which could be over a week, a month or three months. The graph also displays the number of accounts that were created, but, were never used.
For more information, see Software Agent Configuration.

Telemetry Summary

Many connectors that are deployed on the virtual appliance collects telemetry from various points in the network, these connectors must listen on specific ports on the appliance. Connectors can ingest flow logs if you have setup flow logs for your specific security groups. You can also use the telemetry data for visualization and segmentation policy generation.

Figure 418: Telemetry Summary



Orchestrators and Connectors

Connectors are used to integrate Secure Workload with other resources, such as Identity Services Engine (ISE) or AnyConnect, for various purposes.External Orchestrators are used to gather existing metadata that describe workloads from the systems on your network. Some of these orchestrators can also enforce segmentation policy.
For more information, see...

Cluster Summary

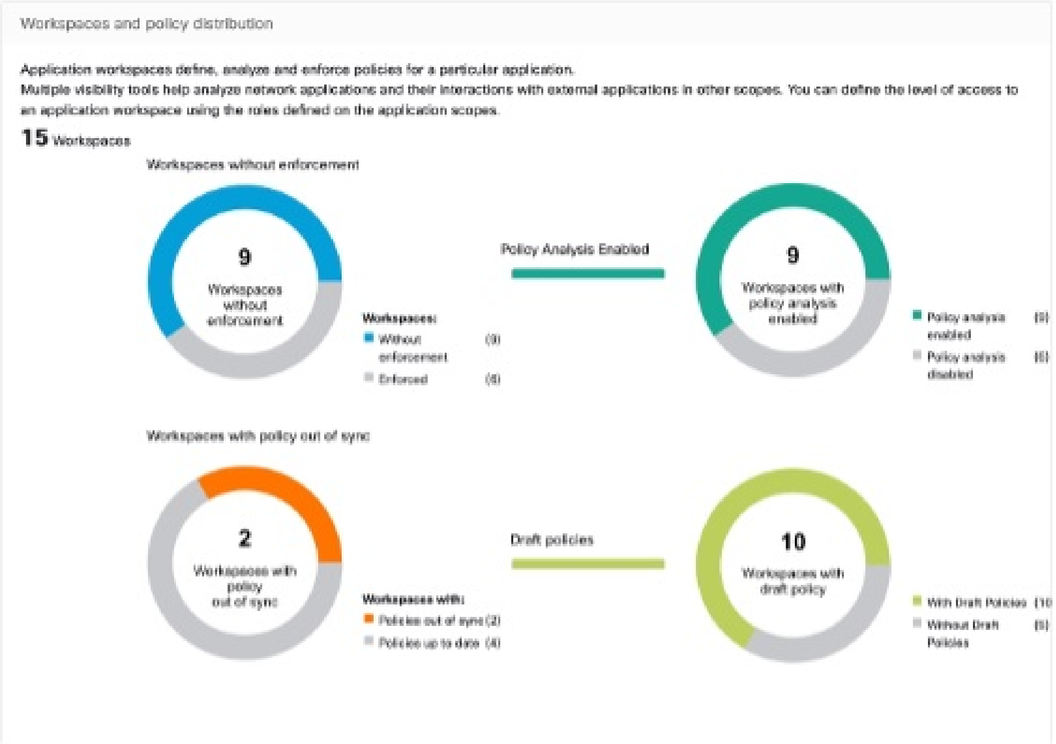
Site admins can access the cluster status page, but the actions can be carried out only by Customer Support users. It shows the status of all the physical servers in Cisco Secure Workload rack.

The processing and retention time for clusters refer to the duration for which data is stored and processed within a cluster. The specific processing and retention times depend on the requirements of the workload and the policies of the organization.

It is important to consider the processing time requirements when configuring the cluster, as this can impact the storage capacity and processing power that is needed to meet the workload's needs.

Retention time refers to the length of time that data is retained within a cluster. For some workloads, data may need to be retained for regulatory or compliance purposes, while for others it may be deleted once it has been processed. It is important to establish retention policies for the workload to ensure that data is retained for the appropriate length of time and then deleted securely to prevent unauthorized access.

Figure 419: Cluster Summary



Workspaces and policy distribution

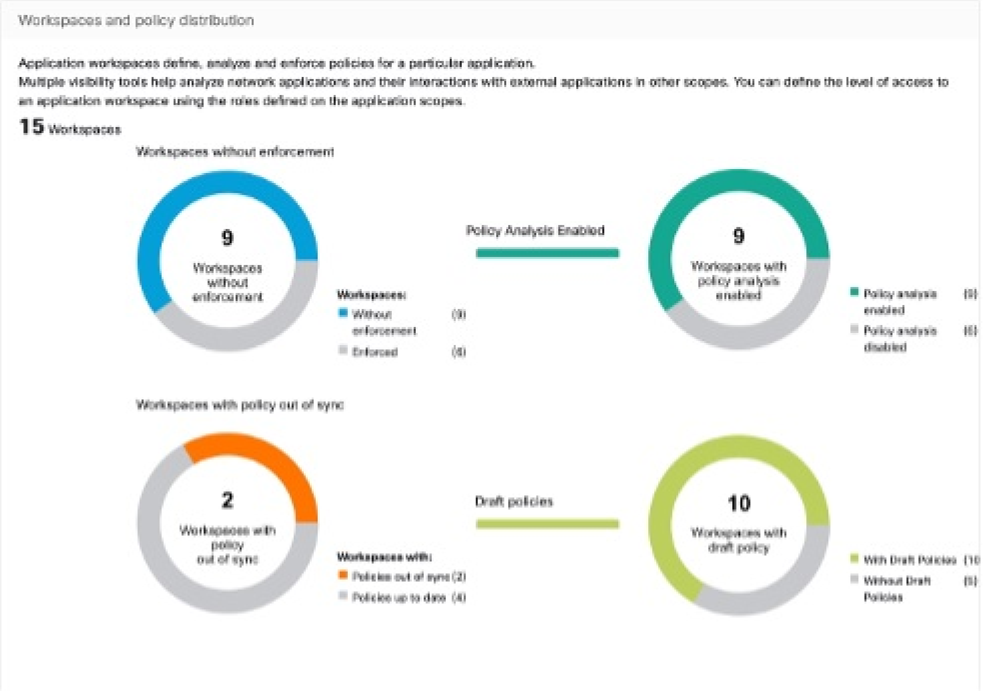
Application workspaces define, analyze and enforce policies for a particular application.
Multiple visibility tools help analyze network applications and their interactions with external applications in other scopes. You can define the level of access to an application workspace using the roles defined on the application scopes.

15 Workspaces
Workspaces without enforcement
9
Workspaces without enforcement
Workspaces:
Without enforcement (9)
Enforced (6)
Policy Analysis Enabled
9
Workspaces with policy analysis enabled
Policy analysis enabled (9)
Policy analysis disabled (6)
Workspaces with policy out of sync
2
Workspaces with policy out of sync
Workspaces with:
Policies out of sync (2)
Policies up to date (4)
Draft policies
10
Workspaces with draft policy
With Draft Policies (10
Without Draft Policies (5)

Segmentation Summary

Segmentation or Application Workspaces are the building blocks for discovering, applying, and managing policy and enforcement within the cluster. The segmentation summary captures the configuration details for each of the Application Workspaces implemented, the no. of workspaces with and without enforcement, policies that have been enabled or disabled, workspaces that have up-to-date policies or out of sync, and with or without draft policies.

Figure 420: Segmentation Summary



Workspaces and policy distribution

Application workspaces define, analyze and enforce policies for a particular application.
Multiple visibility tools help analyze network applications and their interactions with external applications in other scopes. You can define the level of access to an application workspace using the roles defined on the application scopes.

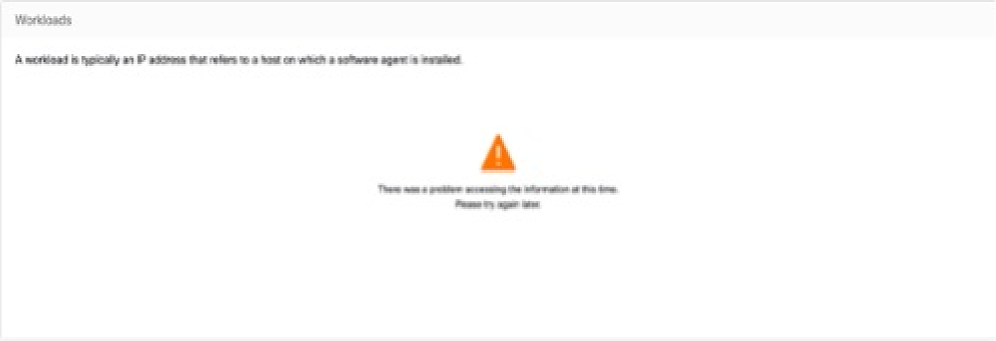
15 Workspaces
Workspaces without enforcement
9
Workspaces without enforcement
Workspaces:
Without enforcement (9)
Enforced (6)
Policy Analysis Enabled
9
Workspaces with policy analysis enabled
Policy analysis enabled (9)
Policy analysis disabled (6)
Workspaces with policy out of sync
2
Workspaces with policy out of sync
Workspaces with:
Policies out of sync (2)
Policies up to date (4)
Draft policies
10
Workspaces with draft policy
With Draft Policies (10
Without Draft Policies (5)

Compliance

Workload Summary

Workload Summary provides a view of the total agents that are deployed on one or more servers and endpoints in the infrastructure. The agents monitor and collect network flow information, enforce security policies with firewall rules on the installed hosts, communicate the status of the workload and receive updates on the security policies.

Figure 421:



Workloads

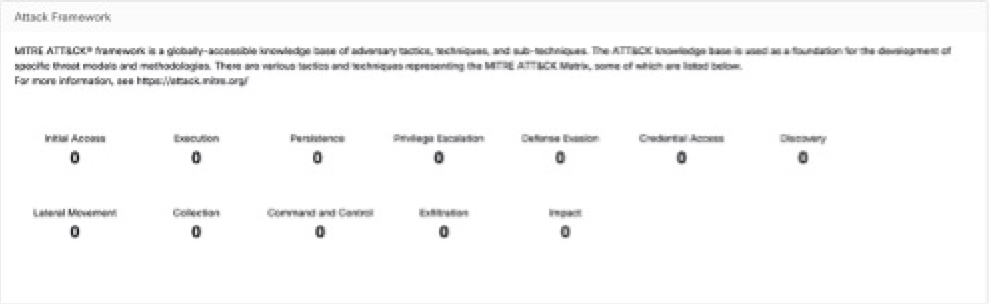
A workload is typically an IP address that refers to a host on which a software agent is installed.

There was a problem accessing the information at this time.
Please try again later.

Security Summary

Configure your forensic events; once configured, all tactics are displayed without any rules under them, with a count of 0. Select one or more forensic rules to make the selection at the tactic level. Selecting a tactic selects all the rules under it. Default MITRE ATT&CK rules are provided to alert techniques from the MITRE ATT&CK Framework.

Figure 422:



Attack Framework

MITRE ATT&CK® framework is a globally-accessible knowledge base of adversary tactics, techniques, and sub-techniques. The ATT&CK knowledge base is used as a foundation for the development of specific threat models and methodologies. There are various tactics and techniques representing the MITRE ATT&CK Matrix, some of which are listed below.
For more information, see https://attack.mitre.org/

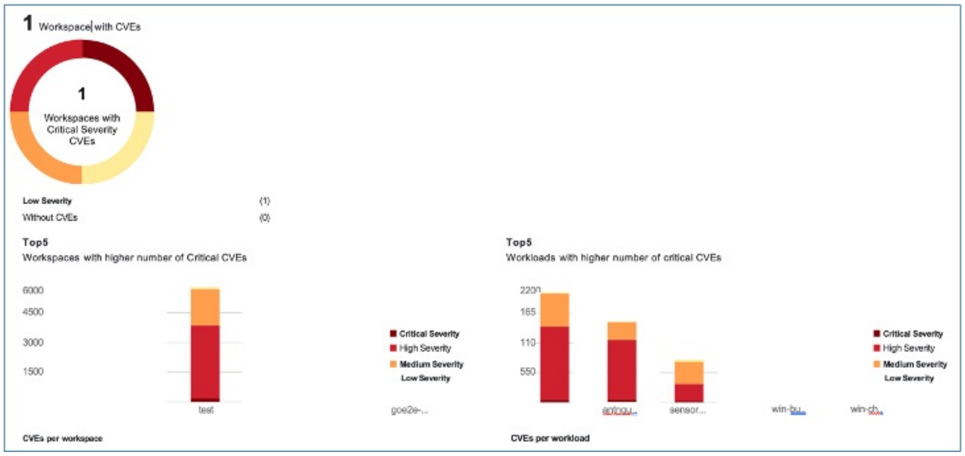
Workspaces with CVEs

Based on the scope that is selected and the scoring system (v2 or v3), the CVE count highlights the vulnerabilities (sorted by the scores) on workloads in the selected scopes. See the distribution of workspaces and the workloads with the highest number of critical CVEs.

Software packages on a workload could potentially be associated with known vulnerabilities (CVE). Common Vulnerability Scoring System (CVSS) is used for assessing the impact of a CVE. CVE can have CVSS v2 and CVSS v3 score. To compute the vulnerability score, consider CVSS v3 if it is available, else CVSS v2 is considered.

Vulnerability score for a workload is derived from scores of vulnerable software that is detected on that workload. The Workload Vulnerability Score is calculated based on the CVSS scores, the vendor data, and the security research team may adjust when the data is missing or inaccurate. Higher the severity of the most severe vulnerability, lower is the score.

Figure 423:



CHAPTER 15

Settings

System-level settings available to you vary depending on your role. For example, only users with **Site Admin** and **Customer Support user** role, can view the **Users** option.

Threat Intelligence

To manage threat intelligence, in the left navigation pane, click **Manage** > **Service Settings** > **Threat Intelligence**.

The **Threat Intelligence** feature provides the most up-to-date datasets for the Secure Workload pipeline that identifies and quarantines threats by inspecting the datacenter workloads against externally known malware command and control addresses, security flaws in processes and geographical location.

The Threat Intelligence dashboard displays the updated status of threat intelligence datasets. These datasets are updated automatically.

Warning The Threat Intelligence feature requires a connection to Cisco Secure Workload servers to automatically update. Your enterprise outbound HTTP request may require:

- Allow the following domain from the enterprise firewall outbound rules: `uas.tetrationcloud.com`
- Configure your Outbound HTTP Connection.

In environments without an outbound connection, upload the datasets directly. See the **Manual Uploads** section.

Table 33: Datasets

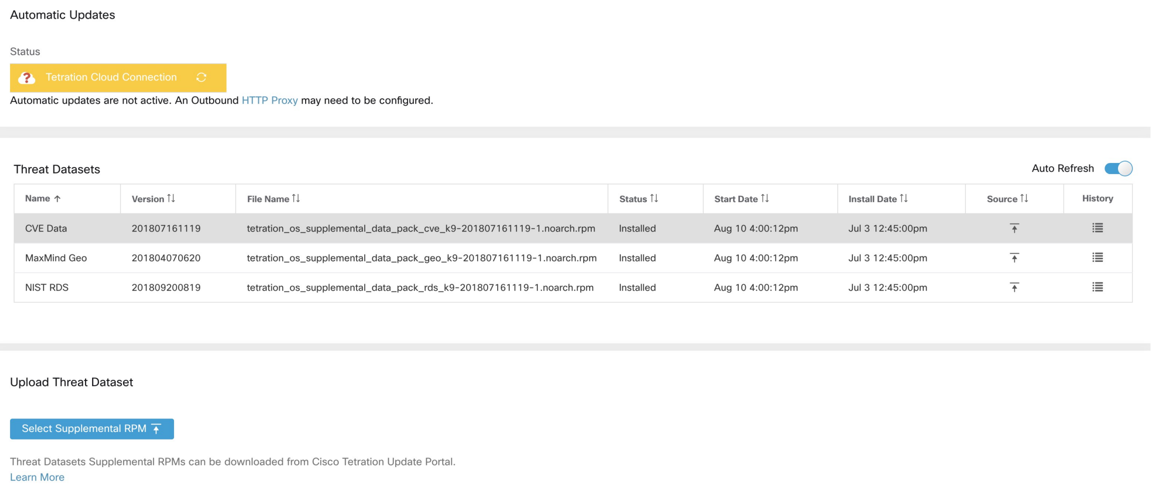
Dataset	Description
NVD CVEs	Security related software flaws, CVSS base score, vulnerable product configuration, and weakness categorization
MaxMind Geo	Identification of the location and other characteristics of source IPs
NIST RDS	NIST Reference Data Set of digital signatures of known, traceable software applications
Team Cymru	Insight on 3,000+ botnet command and control IPs
Hash Verdict	Verdict of Secure Workload on process hashes (only available with the Automatic Updates section).

Note In case the MaxMind Geo dataset is manually uploaded in an earlier release, you must reupload the corresponding RPM to view the location and related information on the Flow Visibility page.

Automatic Updates

The threat dataset updates are triggered from the appliance to synchronize with the global dataset that is hosted on the Internet at uas.tetrationcloud.com, everyday between 3-4 a.m. UTC. The global dataset is refreshed weekly on Fridays or Mondays. The Threat Intelligence dashboard lists the datasets and the date on which the dataset is last updated.

Figure 424: Dashboard



Automatic Updates

Status

Automatic updates are not active. An Outbound HTTP Proxy may need to be configured.

Threat Datasets

Name ↑	Version ⇅	File Name ⇅	Status ⇅	Start Date ⇅	Install Date ⇅	Source ⇅	History
CVE Data	201807161119	tetration_os_supplemental_data_pack_cve_k9-201807161119-1.noarch.rpm	Installed	Aug 10 4:00:12pm	Jul 3 12:45:00pm	⤒	☰
MaxMind Geo	201804070620	tetration_os_supplemental_data_pack_geo_k9-201807161119-1.noarch.rpm	Installed	Aug 10 4:00:12pm	Jul 3 12:45:00pm	⤒	☰
NIST RDS	201809200819	tetration_os_supplemental_data_pack_rds_k9-201807161119-1.noarch.rpm	Installed	Aug 10 4:00:12pm	Jul 3 12:45:00pm	⤒	☰

Upload Threat Dataset

Threat Datasets Supplemental RPMs can be downloaded from Cisco Tetration Update Portal.
Learn More

Manual Uploads

Attention **Scheduling Manual Uploads**—Dataset RPM files are published to Secure Workload Update Portal weekly. It is recommended to install the latest releases periodically by configuring a schedule for an administrator.

Downloading Updated Datasets

The datasets can be downloaded from Secure Workload Update Portal.

Uploading Datasets Manually

To upload dataset RPM files:

Before you begin

Log in as a **Site Administrator** or **Customer Support**.

Procedure

Step 1 In the left navigation pane, click **Manage** > **Service Settings** > **Threat Intelligence**.

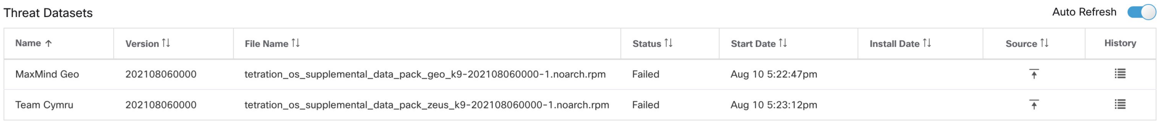
Step 2 Under the **Upload Threat Dataset** section, click **Select Supplemental RPM**.

Step 3 Upload the RPM file downloaded from Secure Workload Update Portal.

Step 4 Click **Upload**.

The RPM upload process is initiated and the status is displayed on a progress bar. After the upload, the RPM file is processed and installed in the background. The table is updated after the installation is complete.

Figure 425: Threat Datasets



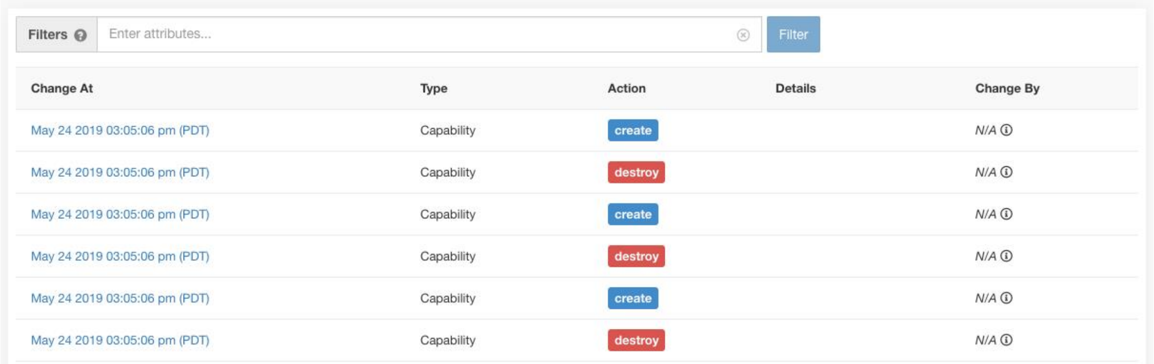
Threat Datasets

Name ↑	Version ⇅	File Name ⇅	Status ⇅	Start Date ⇅	Install Date ⇅	Source ⇅	History
MaxMind Geo	202108060000	tetration_os_supplemental_data_pack_geo_k9-202108060000-1.noarch.rpm	Failed	Aug 10 5:22:47pm		⤒	☰
Team Cymru	202108060000	tetration_os_supplemental_data_pack_zeus_k9-202108060000-1.noarch.rpm	Failed	Aug 10 5:23:12pm		⤒	☰

Change Log

Site Admins can access the **Change Log** page under the **Manage** menu in the navigation bar at the left side of the window. This page displays the most recent changes that are made within Cisco Secure Workload.

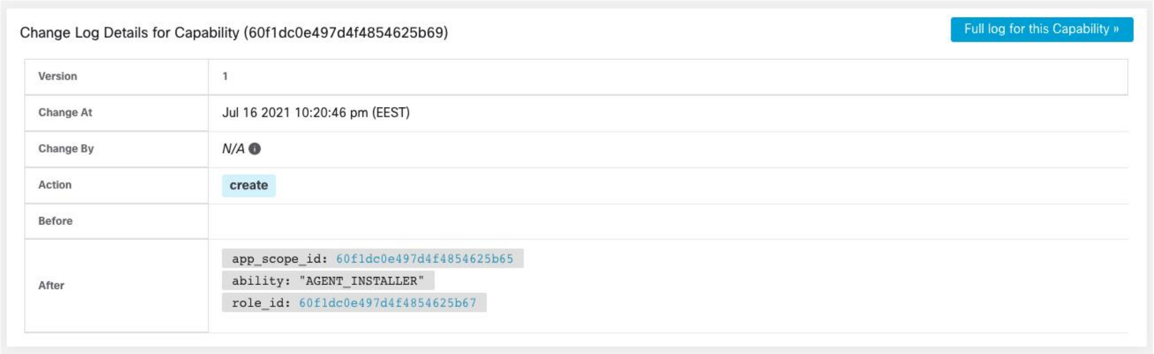
Figure 426: Change Log Page



Change At	Type	Action	Details	Change By
May 24 2019 03:05:06 pm (PDT)	Capability	create		N/A
May 24 2019 03:05:06 pm (PDT)	Capability	destroy		N/A
May 24 2019 03:05:06 pm (PDT)	Capability	create		N/A
May 24 2019 03:05:06 pm (PDT)	Capability	destroy		N/A
May 24 2019 03:05:06 pm (PDT)	Capability	create		N/A
May 24 2019 03:05:06 pm (PDT)	Capability	destroy		N/A

The details of each change log entry can be viewed by clicking on the link in the **Change At** column. This page includes a **Before** and **After** snapshot of the fields changed. The fields may include technical names that require some interpretation to understand how they are surfaced elsewhere throughout Secure Workload.

Figure 427: Change Log Details Page

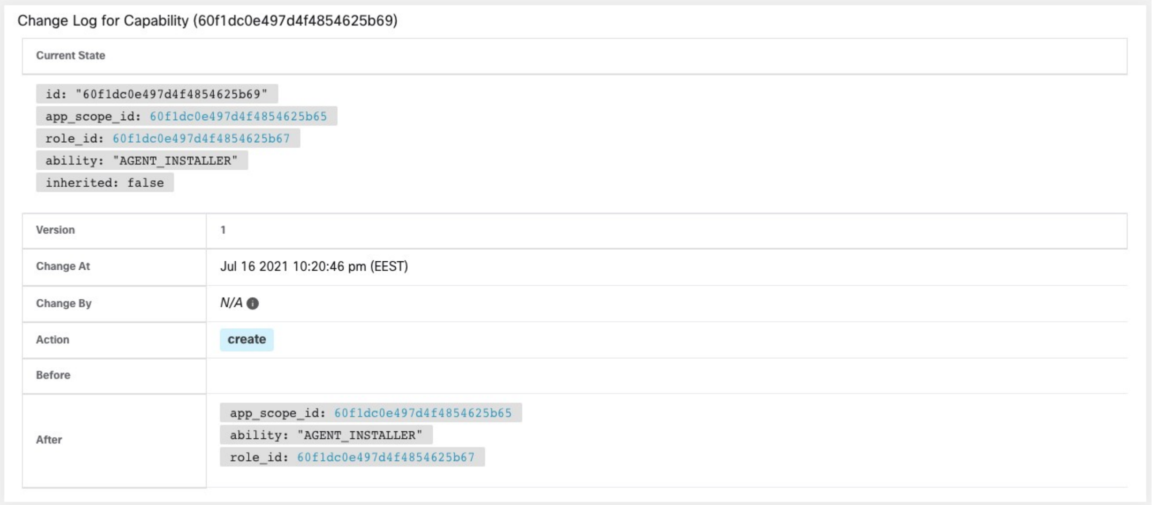


Change Log Details for Capability (60f1dc0e497d4f4854625b69)

Version	1
Change At	Jul 16 2021 10:20:46 pm (EEST)
Change By	N/A
Action	create
Before	
After	app_scope_id: 60f1dc0e497d4f4854625b65 ability: "AGENT_INSTALLER" role_id: 60f1dc0e497d4f4854625b67

The complete list of changes for an entity can be viewed by clicking the button in the upper-right corner, titled **Full log for this <entity type>**. This page displays the details of each change. It also includes the **Current State** of the entity, when available.

Figure 428: Full Change Log for Entity



Change Log for Capability (60f1dc0e497d4f4854625b69)

Current State

```
id: "60f1dc0e497d4f4854625b69"
app_scope_id: 60f1dc0e497d4f4854625b65
role_id: 60f1dc0e497d4f4854625b67
ability: "AGENT_INSTALLER"
inherited: false
```

Version	1
Change At	Jul 16 2021 10:20:46 pm (EEST)
Change By	N/A
Action	create
Before	
After	app_scope_id: 60f1dc0e497d4f4854625b65 ability: "AGENT_INSTALLER" role_id: 60f1dc0e497d4f4854625b67

Collection Rules

Site Admins and **Customer Support users** can access the **Collection Rules** page under the **Manage** > **Service Settings** menu in the navigation bar at the left side of the window. This page displays the hardware collection rules by VRF that is used by switches running the Cisco Secure Workload agent. There is a row in the table for each VRF.

Rules

Click the **Edit** button on a VRF to modify its collection rules. By default, every VRF is configured with two default catch-all rules, one for IPv4 `(0.0.0.0/0 INCLUDE)` and one for IPv6 `(::/0 INCLUDE)`. *These default rules can be removed, but do so with caution.*

Extra include and exclude rules can be added. Enter a valid subnet, select include or exclude, and click **Add Rule**. The priority of these rules can be adjusted via drag-and-drop. Click-and-hold on a rule in the list and drag it to adjust the order.

Changes may take several minutes to propagate to your switches. Click the **Back** button in the upper-right corner to return to the VRF list.

Priority

Collection Rules are ordered in decreasing order priority. No longest prefix match is done to determine the priority. The rule appearing first has higher priority over all the subsequent rules. Example:

1. 1.1.0.0/16 INCLUDE
2. 1.0.0.0/8 EXCLUDE
3. 0.0.0.0/0 INCLUDE

In the earlier example, all addresses belonging to 1.0.0.0/8 subnet are excluded except subnet 1.1.0.0/16 which is included.

Another Example with changed order:

1. 1.0.0.0/8 EXCLUDE
2. 1.1.0.0/16 INCLUDE
3. 0.0.0.0/0 INCLUDE

In the above example, all addresses belonging to 1.0.0.0/8 subnet are excluded. Rule number-2 does not get exercised here because of a higher-order rule already defined for its subnet.

Session Configuration

UI User Authentication idle session timeout can be configured here. This config applies to all the users of the appliance. The default idle session duration is 1 hour. The idle session duration can be set within the range of 5 minutes to 24 hours. The session timeout takes effect on a user's authenticated session when this value is saved.

Site Admins and **Customer Support users** can access this setting. In the left navigation pane, click **Manage** > **Service Settings** > **Session Configuration**.

Idle Session

For those who are authenticating using a local database, this section explains how failed login attempts may lock the user account:

Procedure

Step 1 Five failed login attempts using email and password result in locking the account.

Note As a security measure against probing, no specific message indicating the lock will be provided in the login interface when trying to sign in a locked account.

Step 2 Lock out interval is set at 30 minutes. After the account is unlocked, use the correct password to log in or initiate password recovery by clicking *Forgot password?*

Note Once a user is successfully signed in, one hour of inactivity logs out the user. This timeout is configured from **Manage** > **Service Settings** > **Session Configuration**.

Preferences

The **Preferences** page displays your account details and enables you to update your display preferences, change your landing page, change your password, and configure two-factor authentication.

Change Your Landing Page Preference

To change the page you see when you sign in:

Procedure

Step 1 On the top-right corner of the window, click the user icon and choose **User Preferences**.

Step 2 Choose a landing page from the drop-down menu. Your preference is saved as the default or home page when you log in. To see the change, click the Secure Workload logo at the top-left corner of the page.

Changing a Password

Procedure

Step 1 Click on the user icon in the top-right corner.

Step 2 Select **User Preferences**.

Step 3 In the **Change Password** pane, enter your current password in the **Old Password** field.

Step 4 Enter your new password in the **Password** field.

Step 5 Re-enter your new password in the **Confirm Password** field.

Step 6 Click **Change Password** to submit the change.

Note **Password must be 8–128 characters and contain at least one of the each following:**

- Lower case letters (a b c d . . .)
- Upper case letters (A B C D . . .)
- Numbers (0 1 2 3 4 5 6 7 8 9)
- Special characters (! " # $ % & ’ ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ‘ { | } ~), space included

Recovering Passwords

This section explains how to recover your password.

Before you begin

To reset a password, you must first have an account. A new account can be added by **Site Admins** and **Customer Support users**.

Procedure

Step 1 Point your browser to the Cisco Secure Workload URL and click the **Forgot Password** link. The **Forgot your password?** dialog box is displayed.

Step 2 Enter your email address in the **Email** field.

Step 3 Click **Reset Password**.

Password reset instructions are sent to your email.

Note The password recovery procedure for two-factor authentication requires contacting Secure Workload Customer Support because the email-based password recovery cannot contain the one-time password.

Enabling Two-Factor Authentication

This section explains how to enable two-factor authentication.

Procedure

Step 1 Click on the user icon in the top-right corner.

Step 2 Select **User Preferences**.

Step 3 In the **Two-Factor Authentication** pane, click the **Enable** button. A new **Two-Factor Authentication** pane appears.

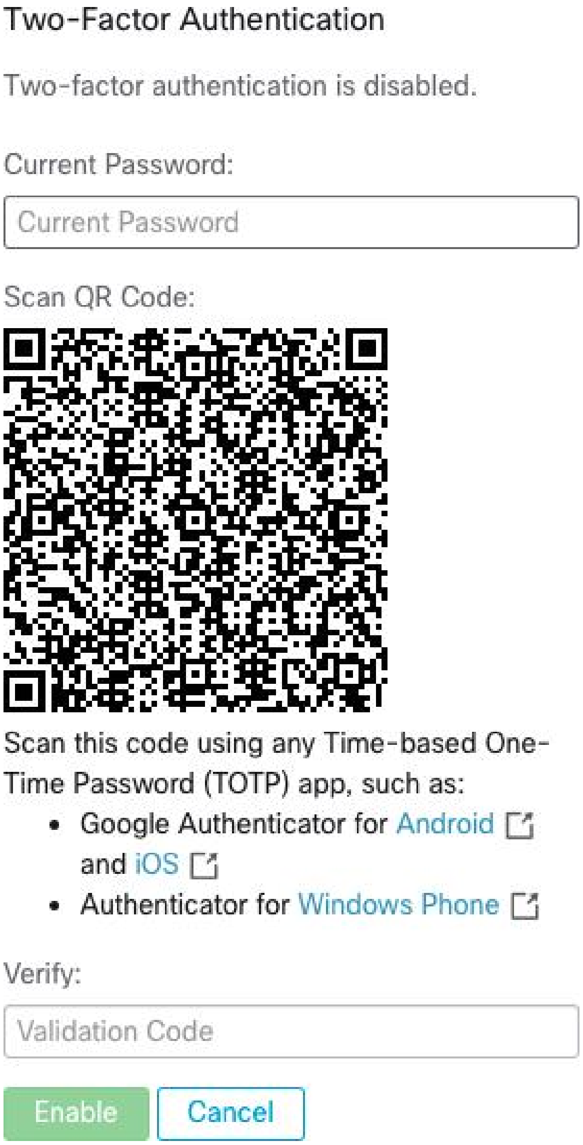
Step 4 Enter your password.

Step 5 Scan the QR code that is displayed under the **Current Password** field using any time-based one-time password (TOTP) app, such as Google Authenticator (for Android or iOS) or Authenticator (for Windows Phone).

Step 6 Enter the validation code that is shown by your chosen TOTP app.

Step 7 Click **Enable**.

Figure 429: Two-Factor Authentication Pane



Two-Factor Authentication

Two-factor authentication is disabled.

Current Password:

Current Password

Scan QR Code:

Scan this code using any Time-based One-Time Password (TOTP) app, such as:

- Google Authenticator for Android and iOS
- Authenticator for Windows Phone

Verify:

Validation Code

The next time that you log into the system, you must select the **Use two-factor authentication** check box and enter the verification code that is shown in your TOTP app to sign in.

Note The password recovery procedure for two-factor authentication requires contacting Secure Workload Customer Support because the email-based password recovery cannot contain the one-time password.

Disabling Two-Factor Authentication

This section explains how to disable two-factor authentication.

Procedure

Step 1 Click on the user icon in the top-right corner.

Step 2 Select **User Preferences**.

Step 3 Under two-factor authentication, click the **Disable** button. The **Two-Factor Authentication** pane appears.

Step 4 Enter your password.

Step 5 Click the **Disable** button again.

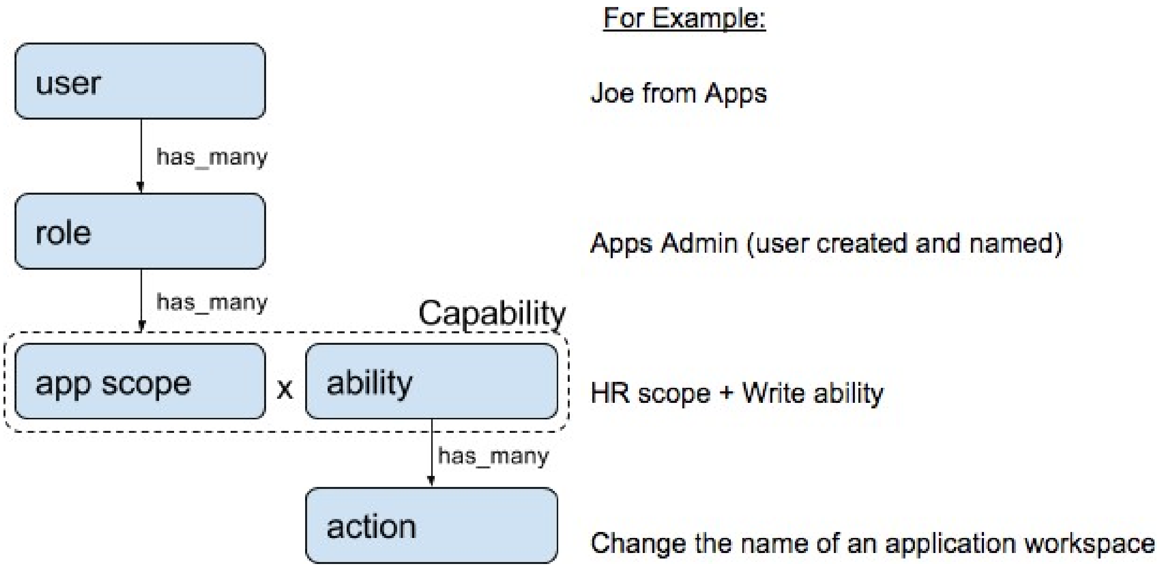
You will no longer be required to enter a two-factor verification code during login.

Roles

You can restrict access to features and data using role-based access control (RBAC) model.

- User - someone with login access to Cisco Secure Workload.
- Role - user created set of capabilities that is assigned to a user.
- Capability - scope + ability pair
- Ability - collections of actions
- Action - low-level user action such as “change workspace name”

Figure 430: Role Model



A user can have any number of roles. Roles can have any number of capabilities. For example, the “HR Search Engineer” role could have two capabilities: “Read on the HR Scope” to give visibility and context and “Execute on “HR:Search” capability to allow the engineers assigned this role to make specific changes that are related to their applications.

Roles contain sets of Capabilities and are assigned to users on the **Users** page. A user can have any number of roles. Roles can have any number of capabilities.

Seven system roles are defined to allow users to get started more quickly. They define different levels of access to **all Scopes**, that is, all data on the system. These system roles are defined below.

Role	Description
Agent Installer	Provide the ability to manage agents life cycle including install, monitor, upgrade, and convert, but **cannot** delete agents and access agent config profile.
Customer Support	For Technical Support or Advanced Services. Provides access to cluster maintenance features. Allows the same access as Site Admin, but **cannot** modify users.
Customer Support Read Only	For Technical Support or Advanced Services. Provides access to cluster maintenance features. Allows the same access as Site Admin, but **cannot** modify users.
Site Admin	Provides the ability to manage users, agents, and so on. Can view and edit all features and data. There must be at least one site admin.
Global Application Enforcement	Provides the Enforce ability on every scope.
Global Application Management	Provides the Execute ability on every scope.
Global Read Only	Provides the Read ability on every scope.

Abilities and Capabilities

Roles are made up of capabilities which include a scope and an ability. These define the allowed actions and the set of data that they apply to. For example, the (HR, Read) capability should be read and interpreted as “Read ability on the HR scope”. This capability would allow access to the HR scope and all its children.

Ability	Description
Installer	Install, monitor, and upgrade software agents.
Audit	Global appliance data read support and access to change logs.
Read	Read all data including flows, application, and inventory filters.
Write	Make changes to applications and inventory filters.
Execute	Perform Automatically discover policies run and publish policies for analysis.
Enforce	Enforce policies that are defined in application workspaces that are associated with the given scope.

Ability	Description
Owner	Required to toggle an application workspace from secondary to primary. Access to Data Tap Admin abilities, such as managing User App sessions, adding Data Taps, and creating Visualization Data Sources.

Important Abilities are inherited, for example, the Execute ability allows all the Read, Write, and Execute actions.

Important Abilities apply to the scope and all the scope's children.

Menu Access by Role

The menus a user can see and use depend on the user's assigned role:

Table 34: Overview Menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Overview	Overview	Yes	Yes	Yes	Yes	Yes	Yes	No
Reporting	Overview	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 35: Organize Menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Organize	Scopes and Inventory	Yes	Yes	Yes	Yes	Yes	Yes	No
Organize	Label Management	Yes	Yes	Yes	Yes	Yes	Yes	No
Organize	Inventory Filters	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 36: Defend Menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Defend	Segmentation	Yes	Yes	Yes	Yes	Yes	Yes	No

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Defend	Enforcement Status	Yes	Yes	Yes	Yes	Yes	Yes	No
Defend	Policy Templates	Yes	Yes	Yes	Yes	Yes	Yes	No
Defend	Forensic Rules	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 37: Investigate Menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Investigate	Traffic	Yes	Yes	Yes	Yes	Yes	Yes	No
	Alerts	Yes	Yes	Yes	Yes	Yes	Yes	No
	Vulnerabilities	Yes	Yes	Yes	Yes	Yes	Yes	No
	Forensics	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 38: Manage Menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Manage	Agents	Yes	Yes	Yes	No	No	No	Yes
Manage	Alerts Configs	Yes	Yes	Yes	Yes	Yes	Yes	No
Manage	Change Logs	Yes	No	Yes	No	No	No	No
Manage	Connectors	Yes	Yes	No	No	No	No	No
Manage	External Orchestrators	Yes	Yes	No	No	No	No	No
Manage	Secure Connector	Yes	Yes	No	No	No	No	No
Manage	Virtual Appliances	Yes	Yes	No	No	No	No	No
Manage	Users	Yes	Yes	No	No	No	No	No

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Manage	Roles	Yes	Yes	Yes	No	No	No	No
Manage	Threat Intelligence	Yes	Yes	Yes	No	No	No	No
Manage	Licenses	Yes	No	No	No	No	No	No
Manage	Collection Rules	Yes	Yes	Yes	Yes	Yes	Yes	No
Manage	Session Configuration	Yes	Yes	No	No	No	No	No
Manage	Usage Analytics	Yes	Yes	No	No	No	No	No
Manage	Data Tap Admin	Yes	No	No	No	No	No	No

Table 39: Platform menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Platform	Tenants	Yes	Yes	No	No	No	No	No
Platform	Cluster Configuration	Yes	Yes	No	No	No	No	No
Platform	Outbound HTTP	Yes	Yes	No	No	No	No	No
Platform	Collectors	Yes	Yes	No	No	No	No	No
Platform	External Authentication	Yes	Yes	No	No	No	No	No
Platform	SSL Certificate	Yes	Yes	No	No	No	No	No
Platform	Login Page Message	Yes	Yes	No	No	No	No	No
Platform	Federation	See below	See below	No	No	No	No	No
Platform	Data Backup	See below	See below	No	No	No	No	No

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Platform	Data Restore	See below	See below	No	No	No	No	No
Platform	Upgrade/ Reboot/ Shutdown	Yes	Yes	No	No	No	No	No

Note

- The Federation option is available to Site Admin and Customer Support roles if Federation is enabled.
- Data Backup and Restore options are available to Site Admin and Customer Support roles if data backup and restore are enabled.

Table 40: Troubleshoot Menu

Menu	Option	Site Admin	Customer Support	Customer Support Read Only	Global Application Enforcement	Global Application Management	Global Read Only	Agent Installer
Troubleshoot	Service Status	Yes	Yes	Yes	No	No	No	No
Troubleshoot	Cluster Status	See below	See below	No	No	No	No	No
Troubleshoot	Virtual Machine	Yes	Yes	Yes	No	No	No	No
Troubleshoot	Snapshots	Yes	Yes	No	No	No	No	No
Troubleshoot	Maintenance Explorer	Yes	Yes	No	No	No	No	No
Troubleshoot	Resque	Yes	Yes	No	No	No	No	No
Troubleshoot	Hawkeye (Charts)	Yes	Yes	Yes	No	No	No	No
Troubleshoot	Abyss (Pipeline)	Yes	Yes	Yes	No	No	No	No

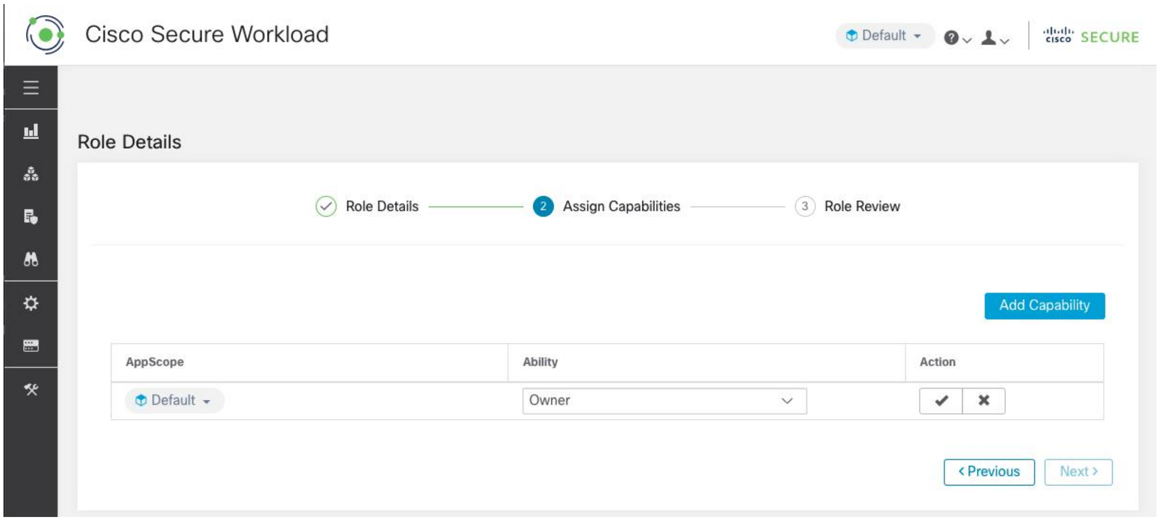
Note The Cluster Status option is available to Site Admin and Customer Support roles if the cluster type is ‘Physical’ or ‘OCI’.

Create a Role

Before you begin

You must already have a **Site Admin** or **Customer Support** user role.

1. In the navigation bar on the left, click **Manage** > **User Access** > **Roles**.
2. Click **Create New Role**. The **Roles** panel appears.



Creating a role using the Create Role Wizard is three-step process.

Procedure

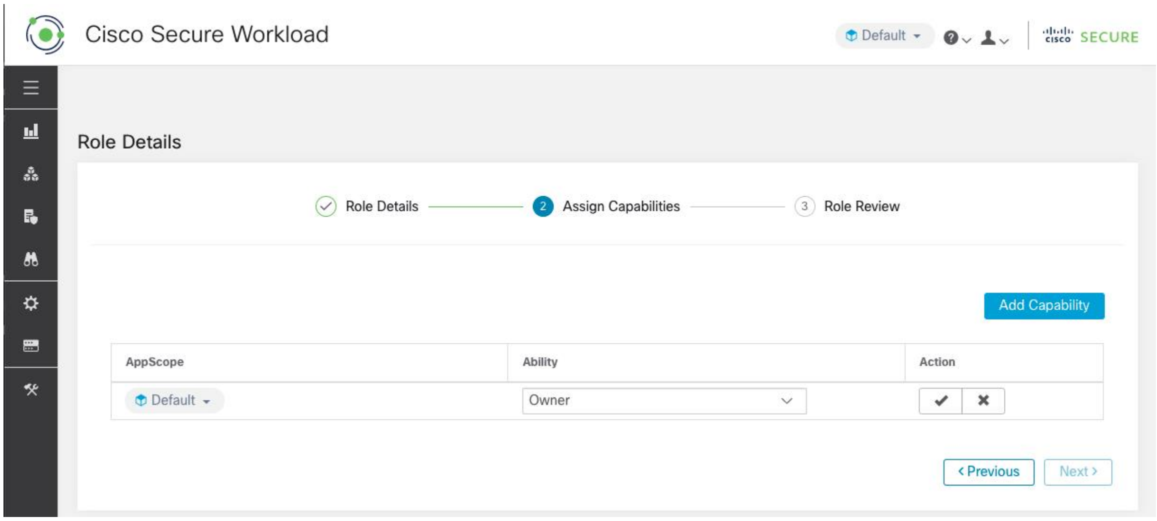
Step 1 a) Enter the appropriate values in the following fields:

Field	Description
Name	The name to identify the role.
Description	A short description to add context about the role.

b) Click the **Next** button to move to the next step or **Back to Roles Page** to go back to Roles Page.

Step 2 a) Click the **Add Capability** button to show the creation form in the top row.
b) Select scope and ability.
c) Click the **Checkmark** button to create a new capability or **Cancel** button to cancel.
d) Click **Next** to review role details or **Previous** to go back and edit.

Figure 431: Capability Assignment



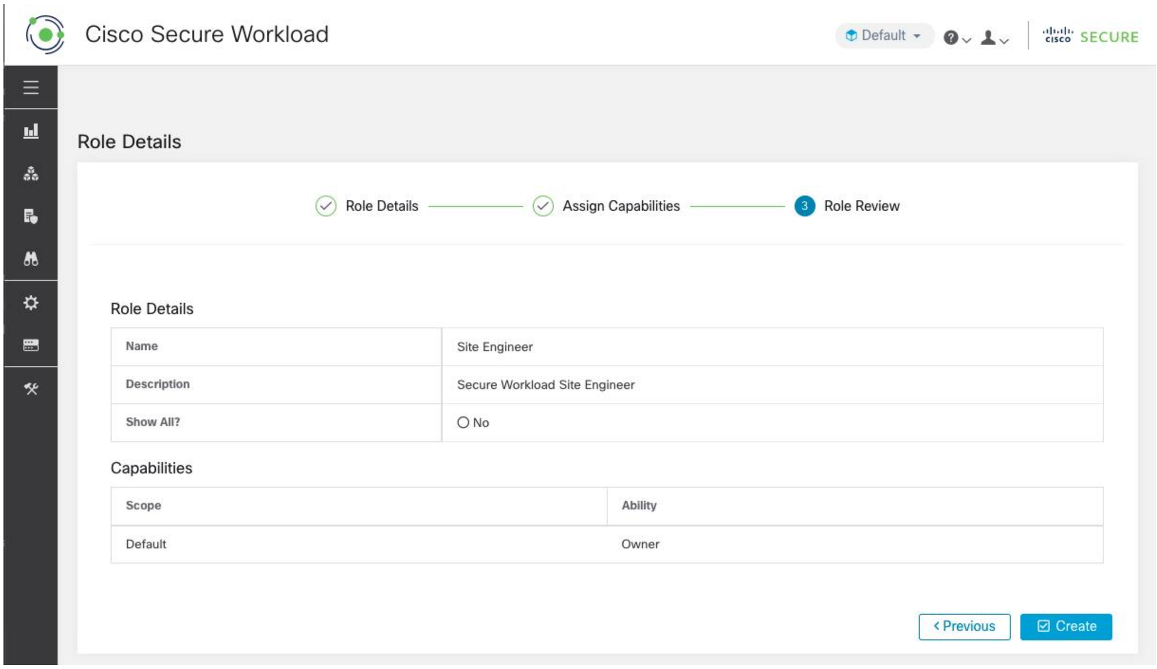
AppScope	Ability	Action
Default	Owner	✓ ✕

Step 3

a) Review the role details and capabilities.

b) Click **Create** to create role.

Figure 432: Role Review



Role Details

Name	Site Engineer
Description	Secure Workload Site Engineer
Show All?	○ No

Capabilities

Scope	Ability
Default	Owner

Edit a Role

This section explains how **Site Admins** and **Customer Support users** can edit roles.

Before you begin

You must be Site Admin or Customer Support User.

1. In the navigation bar on the left, click **Manage** > **User Access** > **Roles**.
2. In the row of the role to edit, click the **Edit** button in the right-hand column. The **Roles** panel appears.

Editing a role using the Edit Role Wizard is three-step process.

Procedure

Step 1
a) Update the name or description if desired.
b) Click the **Next** button to move to the next step or **Back to Roles Page** to go back to Roles Page.

Step 2
a) Remove any capability as needed. In the row of the capability to delete, click the **Delete** icon in the right-hand column.
b) To add, click the **Add Capability** button to show the creation form in the top row.
c) Select scope and ability.
d) Click **Next** to review role details or **Previous** to go back and edit.

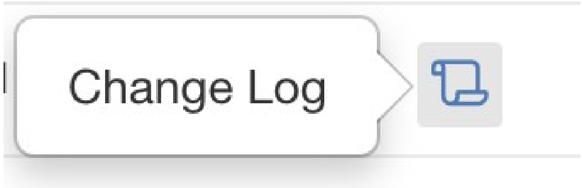
Step 3
a) Review the role details and capabilities.
b) Click **Update** to create the role or **Previous** to go back and edit. Changes to role details and capability assignment are saved after **Update**.

Note Capabilities cannot be edited, they must be deleted and recreated.

Change Log – Roles

Site Admins and users with the `SCOPE_OWNER` ability on the root scope can view the change logs for each role by clicking on the icon in the **Action** column as shown in the following figure.

Figure 433: Change Log



These users can also view a list of deleted roles by clicking on the **View Deleted Roles** link below the table.

For more information on the **Change Log**, see Change Log. Root scope owners are restricted to viewing change log entries for entities belonging to their scope.

Scopes

Note: The **Scopes** page is merged with **Inventory Search**. For more information, see the Scopes and Inventory page.

Users

Site Admins and Root Scope Owners can access the **Users** page under the **Manage** > **User Access** menu in the navigation bar at the left side of the window.

This page shows all Service Provider users and those associated with the scope that is selected on the page header.

Multitenancy

To support multitenancy, users can be assigned to a root scope. These users can be managed by users with the ‘Owner’ ability on the root scope and can only be assigned roles that are associated with the same scope.

Users without a scope are called ‘Service Providers’ and they can be assigned any role allowing them to perform actions across root scopes.

Add a User

Before you begin

- You must be a **Site Admin** or **Scope Owner** user to add users in Secure Workload.
- If a user is assigned a scope for multitenancy, only roles that are assigned to the same scope may be selected.

Note: This page is filtered by the scope preference that is selected on the page header.

Procedure

Step 1 If applicable, select the appropriate root scope from the page header.

Step 2 From the navigation pane, choose **Manage** > **User Access** > **Users**.

Step 3 Click **Create New User**.
The **User Details** page is displayed.

Step 4 Update the following fields under **User Details**.

Table 41: User Details Field Descriptions

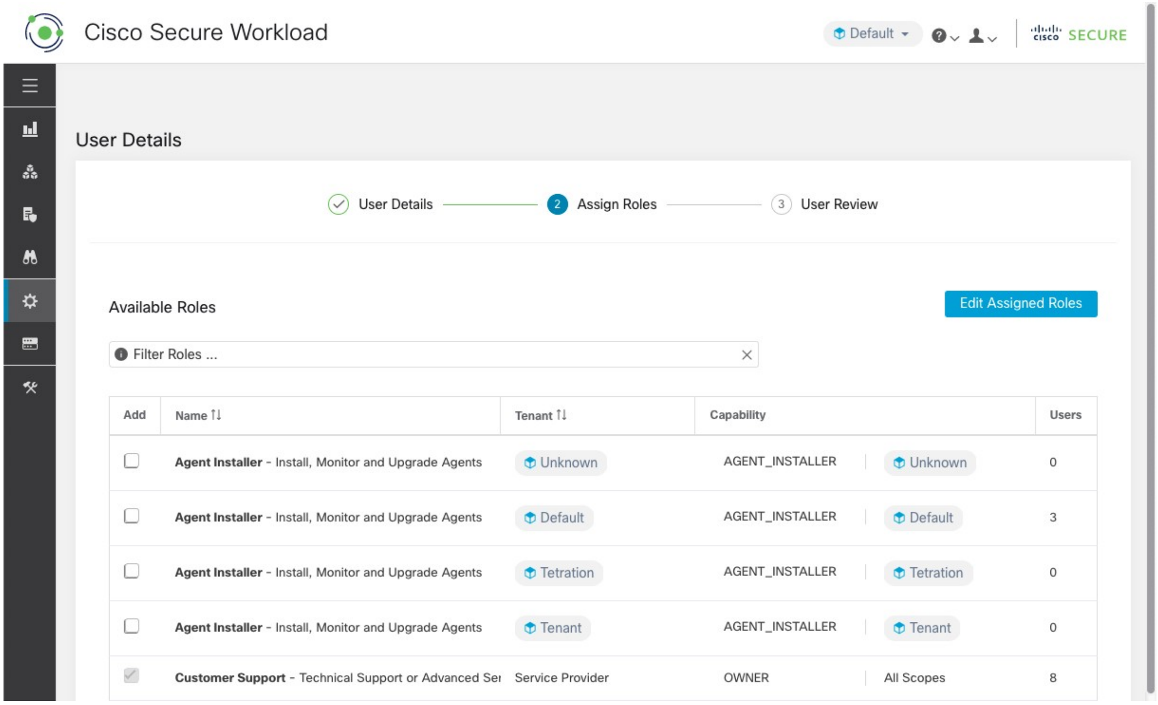
Field	Description
Email	Enter the email ID of the user. It is non case-sensitive. We use the lower case version of your email if it contains letters.
First Name	Enter the user’s first name.
Last Name	Enter the user’s last name.
Scope	Root scope that is assigned to the user for multitenancy. (Available to site admins)

Step 5 Click **Next**.

Step 6 Under **Assign Roles**, add or remove assigned roles to the user.

- Click **Add Roles** to assign new roles, and then click the **Add** check box.

Figure 434: Assigned User Roles



User Details

✓ User Details — 2 Assign Roles — 3 User Review

Available Roles

Edit Assigned Roles

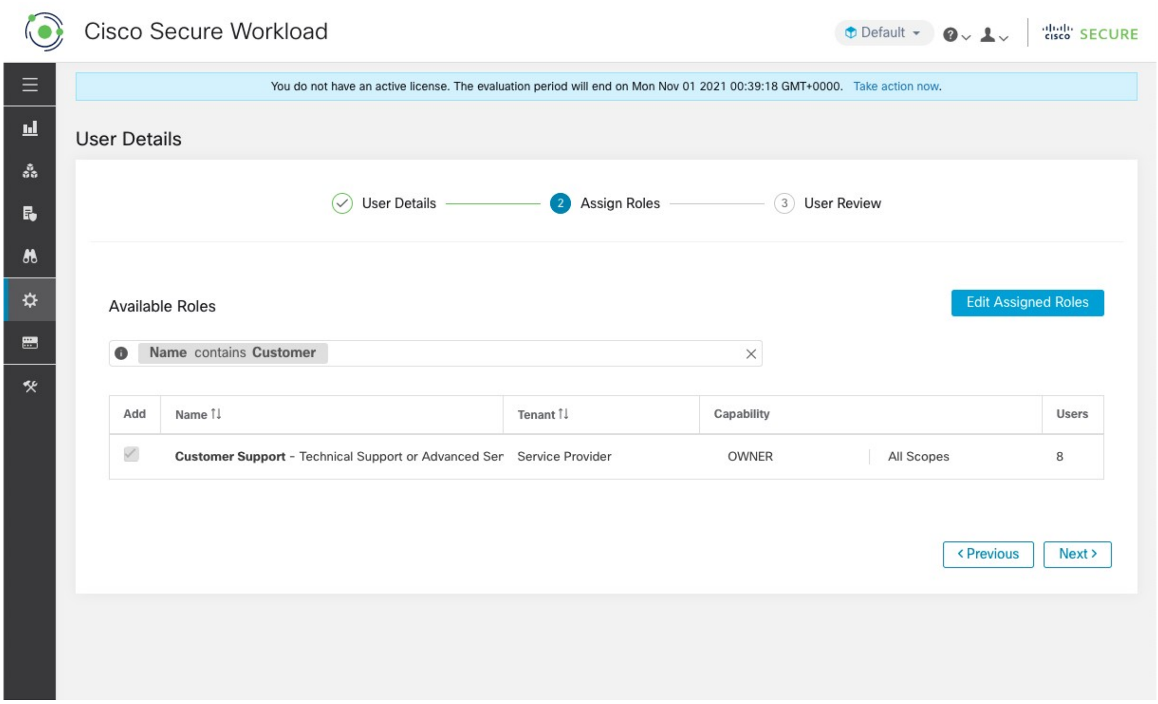
Filter Roles ...

Add	Name	Tenant	Capability		Users
□	**Agent Installer** - Install, Monitor and Upgrade Agents	Unknown	AGENT_INSTALLER	Unknown	0
□	**Agent Installer** - Install, Monitor and Upgrade Agents	Default	AGENT_INSTALLER	Default	3
□	**Agent Installer** - Install, Monitor and Upgrade Agents	Tetration	AGENT_INSTALLER	Tetration	0
□	**Agent Installer** - Install, Monitor and Upgrade Agents	Tenant	AGENT_INSTALLER	Tenant	0
☑	**Customer Support** - Technical Support or Advanced Ser	Service Provider	OWNER	All Scopes	8

- Select the assigned roles, click **Edit Assigned Roles**, and then click the **Remove** icon.

- You can filter the user roles using **Name** or **Tenant**.

Figure 435: Filter User Roles



You do not have an active license. The evaluation period will end on Mon Nov 01 2021 00:39:18 GMT+0000. Take action now.

Name contains Customer

Add	Name	Tenant	Capability		Users
☑	**Customer Support** - Technical Support or Advanced Ser	Service Provider	OWNER	All Scopes	8

Step 7 Click **Next**.

Step 8 Under **User Review**, review the user details and the assigned roles. Click **Create**.

If external authentication is enabled, the authentication details are displayed.

Note After the user is added in Secure Workload, an activation email is sent to the registered email ID to set up the password.

Edit User Details or Roles

Before you begin

You must be a **Site Admin** or **Root Scope Owner** user to edit users in Secure Workload.

Note This page is filtered by the scope preference that is selected on the page header.

Procedure

Step 1 If applicable, select the appropriate root scope from the page header.

Step 2 From the navigation pane, choose **Manage** > **User Access** > **Users**.

Step 3 For the required user account, under **Actions**, click **Edit**.
The **User Details** page is displayed.

Step 4 Edit the following details.

a) Update the following fields under **User Details**.

Table 42: User Details Field Descriptions

Field	Description
Email	Update the email ID of the user.
First Name	Update the user's first name.
Last Name	Update the user's last name.
Scope	Root scope that is assigned to the user for multitenancy. (Available to site admins)
Reset MFA	If the user has lost their multifactor authentication (MFA) device or is locked out of MFA, then click **Reset MFA**. MFA of the user is reset in a few minutes.
Resend Activation Email	If a user has not received an activation email or the activation email link has expired, then click **Resend Activation Email**.

b) Click **Next**.

c) Under **Assign Roles**, add or remove assigned roles to the user.

- Click **Add Roles** to assign new roles, and then click the **Add** check box.
- Select the assigned roles, click **Edit Assigned Roles**, and then click the **Remove** icon.

d) Click **Next**.

e) Under **User Review**, review the user details and the assigned roles. Click **Update** to update the user account.

If external authentication is enabled, the authentication details are displayed.

Deactivating a User Account

Note To maintain consistency of change log audits, users can only be deactivated, they are not deleted from database.

Before you begin

You must be a **Site Admin** or **Root Scope Owner** user.

Note This page is filtered by the scope preference that is selected on the page header.

Procedure

Step 1 In the navigation bar on the left, click **Manage** > **User Access** > **Users**.

Step 2 If applicable, select the appropriate root scope from the top right of the page.

Step 3 In the row of the account you want to deactivate, click **Deactivate** button in the right-hand column.

To view deactivated users, toggle **Hide Deleted Users** button.

Reactivating a User Account

If a user has been deactivated, you can reactivate the user.

Before you begin

You must be a **Site Admin** or **Root Scope Owner** user.

Note This page is filtered by the scope preference that is selected on the page header.

Procedure

Step 1 In the navigation bar on the left, click **Manage** > **User Access** > **Users**.

Step 2 If applicable, select the appropriate root scope from the top right of the page.

Step 3 Toggle **Hide Deleted Users** to display all users, including deactivated users.

Step 4 For the required deactivated account, click **Restore** in the right-hand column to reactivate the account.

Import SSH Public Key

To enable SSH access as **ta_guest** user via one of the collector IP addresses, SSH public key can be imported for each user. This menu will only be available to **Site Admins** and users with the `SCOPE_OWNER` ability on the root scope. The SSH Public Key automatically expires in 7 days.

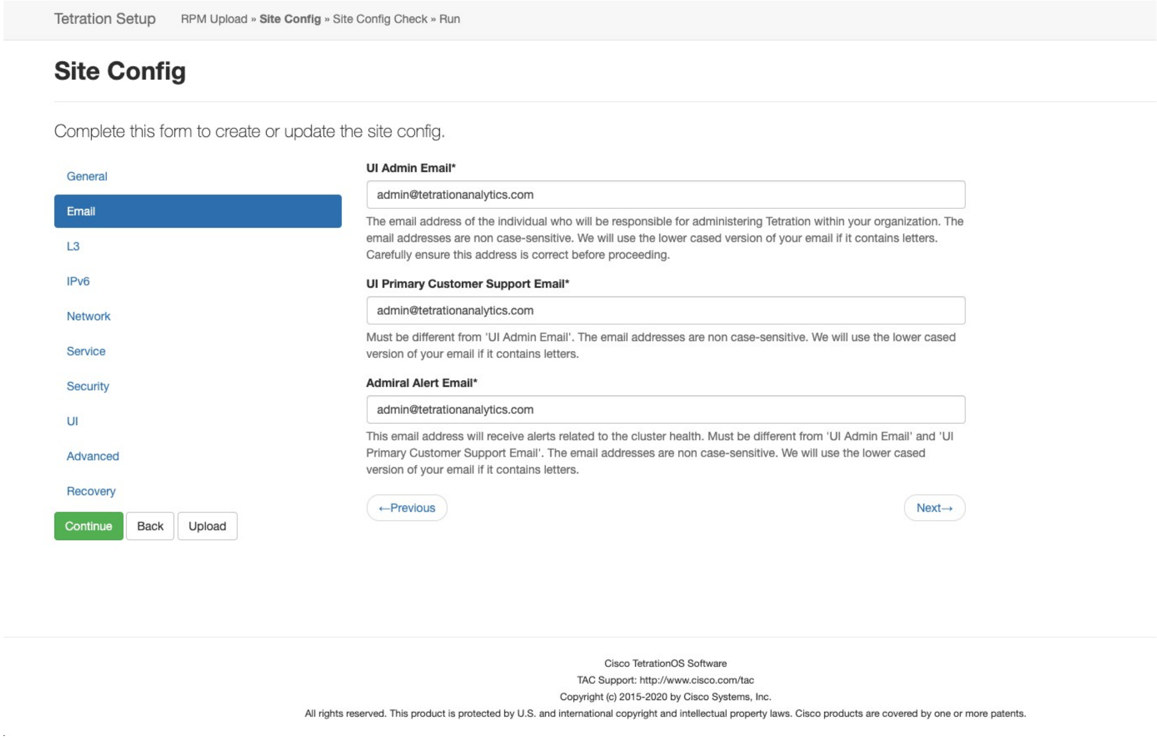
Site Configuration in Secure Workload Setup

This section explains how **Site Admins** can set up a site during the Secure Workload Setup process.

Field	Description
UI Admin Email	The email address of the individual who will be responsible for administering Secure Workload within your organization.
UI Primary Customer Support Email	The email address of primary support. Must be different from UI Admin Email.
Admiral Alert Email	This email address receives alerts that are related to the cluster health. Must be different from UI Admin Email and UI Primary Customer Support Email.

The email addresses are non case-sensitive. We use the lower cased version of your email if it contains letters.

Figure 436: Configure UI Admin, Primary Customer Support, and Admiral Admin Alert Emails



Site Config

Complete this form to create or update the site config.

UI Admin Email*

admin@tetrationanalytics.com

The email address of the individual who will be responsible for administering Tetration within your organization. The email addresses are non case-sensitive. We will use the lower cased version of your email if it contains letters. Carefully ensure this address is correct before proceeding.

UI Primary Customer Support Email*

admin@tetrationanalytics.com

Must be different from 'UI Admin Email'. The email addresses are non case-sensitive. We will use the lower cased version of your email if it contains letters.

Admiral Alert Email*

admin@tetrationanalytics.com

This email address will receive alerts related to the cluster health. Must be different from 'UI Admin Email' and 'UI Primary Customer Support Email'. The email addresses are non case-sensitive. We will use the lower cased version of your email if it contains letters.

Cisco TetrationOS Software
TAC Support: http://www.cisco.com/tac
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Change Log – Users

Site Admins and users with the `SCOPE_OWNER` ability on the root scope can view the change logs for each user by clicking on the icon in the **Actions** column as shown in the following figure.

Figure 437: Change Log

For more information on the **Change Log**, see Change Log. Root scope owners are restricted to viewing change log entries for entities belonging to their scope.

CHAPTER 16

OpenAPI

OpenAPI provides a REST API for Secure Workload features.

OpenAPI Authentication

OpenAPI uses a digest-based authentication scheme. The workflow is as follows:

1. Log in to the Secure Workload UI Dashboard.
2. Generate an API key and an API secret with the desired capabilities.
3. Use Secure Workload API SDK to send REST requests in JSON format.
4. To use the Python SDK, you install the SDK using `pip install tetpyclient`.
5. After the Python SDK is installed, here is some boilerplate code for instantiating the RestClient:

```
from tetpyclient import RestClient

API_ENDPOINT="https://<UI_VIP_OR_DNS_FOR_TETRATION_DASHBOARD>"

# ``verify`` is an optional param to disable SSL server authentication.
# By default, cluster dashboard IP uses self signed cert after
# deployment. Hence, ``verify=False`` might be used to disable server
# authentication in SSL for API clients. If users upload their own
# certificate to cluster (from ``Platform > SSL Certificate``)
# which is signed by their enterprise CA, then server side authentication
# should be enabled; in such scenarios, in the code below, verify=False
# should be replaced with verify="path-to-CA-file"
# credentials.json looks like:
# {
#   "api_key": "<hex string>",
#   "api_secret": "<hex string>"
# }

restclient = RestClient(API_ENDPOINT,
                credentials_file='<path_to_credentials_file>/credentials.json',
                verify=False)
# followed by API calls, for example API to retrieve list of agents.
# API can be passed /openapi/v1/sensors or just /sensors.
resp = restclient.get('/sensors')
```

Generate API Key and Secret

Procedure

Step 1 In the upper right corner of Secure Workload UI, click the logged in account and choose **API Keys**.

Step 2 Click **Create API Key**.

Step 3 (Optional) Enter a description for the API key.

Step 4 Select the required capabilities for the key and secret.

Select the limited set of capabilities that are intended for using the API Key+Secret pair.

Note The availability of the API capabilities varies based on the user role.

Table 43: API Capabilities

Capability	Description
`sensor_management`	To configure and monitor status of software agents
`software_download`	To download software packages for agents or virtual appliances
`flow_inventory_query`	To query flows and inventory items in Secure Workload cluster
`user_role_scope_management`	To read, add, modify, or remove users, roles, and scopes
`user_data_upload`	To allow users to upload data for annotating flows and inventory items or upload good or bad file hashes
`app_policy_management`	To manage workspaces (applications) and enforce policies
`external_integration`	To allow integration with external systems such as vCenter and kubernetes

Table 44: API Capabilities for Site Administrators

Capability	Description
`appliance_management`	To manage Secure Workload appliance
`appliance_monitoring`	To monitor Secure Workload appliance settings and configurations (read-only)

Step 5 Click **Create**.

API key and secret are generated and must be copied to a file, and saved in a safe location. Alternatively, you can download the JSON file with the key and secret.

Note If External Auth with LDAP and LDAP Authorization are enabled, access to OpenAPI using API Keys stop because Secure Workload roles that are derived from LDAP MemberOf groups are reassessed after the user session terminates. Therefore, to ensure uninterrupted OpenAPI access, it is recommended that any user with API keys have the **Use Local Authentication** option that is enabled in the Edit User Details flow for the user.

Workspaces and Security Policies

The following pages describe the OpenAPI endpoints to manage Policies.

Workspaces

Workspaces (formerly known as "application workspaces" or "Applications") are the containers for defining, analyzing and enforcing policies for the workloads in a particular scope. For more information about how they work see the Use Workspaces to Manage Policies documentation. This set of APIs requires the `app_policy_management` capability associated with the API key.

Workspace Object

The workspace ("application") JSON object is returned as a single object or an array of objects depending on the API endpoint. The object's attributes are described below:

Attribute	Type	Description
id	string	A unique identifier for the workspace.
name	string	User specified name of the workspace.
description	string	User specified description of the workspace.
app_scope_id	string	ID of the scope with which the workspace is associated.
author	string	First and last name of the user who created the workspace.
primary	boolean	Indicates if the workspace is primary for its scope.
alternate_query_mode	boolean	Indicates if 'dynamic mode' is used for the workspace. In the dynamic mode, an automatic policy discovery run creates one or more candidate queries for each cluster. Default value is true.
created_at	integer	Unix timestamp of when the workspace was created.
latest_adm_version	integer	The latest adm (v*) version of the workspace.
analysis_enabled	boolean	Indicates if analysis is enabled on the workspace.
analyzed_version	integer	The analyzed p* version of the workspace.
enforcement_enabled	boolean	Indicates if enforcement is enabled for the workspace.
enforced_version	integer	The enforced p* version of the workspace.

List Applications

This endpoint will return an array of workspaces (“applications”).

```
GET /openapi/v1/applications
```

Table 45: Parameters

Name	Type	Description
app_scope_id	string	Match workspaces associated with a specific app scope.
exact_name	string	Match workspaces with exactly the value provided.

Response object: Returns an array of workspace objects.

Sample python code

```
restclient.get('/applications')
```

Retrieve a Single Workspace

This endpoint will return the requested workspace (“application”) as a single JSON object.

```
GET /openapi/v1/applications/{application_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Response object: Returns the workspace object for the specified ID.

Sample python code

```
  application_id = '5d02b493755f0237a3d6e078'
  restclient.get('/applications/%s' % application_id)
```

Create a Workspace

This endpoint creates a workspace (“application”). It is possible to define policies by posting a JSON body containing the cluster and policy definitions.

Note If a primary workspace exists for the same scope and new policies are provided, the policies will be added as a new version to the existing workspace.

```
POST /openapi/v1/applications
```

Parameters: The JSON query body contains the following keys

Name	Type	Description
app_scope_id	string	The scope ID to assign to the workspace.

Name	Type	Description
name	string	(optional) A name for the workspace.
description	string	(optional) A description for the workspace.
alternate_query_mode	boolean	(optional) Indicates if 'dynamic mode' is used for the workspace. In the dynamic mode, an automatic policy discovery run creates one or more candidate queries for each cluster. Default value is true.
strict_validation	boolean	(optional) Will return an error if there are unknown keys or attributes in the uploaded data. Useful for catching misspelled keys. Default value is false.
primary	string	(optional) Set to 'true' to if this workspace should be primary for the associated scope. **Default is true**

Extra optional parameters may be included describing policies to be created within the workspace.

Note The scheme corresponds to that returned during export from the UI and the **Details** endpoint.

Name	Type	Description
clusters	array of clusters	Groups of nodes to be used to define policies.
inventory_filters	array of inventory filters	Filters on datacenter assets.
absolute_policies	array of policies	Ordered policies to be created with the absolute rank.
default_policies	array of policies	Ordered policies to be created with the default rank.
catch_all_action	string	"ALLOW" or "DENY"

Cluster object attributes:

Name	Type	Description
id	string	Unique identifier to be used with policies.

Name	Type	Description
name	string	Displayed name of the cluster.
description	string	Description of the cluster.
nodes	array of nodes	Nodes or endpoints that are part of the cluster.
consistent_uuid	string	Must be unique to a given workspace. After an automatic policy discovery run, the similar/same clusters in the next version will maintain the consistent_uuid.

Node object attributes:

Name	Type	Description
ip	string	IP or subnet of the node. For example 10.0.0.0/8 or 1.2.3.4
name	string	Displayed name of the node.

Inventory Filter object attributes:

Name	Type	Description
id	string	Unique identifier to be used with policies.
name	string	Displayed name of the cluster.
query	object	JSON object representation of an inventory filter query.

Policy object attributes:

Name	Type	Description
consumer_filter_id	string	ID of a cluster, user inventory filter or app scope.
provider_filter_id	string	ID of a cluster, user inventory filter or app scope.
action	string	“ALLOW” or “DENY”
l4_params	array of l4params	List of allowed ports and protocols.

L4Params object attributes:

Name	Type	Description
proto	integer	Protocol Integer value (NULL means all protocols).

Name	Type	Description
port	array	Inclusive range of ports. For example, [80, 80] or [5000, 6000].
approved	boolean	(optional) Indicates if the policy is approved. Default is False.

Response object: Returns the newly created workspace object.

Sample python code

```
  name = 'test'
  scope_id = '5ce480cc497d4f1b4b9a9e8d'
  filter_id = '5ce480cd497d4f1b4b9a9ea4'
  application = {
      'app_scope_id': scope_id,
      'name': name,
      'absolute_policies': [
          {
       # consumer/provider filter IDs can be ID of a cluster identified during automatic
policy discovery (formerly known as ADM),
       # user inventory filter or app scope.
              'provider_filter_id': filter_id,
              'consumer_filter_id': filter_id,
              'action': 'ALLOW',
       # ALLOW policy for TCP on port 80.
              'l4_params': [
                  {
                      'proto': 6, # TCP
                      'port': [80, 80],  # port range
                  }
              ],
          }
      ],
      'catch_all_action': 'ALLOW'
  }
  restclient.post('/applications', json_body=json.dumps(application))
```

Import a New Version

Imports policies and creates a new v* version for the workspace (“application”).

`POST /openapi/v1/applications/{application_id}/import`

The parameters are the same as the create workspace endpoint.

Response object: Returns the workspace object.

Validate a Set of Policies

Validates a set of policies without creating a new version.

`POST /openapi/v1/applications/validate_policies`

An *app_scope_id* is required. The rest of the parameters are the same as the create workspace endpoint.

Response object:

Attribute	Type	Description
valid	boolean	Indicates if the policies are valid
errors	array	If invalid, details about the errors

Delete a Workspace

Removes a workspace (“application”).

`DELETE /openapi/v1/applications/{application_id}`

Enforcement must be disabled on the workspace before it can be deleted.

If the workspace, or its clusters, are used on by other Applications (via a Provided Service relationship) this endpoint will return `422 Unprocessable Entity`. The returned Error object will contain a `details` attribute with the count of dependent objects along with the ids of the first 10 of each type. This information can be used to locate and remove the blocking dependencies.

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Response object: None

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
restclient.delete('/applications/%s' % application_id)
```

Update a Workspace

This end point updates an existing workspace (“application”).

`PUT /openapi/v1/applications/{application_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

The JSON query body contains the following keys

Name	Type	Description
name	string	(optional) The updated name for the workspace.
descrip	string	(optional) The updated description for the workspace.

Name	Type	Description
primary	string	(optional) Set to ‘true’ to make the workspace primary. Set to ‘false’ to make the workspace secondary.

Response object: The updated workspace object for the specified ID.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
req_payload = {
      'name': 'Updated Name',
      'description': 'Updated Description',
      'primary': 'true'
}
resp = restclient.put('/applications/%s' % application_id,
                      json_body=json.dumps(req_payload))
```

Retrieve Workspace Details

This endpoint returns a full export JSON file for the workspace. This will include policy and cluster definitions.

`GET /openapi/v1/applications/{application_id}/details`

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.
version	string	(optional) A version in the form of ‘v10’ or ‘p10’, defaults to ‘latest’.

Response object: Returns the clusters and policies for the given workspace version.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
# For v* version v10 and for p* version p10
version = 'v10'
resp = restclient.get('/applications/%s/details?version=%s' % (application_id, version))
```

List Workspace Versions

This endpoint will return a list of all the versions for a given workspace.

`GET /openapi/v1/applications/{application_id}/versions`

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Name	Type	Description
created_before	integer	(optional) For pagination, set to 'created_at' of the last version from previous response.
limit	integer	(optional) Max results to return, default is 50.

Response object: An array of objects with the following attributes:

Attribute	Type	Description
version	string	A version in the form of 'v10' or 'p10'.
created_at	integer	Unix timestamp of when the workspace was created.
description	string	User provided description.
name	string	Displayed name.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
created_before = 1612325705
limit = 10
resp = restclient.get('/applications/%s/versions?created_before=%s&limit=%s' %
                      (application_id, created_before, limit))
```

Delete Workspace Version

This endpoint will remove the given version including clusters and policies. Enforced or Analyzed versions can not be deleted. If members are referenced by another workspace, through an external policy, the response will return error with a list of the references.

`DELETE /openapi/v1/applications/{application_id}/versions/{version}`

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.
version	string	A version in the form of 'v10' or 'p10'.

Response object: None

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
version = 'v10'
resp = restclient.delete('/applications/%s/versions/%s' %
                         (application_id, version))
```

Compare Workspace versions

This endpoint computes the difference between the provided workspace versions. It will return the added, removed and optionally the unchanged policies. Cluster changes are included if the cluster is present in both versions, defined by a matching consistent_uuid, and the query has changed.

```
GET /openapi/v1/applications/{application_id}/version_diff
```

Parameters: The request URL contains the following parameters

Name	**Type**	**Description**
application_id	string	The unique identifier for the workspace.
base_version	string	Full version, for example 'v10' or 'p10'.
draft_version	string	Full version, for example 'v10' or 'p10'.
include_unchanged	boolean	Default is false. Returns unchanged policies in the response.

Response object: Returns an object with the following attributes:

Attribute	Type	Description
clusters	array	The clusters that have changed between the versions.
policies	array	The policies that have changed between the versions.

Analyze latest policies

Enable analysis on the latest set of policies in the workspace.

```
POST /openapi/v1/applications/{application_id}/enable_analysis
```

Parameters: The request URL contains the following parameters

Name	**Type**	**Description**
application_id	string	The unique identifier for the workspace.

Parameters: The optional JSON query body contains the following keys

Name	**Type**	**Description**
action_note	string	(optional) Reason for the publish policies action.
name	string	(optional) Name for the published policy version.

Name	Type	Description
description	string	(optional) description for the published policy version.

Response object: Returns an object with the following attributes:

Attribute	Type	Description
data_set	object	JSON object representation of the data set.
analyzed_policy_version	integer	The analyzed p* version of the workspace.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
req_payload = {
  'action_note': 'Policy analysis',
  'name': 'Test run 1',
  'description': 'New workloads added.'
}
resp = restclient.post('/applications/%s/enable_analysis' % application_id,
                       json_body=json.dumps(req_payload))
```

Disable policy analysis on a single workspace

Disable policy analysis on the workspace.

`POST /openapi/v1/applications/{application_id}/disable_analysis`

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Response object: Returns an object with the following attributes:

Attribute	Type	Description
data_set	object	JSON object representation of the data set.
analyzed_policy_version	integer	Last analyzed p* version of the workspace.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
resp = restclient.post('/applications/%s/disable_analysis' % application_id)
```

Enforce a single workspace

Enable enforcement on the latest set of policies in the workspace.

```
POST /openapi/v1/applications/{application_id}/enable_enforce
```

Warning New host firewall rules will be inserted and any existing rules will be deleted on the relevant hosts.

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.
version	string	(optional) The policy version to enforce.

If a version is not provided the latest policies of the workspace will be enforced. versions is preferred to be of the form ‘p*’, if just an integer is provided the corresponding ‘p*’ version will be enforced.

Response object: Returns an object with the following attributes:

Name	Type	Description
epoch	string	Unique identifier for the latest enforcement profile.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
req_payload = {
  'version': 'p10'
}
resp = restclient.post('/applications/%s/enable_enforce' % application_id,
                       json_body=json.dumps(req_payload))
```

Disable enforcement for a single workspace

Disable enforcement on the workspace.

```
POST /openapi/v1/applications/{application_id}/disable_enforce
```

Warning New host firewall rules will be inserted and any existing rules will be deleted on the relevant hosts.

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Response object: Returns an object with the following attributes:

Name	Type	Description
epoch	string	Unique identifier for the latest enforcement profile.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
resp = restclient.post('/applications/%s/disable_enforce' %
                       application_id)
```

Initiate Automatic Policy Discovery

Automatically discover policies for the workspace. (Formerly known as “submitting an ADM run”).

`POST /openapi/v1/applications/{application_id}/submit_run`

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Parameters: The JSON query body contains the following keys

Name	Type	Description
start_time	string	Start time of the input time interval for an automatic policy discovery run.
end_time	string	End time of the input time interval for an automatic policy discovery run.
clustering_granularity	string	(optional) Cluster Granularity allows the user to have a control on the size of the clusters generated by automatic policy discovery. Expected values: VERY_FINE, FINE, MEDIUM, COARSE, or VERY_COARSE
port_generalization	string	(optional) Port Generalization controls the level of statistical significance required when performing port generaliza- tion. Expected values: DISABLED, CONSERVATIVE, MODERATE, AGGRESSIVE, or VERY_AGGRESSIVE

Name	Type	Description
policy_compression	string	(optional) Policy Compression when enabled, policies that are sufficiently frequent, i.e. they use the same provider port, among the generated clusters inside a workspace may be 'factored out' to the parent, that is, replaced with one or more policies applicable to the entire parent scope. Expected values: DISABLED, CONSERVATIVE, MODERATE, AGGRESSIVE, or VERY_AGGRESSIVE
auto_accept_policy_connectors	boolean	(optional) Auto Accept Policy Connectors any outgoing policy requests created during the automatic policy discovery will be auto accepted.
enable_exclusion_filter	boolean	(optional) Enable exclusion filter option provides the flexibility to ignore all con- versations matching any of the user defined exclusion filters (if any). For more information, see Exclusion Filters.
enable_default_exclusion_filter	boolean	(optional) Enable default exclusion filter option provides the flexibility to ignore all conversations matching any of the default exclusion filters (if any). For more information, see Default Exclusion Filters for more info.
enable_service_discovery	boolean	(optional) When Enable service discovery on agent is set, ephemeral port-range in- formation regarding services present on the agent node are reported. Policies are then generated based on the reported port-range information.
carry_over_policies	boolean	(optional) When Carry over Approved Policies is set, all the policies that are marked as approved by the user via UI or OpenAPI will be preserved.

Name	Type	Description
skip_clustering	boolean	(optional) When Skip clustering and only generate policies is set, no new clusters are generated, and policies are generated from any existing approved clus- ters or inventory filters and otherwise involve all workloads in the scope.
deep_policy_generation	boolean	(Optional) You can generate policies for a branch of the scope tree rather than for a single scope. For more information, see Discover Policies for One Scope or for a Branch of the Scope Tree, on page 435 and subtopic.
use_default_config	boolean	(optional) When this option is set, automatic policy discovery will use the Default Policy Discovery Config instead of the previous run config. For more information, see Default Policy Discovery Config.

Note Unspecified optional parameter default values will be taken from the previous automatic policy discovery run config if automatic policy discovery was performed earlier in the workspace or else the default values will be taken from the Default Policy Discovery Config.

Response object: Returns an object with the following attributes:

Name	Type	Description
message	string	Message regarding success/failure of automatic policy discovery run.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
req_payload = {
      'start_time': '2020-09-17T10:00:00-0700',
      'end_time': '2020-09-17T11:00:00-0700',
      # Optional Parameters.
      'clustering_granularity': 'FINE',
      'port_generalization': 'AGGRESSIVE',
      'policy_compression': 'AGGRESSIVE',
      'auto_accept_policy_connectors': False,
      'enable_exclusion_filter': True,
      'enable_default_exclusion_filter': True,
      'enable_service_discovery': True,
      'carry_over_policies': True,
      'skip_clustering': False,
        'deep_policy_generation': True,
        'use_default_config': False
}
resp = restclient.post('/applications/%s/submit_run' % application_id,
                       json_body=json.dumps(req_payload))
```

Get Status of a Policy Discovery Run

Query the status of an automatic policy discovery run in the workspace.

```
GET /openapi/v1/applications/{application_id}/adm_run_status
```

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

Response object: Returns an object with the following attributes:

Name	Type	Description
status	string	Status of the automatic policy discovery run. Values: PENDING, COMPLETE, or FAILED

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
resp = restclient.get('/applications/%s/adm_run_status' % application_id)
```

Policies

This set of APIs can be used to manage add, edit or delete Policies. `version` parameter is required for create and update catch all actions. They require the `user_role_scope_management` capability associated with the API key.

Policy object

The policy object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the policy.
application_id	string	The id for the workspace to which the policy belongs.
consumer_filter_id	string	ID of a defined filter. Currently, any cluster, user defined filter or scope can be used as the consumer of a policy.

Attribute	Type	Description
provider_filter_id	string	ID of a defined filter. Currently, any cluster, user defined filter or scope can be used as the provider of a policy.
version	string	Indicates the version of the workspace to which the policy belongs.
rank	string	Policy rank, possible values: DEFAULT, ABSOLUTE or CATCHALL.
policy_action	string	Possible values can be ALLOW or DENY. Indicates whether traffic should be al- lowed or dropped for the given service port/protocol between the consumer and provider.
priority	integer	Used to sort policy.
l4_params	array of l4params	List of allowed ports and protocols.

L4Params object attributes:

Name	Type	Description
proto	integer	Protocol Integer value (NULL means all protocols).
port	array	Inclusive range of ports. eg [80, 80] or [5000, 6000].
description	string	Short string about this proto and port.
approved	boolean	If the policy has been approved by the user.

Get Policies

This endpoint returns a list of policies in a particular workspace. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/applications/{application_id}/policies
```

Parameters: The request URL contains the following parameters

Name	Type	Description
version	string	Indicates the version of the workspace from which to get the policies.
consumer_filter_id	string	(optional) Filters the output by the consumer filter id.
provider_filter_id	string	(optional) Filters the output by the consumer filter id.

Policy IDs can change from version to version. To obtain the list of policies from a published version, the version number should be prefixed with a 'p'. For example, to fetch all the policies in published version 3 we can perform a request such as:

```
GET /openapi/v1/applications/{application_id}/policies?version=p3
```

Returns an object of all policies in this particular workspace as shown below

```
{
  absolute_policies: [ ... ],
  default_policies: [ ... ],
  catch_all_action:
}
```

Sample Python code

```
application_id = '5f88c996755f023f3bafe163'
restclient.get('/applications/%s/policies' % application_id, params={'version': '1'})
```

Get Default Policies

This endpoint returns a list of Default policies for a given workspace. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/applications/{application_id}/default_policies
```

Parameters:

Name	Type	Description
id	string	Unique identifier for the policy.
version	string	Indicates the version of the workspace for which to get the policies.
limit	integer	Limits the number of policies per request.
offset	integer	(optional) Offset number received from previous response, should always be used along with `limit`.

Name	Type	Description
consumer_filter_id	string	(optional) Filters the output by the consumer filter id.
provider_filter_id	string	(optional) Filters the output by the provider filter id.

Returns a list of default policies for the provided version of this workspace. The response contains the requested number of polices and an `offset`, to get the next set policies use this `offset` in the subsequent requests. Absence of an `offset` in the response indicates that all the policies are already retrieved.

Sample Python code

```
  application_id = '5f88c996755f023f3bafe163'
  restclient.get('/applications/%s/default_policies' % application_id, params={'version':
'1', 'limit': 3, 'offset': 3})
```

Sample response

```
    {
      "results": [
      PolicyObject4,
      PolicyObject5,
      PolicyObject6
      ],
      "offset": 6
    }
```

Get Absolute Policies

This endpoint returns a list of Absolute policies in a given workspace. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/applications/{application_id}/absolute_policies
```

Parameters:

Name	Type	Description
version	string	Indicates the version of the workspace from which to get the policies.
limit	integer	Limits the number of policies per request.
offset	integer	(optional) Offset number received from previous response, should always be used along with `limit`.
consumer_filter_id	string	(optional) Filters the output by the consumer filter id.
provider_filter_id	string	(optional) Filters the output by the provider filter id.

Returns a list of absolute policies in the provided version of this workspace. The response contains the requested number of polices and an `offset`, to get the next set policies use this `offset` in the subsequent requests. Absence of an `offset` in the response indicates that all the policies are already retrieved.

Sample Python code

```
  application_id = '5f88c996755f023f3bafe163'
  restclient.get('/applications/%s/absolute_policies' % application_id, params={'version':
 '1', 'limit': 3})
```

Sample response

```
    {
      "results": [
      PolicyObject1,
      PolicyObject2,
      PolicyObject3
      ],
      "offset": 3
    }
```

Get Catch All Policies

This endpoint returns a Catch All policy for a given workspace. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/applications/{application_id}/catch_all
```

Parameters:

Name	Type	Description
version	string	Indicates the version of the workspace from which to get the policies.

Returns a single policy object representing the catch all policy of the given version of the workspace.

Sample Python code

```
  application_id = '5f88c996755f023f3bafe163'
  restclient.get('/applications/%s/catch_all' % application_id, params={'version': '1'})
```

Get Specific Policy

This endpoint returns an instance of a policy.

```
GET /openapi/v1/policies/{policy_id}
```

Returns the policy object associated with the specified ID.

Sample Python code

```
  policy_id = '5f88ca1e755f0222f85ce85c'
  restclient.get('/policies/%s' % policy_id)
```

Search for a Specific Policy With Policy Identifier

This endpoint searches for the specified policy using Policy Identifier Parameters as a composite key.

```
POST /openapi/v1/policies/search
```

The query body consists of a JSON body with the following schema:

Name	Type	Description
application_id	string	The ID of the application workspace.
policy_identifier	object	Fields that make up the consistent policy identifier.

The policy identifier fields are made up using the following schema:

Name	Type	Description
version	string	(optional) Indicates the version of the application for which to get the policies; defaults to the latest 'v' version of the application when left unspecified.
consumer_consistent_uuid	string	Consistent UUID of the consumer or source.
provider_consistent_uuid	string	Consistent UUID of the provider or destination.
rank	string	Policy rank has to be one of "DEFAULT" or "ABSOUTE".
action	string	Policy action has to be one of "ALLOW" or "DENY".
priority	integer	Priority value for the policy.
protocol	integer	IP protocol number (0-255) for the .
start_port	integer	(optional) Start of port range (0-65535); defaults to 0 when unspecified.
end_port	integer	(optional) End of port raneg (0-65535); defaults to 65535 if start_port is 0 or else to the start_prot.

Sample Python code

```
application_id = '5f88ca1e755f0222f85ce85c'
consumer_id = '5f88ca1e755f0222f85ce85d'
provider_id = '5f88ca1e755f0222f85ce85d'
rank = 'DEFAULT'
action = 'ALLOW'
priority = 100
protocol = 6
start_port = 80
version = 'p3'
```

```
  req_body = f'''
  {{
      "application_id": "{application_id}",
      "policy_identifier": {{
          "consumer_consistent_uuid": "{consumer_id}",
          "provider_consistent_uuid": "{provider_id}",
          "rank": "{rank}",
          "action": "{action}",
          "priority": {priority},
          "protocol": "{protocol}",
          "start_port": "{start_port}",
          "version": "{version}"
      }}
  }}'''
  restclient.post('/policies/search', json_body=req_body)
```

Create a Policy

This endpoint is used to create new policies.

`POST /openapi/v1/applications/{application_id}/policies`

Parameters:

Attribute	Type	Description
consumer_filter_id	string	ID of a defined filter.
provider_filter_id	string	ID of a defined filter.
version	string	Indicates the version of the workspace in which to update the policies.
rank	string	values can be DEFAULT, ABSOLUTE or CATCHALL for ranking
policy_action	string	values can be ALLOW or DENY: means whether we should allow or drop traffic from consumer to provider on the given service port/protocol
priority	integer	Used to sort policy.

Sample Python code

```
  req_payload = {
    "version": "v1",
    "rank" : "DEFAULT",
    "policy_action" : "ALLOW",
    "priority" : 100,
    "consumer_filter_id" : "123456789",
    "provider_filter_id" : "987654321",
  }
  resp = restclient.post('/openapi/v1/applications/{application_id}/policies',
json_body=json.dumps(req_payload))
```

Create a Default Policy

This endpoint is used to create new default policies. This endpoint creates a default policy similar to the create a policy endpoint.

```
POST /openapi/v1/applications/{application_id}/default_policies
```

Create an Absolute Policy

This endpoint is used to create new absolute policies. This endpoint creates a absolute policy similar to the create a policy endpoint.

```
POST /openapi/v1/applications/{application_id}/absolute_policies
```

Update a Policy

This endpoint updates a policy.

```
PUT /openapi/v1/policies/{policy_id}
```

Parameters:

Attribute	Type	Description
consumer_filter_id	string	ID of a defined filter.
provider_filter_id	string	ID of a defined filter.
policy_action	string	Possible values can be ALLOW or DENY. Indicates whether traffic should be al- lowed or dropped for the given service port/protocol between the consumer and provider.
priority	integer	Used to sort policy priorities

Returns the modified policy object associated with specified ID.

Update a Catch All

This endpoint updates Catch All for a particular workspace.

```
PUT /openapi/v1/applications/{application_id}/catch_all
```

Parameters:

Attribute	Type	Description
version	string	Indicates the version of the workspace in which to update the policies.

Attribute	Type	Description
policy_action	string	Possible values can be ALLOW or DENY. Indicates whether traffic not matching any of the policies in this workspace will be allowed or dropped.

Adding Service Ports to a Policy

This endpoint is used to create service ports for a specific policy.

```
POST /openapi/v1/policies/{policy_id}/l4_params
```

Parameters:

Attribute	Type	Description
version	string	Indicates the version of the workspace from which to get the policies.
start_port	integer	Start port of the range.
end_port	integer	End port of the range.
proto	integer	Protocol Integer value (NULL means all protocols).
description	string	(optional) Short string about this proto and port.

Updating Service Ports of a Policy

This endpoint updates the specified service port of a Policy.

```
PUT /openapi/v1/policies/{policy_id}/l4_params/{l4_params_id}
```

Parameters:

Attribute	Type	Description
approved	bool	Marks the policy as approved.

Deleting Service Ports of a Policy

This endpoint deletes the specified service port of a policy. (Optional) See Exclusion Filters for more details.

```
DELETE /openapi/v1/policies/{policy_id}/l4_params/{l4_params_id}
```

Parameters:

Attribute	Type	Description
create_exclusion_filter	bool	(Optional) If true, creates an exclusion filter matching the policy. Flows matching this filter will be excluded from future automatic policy discovery runs. See Exclusion Filters for more details.

Deleting a Policy

This endpoint deletes the specified Policy. No exclusion filters are created.

```
DELETE /openapi/v1/policies/{policy_id}
```

Deleting a Policy with Identifier

This endpoint deletes the specified policy using Policy Identifier Parameters. No exclusion filters are created.

```
DELETE /openapi/v1/policies/destroy_with_identifier
```

The query body consists of a JSON body with the following schema:

Name	Type	Description
application_id	string	The ID of the application workspace.
policy_identifier	object	Fields that make up the consistent policy identifier.

The policy identifier fields are made up using the following schema:

Name	Type	Description
version	string	(optional) 'v' version of the application workspace in which to perform the delete operation; defaults to the latest 'v' version of the workspace when unspecified.
consumer_consistent_uuid	string	Consistent UUID of the consumer or source
provider_consistent_uuid	string	Consistent UUID of the provider or destination
rank	string	Policy rank has to be one of “DEFAULT” or “ABSOUTE”
action	string	Policy action has to be one of “ALLOW” or “DENY”
priority	integer	Priority value for the policy

Name	Type	Description
protocol	integer	IP protocol number (0-255) for the policy
start_port	integer	(optional) Start of port range (0-65535); defaults to 0 when unspecified
end_port	integer	(optional) End of port raneg (0-65535); defaults to 65535 if start_port is 0 or else to the start_prot

Sample Python code

```
application_id = '5f88ca1e755f0222f85ce85c'
consumer_id = '5f88ca1e755f0222f85ce85d'
provider_id = '5f88ca1e755f0222f85ce85d'
action = 'ALLOW'
rank = 'DEFAULT'
protocol = 6
start_port = 80
priority = 100
version = '5'

req_body = f'''
{{
    "application_id": "{application_id}",
    "policy_identifier": {{
        "consumer_consistent_uuid": "{consumer_id}",
        "provider_consistent_uuid": "{provider_id}",
        "rank": "{rank}",
        "priority": {priority},
        "action": "{action}",
        "protocol": "{protocol}",
        "start_port": "{start_port}",
        "version": "{version}"
    }}
}}'''
restclient.delete('/policies/destroy_with_identifier', json_body=req_body)
```

Policy Quick Analysis

This endpoint can be used to find matching set of policies for any hypothetical flow against the analyzed/enforced polices in a root scope. For more details refer Quick Analysis

This API is only available to users with a minimum read access to root scope and requires `app_policy_management` capability associated with the API key.

`POST /openapi/v1/policies/{rootScopeID}/quick_analysis`

The query body consists of a JSON body with the following schema:

Name	Type	Description
consumer_ip	string	IP Address of the client / consumer.

Name	Type	Description
provider_ip	string	IP Address of the server / provider.
provider_port	integer	(optional) Provider Port, only relevant for TCP or UDP flows.
protocol	string	Protocol of the flow, e.g. TCP.
analysis_type	string	Analysis type can be either **analyzed** or **enforced**. Analysis type “analyzed” makes the flow decision by matching the flow against all the analyzed polices in the root scope. Analysis type “enforced” makes the flow decision by matching the flow against all enforced policies in the root scope.
application_id	string	(optional) The ID of the primary workspace, always accompanied by the workspace ‘v’ version, if specified, makes the flow decision by using the policies from the specified version along with analyzed/enforced policies from other workspaces in the root scope. If this field is skipped, the flow decision is made by considering all the analyzed/enforced polices in the root scope.
version	integer	(optional) The ‘v’ version of the workspace mentioned above. This must be specified if the application_id is specified and must be skipped otherwise.

Sample request

The body of the request should be a JSON formatted query.

An example of a query body where the flow decision is based on all analyzed polices:

```
    req_payload = {
        "consumer_ip": "4.4.1.1",
        "provider_ip": "4.4.2.1",
        "provider_port": 9081,
        "protocol": "TCP",
        "analysis_type": "analyzed"
    }
    resp = restclient.post('/openapi/v1/policies/{rootScopeID}/quick_analysis',
json_body=json.dumps(req_payload))
```

An example of a query body where the flow decision is based on the policies from the workspace's ‘v’ version along with the analyzed polices from all other workspaces in the root scope:

```
    req_payload = {
        "consumer_ip": "4.4.1.1",
        "provider_ip": "4.4.2.1",
        "provider_port": 9081,
        "protocol": "TCP",
        "analysis_type": "analyzed",
        "application_id": "5e7e5f56497d4f0bc26c7bb3",
        "version": 1
    }
    resp = restclient.post('/openapi/v1/policies/{rootScopeID}/quick_analysis',
json_body=json.dumps(req_payload))
```

Sample response

The response is a JSON object in the body with the following properties:

Keys	Values
policy_decision	The decision of the hypothetical flow whether is allowed or denied.
outbound_policy	The policy on the consumer thats allowing/denying the outgoing traffic
inbound_policy	The policy on the provider thats allowing/denying the incoming traffic

```
    {
        "policy_decision": "ALLOW",
        "outbound_policy": {
            "policy_rank": "DEFAULT",
            "start_port": 9082,
            "l4_detail_id": "5e7e600f497d4f7341f4f6d0",
            "src_filter_id": "5e7e600e497d4f7341f4f459",
            "end_port": 9082,
            "cluster_edge_id": "5e7e600f497d4f7341f4f6d1",
            "dst_filter_id": "5e7d0efc497d4f44b6b09351",
            "action": "ALLOW",
            "protocol": "TCP",
            "app_scope_id": "5e7e5f3a497d4f0bc26c7bb0"
        },
        "inbound_policy": {
            "policy_rank": "DEFAULT",
            "start_port": 9082,
            "l4_detail_id": "5e7e600f497d4f7341f4f6d0",
            "src_filter_id": "5e7e600e497d4f7341f4f459",
            "end_port": 9082,
            "cluster_edge_id": "5e7e600f497d4f7341f4f6d1",
            "dst_filter_id": "5e7d0efc497d4f44b6b09351",
            "action": "ALLOW",
            "protocol": "TCP",
            "app_scope_id": "5e7e5f3a497d4f0bc26c7bb0"
        }
    }
```

Policy Statistics

This endpoint returns the number of packets, bytes and conversations observed for a policy over a time interval. A conversation can be broadly described as a flow observation matching a policy that is aggregated with a granularity of one hour. The number of conversations measured for a given policy within one hour represents the number of distinct pairs of consumer and provider inventory items that have communicated over the network during that one hour.

Although this endpoint accepts Policy Identifier Parameters as input, it is strongly recommended to use policy and L4 parameter IDs from an published version of the workspace.

Note After a new version of the application workspace is published, it can take up to 6 hours before results become available. All the timestamp resolutions will also have a minimum granularity of 6 hours.

To get the policy statistics for a policy across enforced versions of an application workspace the URL path is:

```
POST /openapi/v1/policies/stats/enforced
```

To get the policy statistics for a policy across analyzed versions of an application workspace the URL path is:

```
POST /openapi/v1/policies/stats/analyzed
```

The query body consists of a JSON body with the following schema:

Table 46:

Name	Type	Description
application_id	string	The ID of the application workspace.
t0	string	The beginning of the time interval in RFC-3339 format.
t1	string	(optional) The end of the time interval in RFC-3339 format; defaults to current time if left unspecified.
policy_id	string	The ID of the policy; not required if policy identifier is present.
l4_param_id	string	The ID of the l4 parameter; not required if the policyidentifier is present, or for “CATCH_ALL” policies.
policy_identifier	object	Fields that make up the consistent policy identifier.

The policy identifier fields are made up using the following schema:

Name	Type	Description
consumer_consistent_uuid	string	Consistent UUID of the consumer or source.
provider_consistent_uuid	string	Consistent UUID of the provider or destination.
rank	string	Policy rank has to be one of “DEFAULT” or “ABSOUTE”.
action	string	Policy action has to be one of “ALLOW” or “DENY”.
priority	integer	Priority value for the policy.
protocol	integer	IP protocol number (0-255) for the policy.
start_port	integer	(optional) Start of port range (0-65535); defaults to 0 when unspecified
end_port	integer	(optional) End of port raneg (0-65535); defaults to 65535 if start_port is 0 or else to the start_prot.

Sample Python code

```
application_id = '5f88ca1e755f0222f85ce85c'
consumer_id = '5f88ca1e755f0222f85ce85d'
provider_id = '5f88ca1e755f0222f85ce85d'
action = 'ALLOW'
rank = 'DEFAULT'
protocol = 6
start_port = 80
priority = 100

req_body = f'''
{{
    "application_id": "{application_id}",
    "t0":"2022-07-06T00:00:00Z",
    "t1":"2022-07-28T19:00:00Z",
    "policy_identifier": {{
        "consumer_consistent_uuid": "{consumer_id}",
        "provider_consistent_uuid": "{provider_id}",
        "rank": "{rank}",
        "priority": {priority},
        "action": "{action}",
        "protocol": "{protocol}",
        "start_port": "{start_port}"
    }}
}}'''
restclient.post('/policies/stats/analyzed', json_body=req_body)

# For CATCH_ALL policies:
root_app_scope_id = '6f88ca1e755f0222f85ce85e'
```

```
rank = 'CATCH_ALL'
action = 'DENY'
req_body = f'''
{{
    "application_id": "{application_id}",
    "t0":"2022-07-06T00:00:00Z",
    "t1":"2022-07-28T19:00:00Z",
    "policy_identifier": {{
        "consumer_consistent_uuid": "{root_app_scope_id}",
        "provider_consistent_uuid": "{root_app_scope_id}",
        "rank": "{rank}",
        "action": "{action}"
    }}
}}'''

restclient.post('/policies/stats/analyzed', json_body=req_body)
```

Sample response

The response is a JSON object in the body with the following properties.

Table 47:

Keys	Values
conversation_count	The number of conversations observed for the specified duration and policy.
packet_count	The number of packets observed for the specified duration and policy.
byte_count	The number of bytes observed for the specified duration and policy.
first_seen_at	The timestamp (in RFC-3339 format) when we first observed flows for this policy.
last_seen_at	The timestamp (in RFC-3339 format) when we last observed flows for this policy.
agg_start_version	The earliest published version of this policy on record from time t0 onwards.
agg_start_time	The timestamp the agg_start_version was published.

```
  {
    "conversation_count": 72,
    "packet_count": 800,
    "byte_count": 1960,
    "first_seen_at": "2022-09-09T11:00:00.000Z",
    "last_seen_at": "2022-09-09T11:00:00.000Z",
    "agg_start_version": 4,
    "agg_start_time": "2022-08-10T23:00:00.000Z"
  }
```

Unused Policies

This endpoint returns the policy identifiers in an published workspace for which no conversations are observed over a specified time interval.

Policy Identifier

All policies and ADM-generated clusters can change their IDs across application workspace versions even if the underlying filter queries or policy port and protocol do not change. In order to keep track of flow hit counts for a particular policy across workspace versions we use consistent UUIDs for the filters that do not change across versions and a composite key called the *policy identifier* comprising the provider and consumer consistent UUIDs along with rank, action, priority, port and protocol.

Thus, policy identifiers serve as a composite key that can both identify and describe the important aspects of a policy across application workspace versions, whereas policy IDs (such as those used in the regular CRUD endpoints) can change across versions of the workspace.

Note Provider/Consumer consistent UUIDs and policy identifiers do not uniquely identify a filter or policy as they are shared across different application workspace versions.

To perform CRUD operations on a particular cluster or policy it is recommended to resolve the identifier to a concrete policy for a specific application workspace version the search endpoint.

Regular CRUD operations can be performed using policy IDs whereas only Policy Statistics and Destroy With Identifier accept the policy identifier as input. This is mainly for convenience to avoid the intermediate call to search, and instead directly validate and destroy all unused policies in a workspace.

It is strongly recommended that policy and filter IDs are used wherever possible and to not manually generate policy identifiers for the Policy Statistics or Destroy With Identifier API endpoints. However, the following example illustrates one way of generating policy identifiers from the policy object:

```
resp = restclient.get(f'/policies/631b0590497d4f09b537b973')
policy = resp.json() # policy object
policy_identifer = {
    'consumer_consistent_uuid': policy['consumer_filter']['consistent_uuid'],
    'provider_consistent_uuid': policy['provider_filter']['consistent_uuid'],
    'rank': policy['rank'],
    'action': policy['action'],
    'priority': policy['priority'],
    'protocol': policy['l4_params'][0]['proto'],
    'start_port': policy['l4_params'][0]['port'][0],
    'end_port': policy['l4_params'][0]['port'][1]
}
```

Note After a new version of the application workspace is published it can take up to 6 hours before results become available. All the timestamp resolutions will also have a minimum granularity of 6 hours.

To get the unused policies across enforced versions of an application workspace the URL path is:

```
POST /openapi/v1/unused_policies/{application_id}/enforced
```

To get the unused policies across analyzed versions of an application workspace the URL path is:

```
POST /openapi/v1/unused_policies/{application_id}/analyzed
```

The query body consists of a JSON body with the following schema:

Name	Type	Description
t0	string	The beginning of the time interval in RFC-3339 format.
t1	string	(Optional) The end of the time interval in RFC-3339 format; defaults to current time if left unspecified.
limit	integer	(Optional) Limits the number of policies per request.
offset	string	(Optional) Offset received from previous response – useful for pagination.

```
application_id = '62e1915e755f026f2bcdd805'
resp = restclient.post(f'/unused_policies/{application_id}/analyzed', json_body=f'''
{{
    "t0":"2022-07-06T00:00:00Z",
    "t1":"2022-07-28T19:00:00Z"
}}''')'
```

Sample response

The response is a JSON object in the body with the following properties.

Keys	Values
application_id	The ID of the application workspace.
policy_identifiers	A list of policy identifiers of the unused policies.
offset	Response offset to be passed for the next page of results.

To generate the next page of results, take the object received by the response in offset and pass it as the value for the offset of the next query.

```
{
  "application_id": "63054a97497d4f2dc113a9c4",
  "policy_identifiers": [
    {
      "consumer_consistent_uuid": "62fff45c497d4f5064973c4d",
      "provider_consistent_uuid": "62fff45c497d4f5064973c4d",
      "version": "p1",
      "rank": "DEFAULT",
      "policy_action": "ALLOW",
      "priority": 10,
      "proto": 6,
      "start_port": 10000,
      "end_port": 10000,
      "agg_start_version": 1,
      "agg_start_time": "2022-08-10T23:00:00.000Z"
    },
    {
      "consumer_consistent_uuid": "62fff45c497d4f5064973c4d",
      "provider_consistent_uuid": "62fff45c497d4f5064973c4d",
      "version": "p1",
      "rank": "DEFAULT",
      "policy_action": "ALLOW",
      "priority": 10,
      "protocol": 6,
      "start_port": 10001,
      "end_port": 10001,
      "agg_start_version": 1,
      "agg_start_time": "2022-08-10T23:00:00.000Z"
    }
  ],
  "offset": "eyJvZmZzZXQiOjZ9"
}
```

Policy Templates

This set of APIs can be used to add, edit or delete Policy Templates and require the app_policy_management capability associated with the API key.

Get Policy Templates

This endpoint returns a list of policy templates for a particular root scope. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/application_templates?root_app_scope_id={root_app_scope_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
root_app_scope_id	string	The unique identifier of the root scope.

Response object: Returns a list of policy template objects for the specified root scope.

Sample python code

```
root_app_scope_id = '<root-app-scope-id>'
restclient.get('/application_templates?root_app_scope_id=%s' % root_app_scope_id)
```

Get Specific Policy Template

This endpoint returns an instance of policy templates.

```
GET /openapi/v1/application_templates/{template_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
template_id	string	The unique identifier for the policy template.

Response object: Returns the policy template object with the specified ID.

Sample python code

```
template_id = '<template-id>'
restclient.get('/application_templates/%s' % template_id)
```

Create a Policy Template

This endpoint is used to create a new policy template.

`POST /openapi/v1/application_templates`

The JSON request body contains the following keys

Attribute	Type	Description
name	string	Used as the name of the template during import.
description	string	(optional) Template description displayed during the apply process
parameters	parameters object	Template parameters, see below.
absolute_policies	array of policy objects	(optional) Array of absolute policies.
default_policies	array of policy objects	(required) Array of default policies, can be empty.

Response object: Returns the created policy template object.

Sample python code

```
root_app_scope_id = '<root-app-scope-id>'
payload = {'root_app_scope_id': root_app_scope_id,
           'name': "policy_name",
           'default_policies': [
              {
                'action': 'ALLOW',
                'priority': 100,
                'l4_params': [
                  {
                    'proto': 17,
                    'port': [80, 90]
                  }
                ]
              }
            ]
          }
restclient.post('/application_templates',
                json_body=json.dumps(payload))
```

Update a Policy Template

This endpoint updates a policy template.

```
PUT /openapi/v1/application_templates/{template_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
template_id	string	The unique identifier for the policy template.

The JSON request body contains the following keys

Attribute	Type	Description
name	string	(optional) Used as the name of the template during import.
description	string	(optional) Template description displayed during the apply process

Response object: Returns the modified policy template object with the specified ID.

Sample python code

```
new_name = <new-name>
payload = {'name': new_name}
template_id = '<template-id>'
restclient.post('/application_templates/%s' % template_id,
                json_body=json.dumps(payload))
```

Deleting a Policy Template

This endpoint deletes the specified policy template.

```
DELETE /openapi/v1/application_templates/{template_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
template_id	string	The unique identifier for the policy template.

Response object: None

Sample python code

```
template_id = '<template-id>'
restclient.delete('/application_templates/%s' % template_id)
```

Download a Policy Template

This endpoint downloads a policy template.

```
GET /openapi/v1/application_templates/{template_id}/download
```

Parameters: The request URL contains the following parameters

Name	Type	Description
template_id	string	The unique identifier for the policy template.

Response object: Returns the full policy template definition with the specified ID.

Sample python code

```
template_id = '<template-id>'
restclient.get('/application_templates/%s/download' % template_id)
```

Clusters

This set of APIs can be used to add, edit or delete Clusters, which are members of workspaces (“applications”). They require the `user_role_scope_management` capability associated with the API key.

Cluster object

The cluster object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the cluster.
consistent_uuid	string	An id that is consistent across automatic policy discovery runs.
application_id	string	The id for the workspace to which the cluster belongs.
version	string	The version of the workspace to which the cluster belongs
name	string	The name of the cluster.
description	string	The description of the cluster.
approved	boolean	If the cluster has been ‘approved’ by the user.
query	JSON	Filter (or match criteria) associated with the filter in conjunction with the filters of the parent scopes.
short_query	JSON	Filter (or match criteria) associated with the filter.
alternate_queries	array of queries	Alternate suggested queries generated by an automatic policy discovery run in dynamic mode.

Attribute	Type	Description
inventory	array of inventory	If requested, returns member inventory of the cluster including IP, hostname, vrf_id and uuid.

Get Clusters

This endpoint returns a list of clusters for a particular workspace ("application"). This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/applications/{application_id}/clusters
```

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The id for the workspace to which the cluster belongs.
version	string	Indications the version of the workspace for which to get the clusters.
include_inventory	boolean	Include the inventory of the clusters.

Response object: Returns an array of all clusters for this particular workspace and version.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
restclient.get('/applications/%s/clusters' % application_id)
```

Get Specific Cluster

This endpoint returns an instance of a cluster.

```
GET /openapi/v1/clusters/{cluster_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
cluster_id	string	Unique identifier for the cluster.
include_inventory	boolean	Include the inventory of the clusters.

Response object: Returns the cluster object associated for the specified ID.

Sample python code

```
cluster_id = '5d02d021497d4f0949ba74e4'
```

```
restclient.get('/clusters/%s' % cluster_id)
```

Create a Cluster

This endpoint is used to create a new cluster.

```
POST /openapi/v1/applications/{application_id}/clusters
```

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The id for the workspace to which the cluster belongs.

The JSON query body contains the following keys

Attribute	Type	Description
name	string	The name of the cluster.
version	string	Indicates the version of the workspace the cluster will be added to.
description	string	(optional) The description of the cluster.
approved	boolean	(optional) An approved cluster will not be updated during an automatic policy discovery run. Default false.
query	JSON	Filter (or match criteria) associated with the filter. Alternate Query Mode (also called Dynamic Mode) must be enabled on the workspace, otherwise ignored.
query	JSON	Filter (or match criteria) associated with the filter. Alternate Query Mode (also called Dynamic Mode) must be enabled on the workspace, otherwise ignored.
nodes	Array	List of ip addresses or endpoints. Will be used to create the query matching these ips unless a query is provided and the workspace is in Dynamic Mode.

Nodes object attributes:

Name	Type	Description
ip	string	IP address
name	string	(optional) The name of the node.
prefix_len	integer	(optional) Subnet mask.

Note The nodes will be used to create a query unless a query is provided and the workspace is in Dynamic Mode.

Response object: Returns the newly created cluster object.

Sample python code

```
application_id = '5d02b493755f0237a3d6e078'
payload = {
  'name': 'test_cluster',
  'version': 'v2',
  'description': 'basic granularity',
  'approved': False,
  'query': {
      'type': 'eq',
      'field': 'host_name',
      'value': 'centos6001'
  }
}
restclient.post('/applications/%s/clusters' % application_id)
```

Update a Cluster

This endpoint updates a cluster.

`PUT /openapi/v1/clusters/{cluster_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
cluster_id	string	Unique identifier for the cluster.

The JSON query body contains the following keys

Attribute	Type	Description
name	string	The name of the cluster.
description	string	(optional) The description of the cluster.
approved	boolean	An approved cluster will not be updated during an automatic policy discovery run.

Attribute	Type	Description
query	JSON	Filter (or match criteria) associated with the filter. Alternate Query Mode (also called Dynamic Mode) must be enabled on the workspace, otherwise ignored.

Response object: Returns the modified cluster object associated with specified ID.

Sample python code

```
cluster_id = '5d02d2a4497d4f5194f104ef'
payload = {
  'name': 'new_test_cluster',
}
restclient.put('/clusters/%s' % cluster_id, json_body=json.dumps(payload))
```

Deleting a Cluster

This endpoint deletes the specified Cluster. If the cluster is used by any policies the cluster will not be deleted and a list of dependents will be returned.

`DELETE /openapi/v1/clusters/{cluster_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
cluster_id	string	Unique identifier for the cluster.

Response object: None

Sample python code

```
cluster_id = '5d02d2a4497d4f5194f104ef'
restclient.delete('/clusters/%s' % cluster_id)
```

Conversations

Conversations are aggregated flows in the time range of an automatic policy discovery run where the consumer port is removed. More detailed description about the conversations can be found in Conversations.

This API enables you to search the conversations generated during an automatic policy discovery run for a given workspace. It requires `app_policy_management` capability associated with the API key to invoke this API.

Search Conversations in a Policy Discovery Run

This end point enables you to search the conversations in an automatic policy discovery run for a given workspace. You can also specify a subset of supported dimensions and metrics which you may want to see as part of the downloaded conversations. Optionally, you can query for a subset of conversations using filters on supported dimensions and metrics.

```
POST /openapi/v1/conversations/{application_id}
```

The query consists of a JSON body with the following keys.

Name	Type	Description
version	integer	Version of the automatic policy discovery run
filter	JSON	(optional) Query filter. If filter is empty (i.e. {}), then query matches all the conversations. More specific conversations can be downloaded using filters on supported dimensions and metrics. For the syntax on filters refer to Filters .
dimensions	array	(optional) List of dimensions to be returned for the downloaded conversations. The list of supported dimension can be found Supported dimensions .
metrics	array	(optional) List of metrics to be returned for the downloaded conversations. The list of supported metrics can be found Supported metrics .
limit	integer	(optional) Number of conversations to be returned in a single API response.
offset	string	(optional) Offset received from previous response – useful for pagination.

The body of the request should be a JSON formatted query. An example of a query body is shown below.

```
{
    "version": 1,
    "filter": {
        "type": "and",
        "filters":[
            {
                "type": "eq",
                "field": "excluded",
                "value": False
            },
            {
                "type": "eq",
                "field": "protocol",
                "value": "TCP"
            },
        ]
    },
    "dimensions": ["src_ip", "dst_ip", "port"],
    "metrics": ["byte_count", "packet_count"],
    "limit" : 2,
    "offset": <offset-object>
}
```

Response

The response is a JSON object in the body with the following properties.

Keys	Values
offset	Response offset to be passed for the next page of results
results	List of results

To generate the next page of results, take the object received by the response in `offset` and pass it as the value for the `offset` of the next query.

```
   req_payload = {"version": 1,
                  "limit": 10,
                  "filter": {"type": "and",
                      "filters": [
                          {"type": "eq", "field": "excluded", "value": False},
                          {"type": "eq", "field": "protocol", "value": "TCP"}
                       ]
                  }
    }

    resp = restclient.post('/conversations/{application_id}',
json_body=json.dumps(req_payload))
    print resp.status_code
    if resp.status_code == 200:
        parsed_resp = json.loads(resp.content)
        print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

Top N Conversations in a Policy Discovery Run

This end point enables you to search the top conversations for an automatic policy discovery run for a given workspace based on a metric and grouped by a dimension. The current supported metrics are Supported metrics and the current supported group by dimensions are Supported dimensions you can query for a subset of conversations using filters on supported dimensions and metrics. For example, you can search for the source IP address with the most byte traffic conversations using a query with the `src_ip` dimension with the `byte_count` metric.

```
POST /openapi/v1/conversations/{application_id}/topn
```

The query consists of a JSON body with the following keys.

Name	Type	Description
version	integer	Version of the automatic policy discovery run

Name	Type	Description
dimension	string	The dimension for the conversations to be grouped by for the top N query. Supported dimensions: src_ip, dst_ip
metric	string	The metric to be sorted by for the top N conversations. The list of supported metrics can be found Supported metrics .
filter	JSON	(optional) Query filter. If filter is empty (i.e. {}), then query matches all the conver- sations. More specific conversations can be downloaded using filters on supported dimensions and metrics. For the syntax on filters refer to Filters .
threshold	integer	Number of top N results to be returned in a single API response.

The body of the request should be a JSON formatted query. An example of a query body is shown below.

```
{
    "version": 1,
    "dimension": "src_ip",
    "metric": "byte_count",
    "filter": {
        "type": "and",
        "filters":[
            {
                "type": "eq",
                "field": "excluded",
                "value": False
            },
            {
                "type": "eq",
                "field": "protocol",
                "value": "TCP"
            },
        ]
    },
    "threshold" : 10
}
```

Response

The response is a JSON object in the body with the following properties.

Keys	Values
results	List with one JSON object with a results key and a value of a list of results objects with keys matching the query dimension and metric.

```
[ {"result": [
  {
    "byte_count": 1795195565,
    "src_ip": "192.168.1.6"
  },
  {
    "byte_count": 1781002379,
    "src_ip": "192.168.1.28"
  },
  ...
] } ]
```

```
    req_payload = {"version": 1, "dimension": "src_ip", "metric": "byte_count",
      "filter": {"type": "and",
        "filters": [
          {"type": "eq", "field": "excluded", "value": False},
          {"type": "eq", "field": "protocol", "value": "TCP"},
         {"type": "eq", "field": "consumer_filter_id", "value": "16b12a5614c5af5b68afa7ce"},

          {"type": "subnet", "field": "src_ip", "value": "192.168.1.0/24"}
        ]
      },
      "threshold" : 10
    }

    resp = restclient.post('/conversations/{application_id}/topn',
json_body=json.dumps(req_payload))
    print resp.status_code
    if resp.status_code == 200:
        parsed_resp = json.loads(resp.content)
        print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

Supported dimensions

Name	Type	Description
src_ip	string	IP address of the consumer
dst_ip	string	IP address of the provider
protocol	string	Protocol used in the communication. Ex: “TCP”, “UDP” etc.
port	integer	Port of the provider.
address_type	string	“IPv4” or “IPv6”

Name	Type	Description
consumer_filter_id	string	Cluster ID of the cluster if the consumer IP belongs to a cluster, else the Scope ID the consumer IP belongs to.
provider_filter_id	string	Cluster ID of the cluster if the provider IP belongs to a cluster, else the Scope ID the provider IP belongs to.
excluded	boolean	Whether this conversation is excluded while generating policies.
confidence	double	The confidence level of consumer and provider classification. The value varies from 0.0 to 1.0 with 1.0 being more con- fident about classification.

Supported metrics

Name	Type	Description
byte_count	integer	Total number of bytes in the conversation
packet_count	integer	Total number of packets in the conversation

Exclusion Filters

This set of APIs can be used to add, edit or delete Exclusion Filters and require the `user_role_scope_management` capability associated with the API key.

Exclusion Filters exclude flows from the automatic policy discovery clustering algorithm. See Exclusion Filters for more information.

Exclusion Filter object

The exclusion filter object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the cluster.
application_id	string	The id for the workspace to which the exclusion filter belongs.
version	string	The version of the workspace to which the exclusion filter belongs.

Attribute	Type	Description
consumer_filter_id	string	ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the consumer of a policy.
provider_filter_id	string	ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the provider of a policy.
proto	integer	Protocol Integer value (NULL means all protocols).
port	array	Inclusive range of ports. eg [80, 80] or [5000, 6000]. NULL means all ports.
updated_at	integer	Unix timestamp of when the exclusion filter was updated.

Get Exclusion Filters

This endpoint returns a list of exclusion filters for a particular workspace. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/applications/{application_id}/exclusion_filters
```

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.
version	string	Indicates the version of the workspace for which to get the exclusion filters.

Response object: Returns a list of exclusion filter objects for the specified workspace and version.

Sample python code

```
application_id = '<application-id>'
params = {'version': 'v10'}
restclient.get('/applications/%s/exclusion_filters' % application_id,
               params=params)
```

Get Specific Exclusion Filter

This endpoint returns an instance of an exclusion filters.

```
GET /openapi/v1/exclusion_filters/{exclusion_filter_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
exclusion_filter_id	string	The unique identifier for the exclusion filter.

Response object: Returns the exclusion filter object with the specified ID.

Sample python code

```
exclusion_filter_id = '<exclusion-filter-id>'
restclient.get('/exclusion_filters/%s' % exclusion_filter_id)
```

Create an Exclusion Filter

This endpoint is used to create a new exclusion filter.

```
POST /openapi/v1/applications/{application_id}/exclusion_filters
```

Parameters: The request URL contains the following parameters

Name	Type	Description
application_id	string	The unique identifier for the workspace.

The JSON request body contains the following keys

Attribute	Type	Description
version	string	The version of the workspace to which the exclusion filter belongs.
consumer_filter_id	string	(optional) ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the consumer of a policy.
provider_filter_id	string	(optional) ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the provider of a policy.
proto	integer	(optional) Protocol Integer value (NULL means all protocols).
start_port	integer	(optional) Start port of the range.
end_port	integer	(optional) End port of the range.

Missing optional parameters will be considered as wildcards (match any).

Response object: Returns the created exclusion filter object.

Sample python code

```
provider_filter_id = '<provider-filter-id>'
consumer_filter_id = '<consumer-filter-id>'
payload = {'version': 'v0',
           'consumer_filter_id': consumer_filter_id,
            'provider_filter_id': provider_filter_id,
            'proto': 6,
            'start_port': 800,
            'end_port': 1000}
application_id = '<application-id>'
restclient.post('/applications/%s/exclusion_filters' % application_id,
                json_body=json.dumps(payload))
```

Update an Exclusion Filter

This endpoint updates an exclusion filter.

`PUT /openapi/v1/exclusion_filters/{exclusion_filter_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
exclusion_filter_id	string	The unique identifier for the exclusion filter.

The JSON request body contains the following keys

Attribute	Type	Description
consumer_filter_id	string	(optional) ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the consumer of a policy.
provider_filter_id	string	(optional) ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the provider of a policy.
proto	integer	Protocol Integer value (NULL means all protocols).
start_port	integer	(optional) Start port of the range.
end_port	integer	(optional) End port of the range.

Response object: Returns the modified exclusion filter object with the specified ID.

Sample python code

```
payload = {'proto': 17}
exclusion_filter_id = '<exclusion-filter-id>'
restclient.post('/exclusion_filters/%s' % exclusion_filter_id,
                json_body=json.dumps(payload))
```

Deleting an Exclusion Filter

This endpoint deletes the specified exclusion filter.

`DELETE /openapi/v1/exclusion_filters/{exclusion_filter_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
exclusion_filter_id	string	The unique identifier for the exclusion filter.

Response object: None

Sample python code

```
exclusion_filter_id = '<exclusion-filter-id>'
restclient.delete('/exclusion_filters/%s' % exclusion_filter_id)
```

Default Exclusion Filters

This set of APIs can be used to add, edit or delete Default Exclusion Filters and require the `app_policy_management` capability associated with the API key.

Exclusion Filters exclude flows from the automatic policy discovery clustering algorithm. See Exclusion Filters for more information.

Default Exclusion Filter object

The exclusion filter object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the default exclusion filter.
consumer_filter_id	string	ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the consumer of a policy.
provider_filter_id	string	ID of a defined filter. Currently, any cluster belonging to the workspace, user defined filter or scope can be used as the provider of a policy.
proto	integer	Protocol Integer value (NULL means all protocols).
port	array	Inclusive range of ports. eg [80, 80] or [5000, 6000]. NULL means all ports.
updated_at	integer	Unix timestamp of when the exclusion filter was updated.

Get Default Exclusion Filters

This endpoint returns a list of default exclusion filters. This API is available to API keys with `app_policy_management` capability.

```
GET /openapi/v1/default_exclusion_filters?root_app_scope_id={root_app_scope_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
root_app_scope_id	string	The unique identifier of the root scope.

Response object: Returns a list of default exclusion filter objects for the root scope.

Sample python code

```
root_app_scope_id = '<root-app-scope-id>'
 restclient.get('/default_exclusion_filters?root_app_scope_id=%s' % root_app_scope_id)
```

Get Specific Default Exclusion Filter

This endpoint returns an instance of a default exclusion filters.

```
default_exclusion_filter_id = '<default-exclusion-filter-id>'
```

```
restclient.get('/default_exclusion_filters/%s' % default_exclusion_filter_id)
```

Parameters: The request URL contains the following parameters

Name	Type	Description
default_exclusion_filter_id	string	The unique identifier for the exclusion filter.

Response object: Returns the default exclusion filter object with the specified ID.

Sample python code

```
default_exclusion_filter_id = '<default-exclusion-filter-id>'
restclient.get('/default_exclusion_filters/%s' % default_exclusion_filter_id)
```

Create a Default Exclusion Filter

This endpoint is used to create a new default exclusion filter.

```
POST /openapi/v1/default_exclusion_filters?root_app_scope_id={root_app_scope_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
root_app_scope_id	string	The unique identifier of the root scope.

The JSON request body contains the following keys

Attribute	Type	Description
consumer_filter_id	string	(optional) ID of a defined scope or inventory filter.
provider_filter_id	string	(optional) ID of a defined scope or inventory filter.
proto	integer	(optional) Protocol Integer value (NULL means all protocols).
start_port	integer	(optional) Start port of the range.
end_port	integer	(optional) End port of the range.

Response object: Returns the created default exclusion filter object.

Sample python code

```
provider_filter_id = '<provider-filter-id>'
consumer_filter_id = '<consumer-filter-id>'
payload = {'consumer_filter_id': consumer_filter_id,
           'provider_filter_id': provider_filter_id,
           'proto': 6,
           'start_port': 800,
           'end_port': 1000}
root_app_scope_id = '<root-app-scope-id>'
restclient.post('/default_exclusion_filters?root_app_scope_id=%s' % root_app_scope_id,
                json_body=json.dumps(payload))
```

Update a Default Exclusion Filter

This endpoint updates a default exclusion filter.

```
PUT /openapi/v1/default_exclusion_filters/{default_exclusion_filter_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
default_exclusion_filter_id	string	The unique identifier for the default exclusion filter.

The JSON request body contains the following keys

Attribute	Type	Description
consumer_filter_id	string	(optional) ID of a defined scope or inventory filter.
provider_filter_id	string	(optional) ID of a defined scope or inventory filter.
proto	integer	Protocol Integer value (NULL means all protocols).
start_port	integer	(optional) Start port of the range.

end_port	integer	(optional) End port of the range.

Response object: Returns the modified default exclusion filter object with the specified ID.

Sample python code

```
payload = {'proto': 17}
default_exclusion_filter_id = '<default-exclusion-filter-id>'
restclient.post('/default_exclusion_filters/%s' % default_exclusion_filter_id,
                json_body=json.dumps(payload))
```

Deleting a Default Exclusion Filter

This endpoint deletes the specified default exclusion filter.

`DELETE /openapi/v1/default_exclusion_filters/{default_exclusion_filter_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
default_exclusion_filter_id	string	The unique identifier for the exclusion filter.

Response object: None

Sample python code

```
default_exclusion_filter_id = '<default-exclusion-filter-id>'
restclient.delete('/default_exclusion_filters/%s' % default_exclusion_filter_id)
```

Live Analysis

Live analysis or Policy Analysis is an important aspect of generating security policies. It allows you to evaluate the impact of a set of policies – where generated by automatic policy discovery or manually added by users – before actually enforcing those policies on the workloads. Live analysis allows users to run what-if analysis on live traffic without disrupting any application traffic.

The set of APIs available in this section allow downloading flows and the effect of current set of published policies in a workspace on those flows. It requires `app_policy_management` capability associated with the API key to invoke these set of APIs.

Flows available via Live Analysis have some attributes (dimensions and metrics) and the download API allows user to filter flows by different criteria on dimensions.

Flow dimensions available in Live Analysis

This endpoint is useful to know the columns on which search criteria (or *filters*) can be specified for downloading flows available via Live Analysis. Most common use case would be to download *permitted*, *escaped* or *rejected* flows this can be achieved by passing a search criteria on category dimension to the download API. When used with **type: eq** the flow’s inbound and outbound category must match. When used with **type: contains** the flows inbound or outbound category must match

`GET /openapi/v1/live_analysis/dimensions`

Flow metrics available in Live Analysis

This endpoint returns the list of metrics (e.g. byte count, packet count) associated with live analysis. One use case for this endpoint would be to project a subset of metrics in the download API, i.e. instead of downloading all the metrics, users can specify a small subset of metrics they are interested in.

```
GET /openapi/v1/live_analysis/metrics
```

Download flows available via Live Analysis

This endpoint returns the list of flows matching the filter criteria. Each flow object in the result has attributes that are a union of live analysis dimensions (returned by the live analysis dimensions API above) as well as the live analysis metrics (returned by the live analysis metrics API above). Optionally, user can also specify a small subset of dimensions or metrics if they are not interested in the full set of available dimensions and metrics – this projection of a smaller subset of dimensions or metrics also have the side effect of making API calls fast.

```
POST /openapi/v1/live_analysis/{application_id}
```

The query body consists of a JSON body with the following keys.

Name	Type	Description
t0	integer or string	Start of time interval (epoch or ISO 8601)
t1	integer or string	End of time interval (epoch or ISO 8601)
filter	JSON	Query filter. If filter is empty (i.e. {}), then query matches all flows. Refer to section on Filters in Flow Search regarding syntax of filters.
dimensions	array	(optional) List of flow dimensions to be returned for the downloaded flows available through Live Analysis. If unspecified, all available dimensions are returned.
metrics	array	(optional) List of flow metrics to be returned for the downloaded flows available through Live Analysis.
limit	integer	(optional) Number of flows to be returned in a single API response.
offset	string	(optional) Offset received from previous response – useful for pagination.

The body of the request should be a JSON formatted query. An example of a query body is shown below.

```
{
    "t0": "2016-06-17T09:00:00-0700",
    "t1": "2016-06-17T17:00:00-0700",
    "filter": {
        "type": "and",
        "filters": [
            {
                "type": "contains",
                "field": "category",
                "value": "escaped"
            },
            {
                "type": "in",
                "field": "dst_port",
                "values": ["80", "443"]
            }
        ]
    },
    "limit": 100,
    "offset": <offset-object>
}
```

Response

The response is a JSON object in the body with the following properties.

Keys	Values
offset	Response offset to be passed for the next page of results
results	List of results

To generate the next page of results, take the object received by the response in `offset` and pass it as the value for the `offset` of the next query.

Sample python code

```
   req_payload = {"t0": "2016-11-07T09:00:00-0700",
                  "t1": "2016-11-07T19:00:00-0700",
                  "limit": 10,
                  "filter": {"type": "and",
                      "filters": [
                          {"type": "contains", "field": "category", "value": "escaped"},
                          {"type": "regex", "field": "src_hostname", "value": "web*"}
                       ]
                  }
    }

    resp = restclient.post('/live_analysis/{application_id}',
json_body=json.dumps(req_payload))
    print resp.status_code
    if resp.status_code == 200:
        parsed_resp = json.loads(resp.content)
        print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

Scopes

This set of APIs can be used to manage Scopes (or AppScopes) in Secure Workload cluster deployment. They require the `user_role_scope_management` capability associated with the API key. The API to get the list of scopes is also available to API keys with `app_policy_management` or `sensor_management` capability.

Scope object

The scope object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the scope.
short_name	string	User specified name of the scope.
name	string	Fully qualified name of the scope. This is a fully qualified name, i.e. it has name of parent scopes (if applicable) all the way to the root scope.
description	string	User specified description of the scope.
short_query	JSON	Filter (or match criteria) associated with the scope.
query	JSON	Filter (or match criteria) associated with the scope in conjunction with the filters of the parent scopes (all the way to the root scope).
vrf_id	integer	ID of the VRF to which scope belongs to.
parent_app_scope_id	string	ID of the parent scope.
child_app_scope_ids	array	An array of scope children’s ids.
policy_priority		Used to sort workspace priorities. See Policy Attributes.
dirty	bool	Indicates a child or parent query has been updated and that the changes need to be committed.
dirty_short_query	JSON	Non-null if the query for this scope has been updated but not yet committed.

Get scopes

This endpoint returns a list of scopes known to Secure Workload appliance. This API is available to API keys with either `app_policy_management` or `user_role_scope_management` capability.

```
GET /openapi/v1/app_scopes
```

Parameters:

Name	Type	Description
vrf_id	integer	Match app scopes by vrf_id.
root_app_scope_id	string	Match app ascopes by root app scope id.
exact_name	string	Returns scope matching the exact name, case-sensitive.
exact_short_name	string	Returns scopes matching the exact short_name, case-sensitive.

Returns a list of scope objects.

Create a scope

This endpoint is used to create new scopes.

```
POST /openapi/v1/app_scopes
```

Parameters:

Name	Type	Description
short_name	string	User specified name of the scope.
description	string	User specified description of the scope.
short_query	JSON	Filter (or match criteria) associated with the scope.
parent_app_scope_id	string	ID of the parent scope.
policy_priority	integer	Default is ‘last’. Used to sort workspace priorities. See Policy Ordering under Review Automatically Discovered Policies.

Sample python code

```
req_payload = {
   "short_name": "App Scope Name",
   "short_query": {
       "type":"eq",
            "field":"ip",
            "value": <....>
        },
        "parent_app_scope_id": <parent_app_scope_id>
    }
    resp = restclient.post('/app_scopes', json_body=json.dumps(req_payload))
```

To create a scope based on subnet, use the following short_query:

```
    "short_query":
      {
        "type":"subnet",
        "field":"ip",
        "value": "1.0.0.0/8"
      },
```

Get specific scope

This endpoint returns an instance of a scope.

`GET /openapi/v1/app_scopes/{app_scope_id}`

Returns the scope object associated with the specified ID.

Update a scope

This endpoint updates a scope. Changes to the `name` and `description` are applied immediately. Changes to the short_query mark the scope as 'dirty' and set the `dirty_short_query` attribute. Once all scope query changes, under a given root scope, are made, one needs to ping the Commit scope query changes endpoint to commit all the required updates.

`PUT /openapi/v1/app_scopes/{app_scope_id}`

Parameters:

Name	Type	Description
short_name	string	User specified name of the scope.
description	string	User specified description of the scope.
short_query	JSON	Filter (or match criteria) associated with the scope.

Returns the modified scope object associated with specified ID.

Delete a specific scope

This endpoint deletes the specified scope.

`DELETE /openapi/v1/app_scopes/{app_scope_id}`

If the Scope is associated with a workspace, Policy, User Inventory Filter, etc. this endpoint will return `422 Unprocessable Entity`. The returned Error object will contain a `details` attribute with the count of dependent objects along with the ids of the first 10 of each type. This information can be used to locate and remove the blocking dependencies.

Get scopes in policy priority order

This endpoint lists the scopes in the order that their corresponding primary workspace will be enforced.

```
GET /openapi/v1/app_scopes/{root_app_scope_id}/policy_order
```

Returns an array of scope objects.

Update the policy order

This endpoint will update the order at which policies are applied.

Warning This endpoint changes the order at which policies are applied. As a result new host firewall rules will be inserted and any existing rules will be deleted on the relevant hosts.

```
POST /openapi/v1/app_scopes/{root_app_scope_id}/policy_order
```

Parameters:

Name	Type	Description
root_app_scope_id	string	Root scope or which the order is being changed.
ids	array	array of scope id strings in the order they should be enforced.

The `ids` array parameter must include all members of the root scope, including the root.

Commit scope query changes

This endpoint triggers an asynchronous background job to update all ‘dirty’ children under a given root scope. This job updates scopes and workspaces, see Scopes for more details.

```
POST /openapi/v1/app_scopes/commit_dirty
```

Parameters:

Name	Type	Description
root_app_scope_id	string	ID for a root scope for which all children will be updated.
sync	boolean	(optional) Indicate if the request should be synchronous.

Returns 202 to indicate the job has been enqueued. To check if the job has completed, poll the root scope’s ‘dirty’ attribute to see if it has been set to false.

Users may pass the `sync` parameter to have the job run immediately. The request will return when done with a 200 status code. This request may take some time if many updates need to be applied.

Submit a group suggestion request

Submit a group suggestion request for a scope.

`PUT /openapi/v1/app_scopes/{app_scope_id}/suggest_groups`

Parameters: The request URL contains the following parameters

Name	Type	Description
app_scope_id	string	The unique identifier for the scope.

Parameters: The JSON query body contains the following keys

Name	Type	Description
start_time	string	Start time of the group suggestion input time interval.
end_time	string	End time of the group suggestion input time interval.

Response object: Returns an object with the following attributes:

Name	Type	Description
message	string	Message regarding success/failure in submission of group suggestion request.

Sample python code

```
app_scope_id = '5d02b493755f0237a3d6e078'
req_payload = {
      'start_time': '2020-09-17T10:00:00-0700',
      'end_time': '2020-09-17T11:00:00-0700',
}
resp = restclient.put('/app_scopes/%s/suggest_groups' % app_scope_id,
                       json_body=json.dumps(req_payload))
```

Get group suggestion status

Query group suggestion status of the scope.

`GET /openapi/v1/app_scopes/{app_scope_id}/suggest_groups_status`

Parameters: The request URL contains the following parameters

Name	Type	Description
app_scope_id	string	The unique identifier for the scope.

Response object: Returns an object with the following attributes:

Name	Type	Description

status	string	Status of the group suggestion. Values: PENDING, COMPLETE, or FAILED

Sample python code

```
app_scope_id = '5d02b493755f0237a3d6e078'
resp = restclient.get('/app_scopes/%s/suggest_groups_status' % app_scope_id)
```

Alerts

This set of APIs can be used to manage user alerts. They require the `user_alert_management` capability associated with the API key.

Alert Object

Each alert configuration object contains the following fields:

Attribute	Type	Description
app_name	string	Application name associated with the alert configuration.
rules	object	Set of conditions that must be met for the alert configuration to trigger an alert.
subjects	object	List of users who should receive the alert.
severity	string	Indicates the level of severity associated with an alert configuration.
individual_alert	boolean	Indicates whether individual alerts should be sent that triggers the alert configuration.
summary_alert_freq	string	Frequency of summary alerts to be sent for a particular alert configuration.

Attribute	Type	Description
alert_type	string	Unique identifier of the alert configuration.
app_instance_id	string	Unique identifier of a particular instance associated with the alert configuration

Get Alerts

This endpoint retrieves the list of alert configurations for a user. Alerts can be filtered to a given root scope. If no scope is provided, all alerts, for all scopes the user has access to, are returned. Service provider alerts will only be returned if the user is a site admin.

```
GET /openapi/v1/alert_confs
```

Parameters:

Name	Type	Description
root_app_scope_id	string	(optional) ID of a root scope to return alerts only assigned to that scope.

Response object: Returns a list of user alert objects.

Create an Alert

This endpoint is used to create a new alert.

```
POST openapi/v1/alert_confs
```

Parameters:

Attribute	Type	Description
app_name	string	Application name associated with the alert configuration.
rules	object	Set of conditions that must be met for the alert configuration to trigger an alert.
subjects	object	List of users who should receive the alert.
severity	srting	Indicates the level of severity associated with an alert configuration.

Attribute	Type	Description
individual_alert	boolean	Indicates whether individual alerts should be sent that triggers the alert configuration.
summary_alert_freq	string	Frequency of summary alerts to be sent for a particular alert configuration.
alert_type	string	Unique identifier of the alert configuration.
app_instance_id	string	Unique identifier of a particular instance associated with the alert configuration.

The requesting user must have access to the provided scope. An alert without a scope is a ‘Service Provider Alert’ and only a site admin may create them.

Response object: Returns the newly created alert object.

Get Specific Alert

This endpoint returns a specific alert object.

```
GET /openapi/v1/alert_confs/
```

Parameters: The request URL contains the following parameters

Name	Type	Description
alert_id	string	Uniquely identifies the alert.

Response object: Returns an alert object associated with the specified ID.

Update an Alert

This endpoint is used to update an existing alert.

```
PUT /openapi/v1/alert_confs/
```

Parameters: The request URL contains the following parameters

Name	Type	Description
alert_id	string	To retrieve or modify the configuration settings for the alert.

The JSON request body contains the following parameters

Name	Type	Description
name	string	User specified name for the alert.

Name	Type	Description
description	string	User specified description for the alert.

The requesting user must have access to the provided scope. A alert without a scope is called a ‘Service Provider Alert’ and only site admin may update them.

Response object: The updated alert object with the specified ID.

Delete Specific Alert

This endpoint deletes the specified alert.

```
DELETE /openapi/v1/alert_confs/{alert_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
alert_id	string	Uniquely identifies the alert.

Response object: None.

Roles

This set of APIs can be used to manage user roles. They require the `user_role_scope_management` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

Role object

The role object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the role.
app_scope_id	string	Scope to which the scope is defined, maybe empty for “Service Provider Roles”.
name	string	User specified name for the role.
description	string	User specified description for the role.

Get roles

This endpoint returns a list of roles accessible to the user. Roles can be filtered to a given root scope. If no scope if provided, all roles, for all scopes the user has access to, are returned. Service provider roles will only be returned if the user is a site admin.

```
GET /openapi/v1/roles
```

Parameters:

Name	Type	Description
app_scope_id	string	(optional) ID of a root scope to return roles only assigned to that scope.

Response object: Returns a list of user role objects.

Sample python code

```
resp = restclient.get('/roles')
```

Create a role

This endpoint is used to create a new role.

```
POST /openapi/v1/roles
```

Parameters:

Name	Type	Description
name	string	User specified name for the role.
description	string	User specified description for the role.
app_scope_id	string	(optional) The scope ID under which the role is created If no scope ID mentioned the role is considered as service provider role.

The requesting user must have access to the provided scope. A role without a scope is called a ‘Service Provider Role’ and only site admin may create them.

Response object: Returns the newly created role object.

Sample python code

```
app_scope_id = '<app-scope-id>'
req_payload = {
      'name': 'Role Name',
      'description': 'Role Description',
      'app_scope_id': app_scope_id
}
restclient.post('/roles', json_body=json.dumps(req_payload))
```

Get specific role

This endpoint returns a specific role object.

```
GET /openapi/v1/roles/{role_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Descrption
role_id	string	Uniquely identifies the role.

Response object: Returns a role object associated with the specified ID.

Sample python code

```
role_id = '<role-id>'
restclient.get('/roles/%s' % role_id)
```

Update a role

This endpoint is used to update an existing role.

```
PUT /openapi/v1/roles/{role_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
role_id	string	Uniquely identifies the role.

The JSON request body contains the following parameters

Name	Type	Description
name	string	User specified name for the role.
description	string	User specified description for the role.

The requesting user must have access to the provided scope. A role without a scope is called a ‘Service Provider Role’ and only site admin may update them.

Response object: The updated role object with the specified ID.

Sample python code

```
role_id = '<role-id>'
req_payload = {
      'name': 'Role Name',
      'description': 'Role Description',
}
restclient.put('/roles/%s' % role_id, json_body=json.dumps(req_payload))
```

Give a role access to scope

This endpoint gives a role the specified access level to a scope.

```
POST /openapi/v1/roles/{role_id}/capabilities
```

Capabilities can only be added to the roles that the user has access to. If the roles is assigned to a scope, capabilities must correspond to that scope or its children. Service provider roles (those not assigned to a scope) can add capabilities for any scope.

Parameters: The request URL contains the following parameters

Name	Type	Description
role_id	string	Uniquely identifies the role.

The JSON request body contains the following parameters

Name	Type	Description
app_scope_id	string	ID of the scope to which access is provided.
ability	string	Possible values are SCOPE_READ, SCOPE_WRITE, EXECUTE, ENFORCE, SCOPE_OWNER, DEVELOPER

For more description of abilities, refer to Roles .

Response object:

Name	Type	Description
app_scope_id	string	ID of the scope to which access is provided.
role_id	string	ID of the role.
ability	string	Possible values are SCOPE_READ, SCOPE_WRITE, EXECUTE, ENFORCE, SCOPE_OWNER, DEVELOPER
inherited	boolean	

Sample python code

```
role_id = '<role-id>'
req_payload = {
  'app_scope_id': '<app-scope-id>',
  'ability': 'SCOPE_READ'
}
restclient.post('/roles/%s/capabilities' % role_id,
                json_body=json.dumps(req_payload))
```

Delete specific role

This endpoint deletes the specified role.

```
DELETE /openapi/v1/roles/{role_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
role_id	string	Uniquely identifies the role.

Response object: None.

Sample python code

```
role_id = '<role-id>'
restclient.delete('/roles/%s' % role_id)
```

Users

This set of APIs manages users. They require the `user_role_scope_management` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

User object

The user object attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the user role.
email	string	Email associated with user account.
first_name	string	First name.
last_name	string	Last name.
app_scope_id	string	The scope to which the user is assigned. Maybe empty if the user is a “Service Provider User”.
role_ids	list	List of IDs of roles assigned to the user account.
by- pass_external_auth	boolean	True for local users and false for external auth users (ldap or sso).

Attribute	Type	Description
disabled_at	integer	Unix timestamp of when the user has been disabled. Zero or null, otherwise.

Get users

This endpoint returns a list of user objects known to the Secure Workload appliance.

```
GET /openapi/v1/users
```

Parameters: The request URL contains the following parameters

Name	Type	Description
include_disabled	boolean	(optional) To include disabled users, defaults to false.
app_scope_id	string	(optional) Return only users assigned to the provided scope.

Response object: Returns a list of user objects. Only site admins can see ‘Service provider users’, i.e. those not assigned to a scope.

Sample python code

```
    GET /openapi/v1/users
```

Create a new user account

This endpoint is used to create a new user account.

```
POST /openapi/v1/users
```

Parameters: The JSON request body contains the following parameters

Name	Type	Description
email	string	Email associated with user account.
first_name	string	First name.
last_name	string	Last name.
app_scope_id	string	(optional) Root scope to which user belongs.
role_ids	list	(optional) The list of roles that should be assigned to the user.

The app_scope_id is the ID of the root scope to which the user is to be assigned. If the app_scope_id is not present then the user is a ‘Service Provider user.’ Only site admins can create service provider users. The `role_ids` are the ids of the roles that were created under the specified app scope.

Response object: Returns the newly created user object.

Sample python code

```
req_payload = {
    "first_name": "fname",
    "last_name": "lname",
    "email": "foo@bar.com"
    "app_scope_id": "root_appscope_id",
    "role_ids": ["roleid1", "roleid2"]
}
resp = restclient.post('/users', json_body=json.dumps(req_payload))
```

Get specific user

This endpoint returns specific user object.

`GET /openapi/v1/users/{user_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
user_id	string	ID of the user object.

Response object: Returns a user object associated with specified ID.

Sample python code

```
user_id = '5ce480db497d4f1ca1fc2b2b'
resp = restclient.get('/users/%s' % user_id)
```

Update a user

This endpoint updates an existing user.

`PUT /openapi/v1/users/{user_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
user_id	string	ID of the user object being updated.

The JSON request body contains the following parameters

Name	Type	Description
email	string	Email associated with user account.
first_name	string	First name.
last_name	string	Last name.
app_scope_id	string	Root App Scope ID (only allowed for site admins)

Response object: Returns the newly updated user object.

Sample python code

```
req_payload = {
    "first_name": "fname",
    "last_name": "lname",
    "email": "foo@bar.com"
    "app_scope_id": "root_appscope_id",
}
restclient.put('/users', json_body=json.dumps(req_payload))
```

Enable/reactivate a deactivated user

This endpoint is used to re-enable a deactivated user.

`POST /openapi/v1/users/{user_id}/enable`

Parameters: The request URL contains the following parameters

Name	Type	Description
user_id	string	ID of the user object being enabled.

Response object: Returns the reactivated user object associated with the specified ID.

Sample python code

```
user_id = '5ce480db497d4f1ca1fc2b2b'
resp = restclient.post('/users/%s/enable' % user_id)
```

Add role to the user account

This endpoint is used to add a role to a user account.

`PUT /openapi/v1/users/{user_id}/add_role`

Parameters: The request URL contains the following parameters

Name	Type	Description
user_id	string	ID of the user object being modified.

The JSON request body contains the following parameters

Name	Type	Description
role_id	string	ID of the role object to be added.

Response object: Returns the modified user object associated with the specified ID.

Sample python code

```
user_id = '5ce480db497d4f1ca1fc2b2b'
req_payload = {
    "role_id": "5ce480d4497d4f1c155d0cef",
}
resp = restclient.put('/users/%s/add_role' % user_id,
                      json_body=json.dumps(req_payload))
```

Remove role from the user account

This endpoint is used to remove a role from a user account.

`DELETE /openapi/v1/users/{user_id}/remove_role`

Parameters: The request URL contains the following parameters

Name	Type	Description
user_id	string	ID of the user object being deleted.

The JSON request body contains the following parameters

Name	Type	Description
role_id	string	ID of the role object to be removed.

Response object: Returns the modified user object associated with the specified ID.

Sample python code

```
    user_id = '5ce480db497d4f1ca1fc2b2b'
    req_payload = {
        "role_id": "5ce480d4497d4f1c155d0cef",
    }
    resp = restclient.delete('/users/%s/remove_role' % user_id,
                             json_body=json.dumps(req_payload))
```

Delete specific user

This endpoint deletes the specified user account.

`DELETE /openapi/v1/users/{user_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
user_id	string	ID of the user object being deleted.

Response object: Returns the deleted user object associated with the specified ID.

Sample python code

```
    user_id = '5ce480db497d4f1ca1fc2b2b'
    resp = restclient.delete('/users/%s' % user_id)
```

Inventory filters

Inventory filters encode the match criteria for inventory search queries. This set of APIs provide functionality similar to what is described in Inventory Filters . They require either `sensor_management or app_policy_management` capability associated with the API key.

Inventory Filter Object

The inventory filter JSON object is returned as a single object or an array of objects depending on the API endpoint. The object's attributes are described below:

Attribute	Type	Description
id	string	Unique identifier for the inventory filter.
name	string	User specified name of the inventory filter.
app_scope_id	string	ID of the scope associated with the filter.
short_query	JSON	Filter (or match criteria) associated with the filter.
primary	boolean	When 'true' the filter is restricted to the ownership scope.
public	boolean	When 'true' the filter provides a service for its scope. Must also be primary/scope re- stricted.
query	JSON	Filter (or match criteria) associated with the filter in conjunction with the filters of the parent scopes. These conjunctions take effect if 'restricted to ownership scope' checkbox is checked. If 'primary' field is false then query is same as short_query.

Get inventory filters

This endpoint returns a list of inventory filters visible to the user.

```
GET /openapi/v1/filters/inventories
```

Parameters:

Name	Type	Description
vrf_id	integer	Match inventory filters by vrf id.
root_app_scope_id	string	Match inventory filters by root app scope id.
name	string	Returns inventory filters matching part of the name, case-insensitive.
exact_name	string	Returns inventory filters matching the exact name, case-sensitive.

Create an inventory filter

This endpoint is used to create an inventory filter.

```
POST /openapi/v1/filters/inventories
```

Parameters:

Name	Type	Description
name	string	User specified name of the application scope.
query	JSON	Filter (or match criteria) associated with the filter.
app_scope_id	string	ID of the scope associated with the filter.
primary	boolean	When ‘true’ the filter is restricted to the ownership scope.
public	boolean	When ‘true’ the filter provides a service for its scope. Must also be primary/scope restricted.

Sample python code

```
req_payload = {
  "app_scope_id": <app_scope_id>,
  "name": "sensor_config_inventory_filter",
  "query": {
    "type": "eq",
    "field": "ip",
    "value": <sensor_interface_ip>
  },
}
resp = restclient.post('/filters/inventories', json_body=json.dumps(req_payload))
```

Validate an inventory filter query

This endpoint will validate a query's structure against the required schema.

```
POST /openapi/v1/filters/inventories/validate_query
```

Parameters:

Name	Type	Description
query	JSON	Filter (or match criteria) associated with the scope.

Response object:

Attribute	Type	Description
valid	boolean	Indicates if the query is valid
errors	array	If invalid, details about the errors

Get specific inventory filter

This endpoint returns an instance of an inventory filter.

```
GET /openapi/v1/filters/inventories/{inventory_filter_id}
```

Returns an inventory filter object associated with specified ID.

Update specific inventory filter

This endpoint is used to update an inventory filter.

```
PUT /openapi/v1/filters/inventories/{inventory_filter_id}
```

Parameters:

Name	Type	Description
name	string	User specified name of the scope.
query	JSON	Filter (or match criteria) associated with the scope.
app_scope_id	string	ID of the scope associated with the filter.
primary	boolean	When 'true' the filter is restricted to the ownership scope.
public	boolean	When 'true' the filter provides a service. May be used as part of policy generation. Must also be primary/scope restricted.

Name	Type	Description
Usages	boolean	Collection of member policy and configuration statistics.

Delete a specific inventory filter

This endpoint deletes the specified inventory filter.

```
DELETE /openapi/v1/filters/inventories/{inventory_filter_id}
```

Flow Search

The flow search feature provides similar functionality as described in Flows. These set of APIs require the `flow_inventory_query` capability associated with the API key.

Query for Flow Dimensions

This endpoint returns the list of flow columns on which search criteria (or *filters*) can be specified for flow search queries (below). For more information on column descriptions, see Columns and Filters.

```
GET /openapi/v1/flowsearch/dimensions
```

Parameters: None

Response object:

Name	Type	Description
dimensions	List of strings	List of user uploaded and orchestrator dimensions.

Sample python code

```
restclient.get('/flowsearch/dimensions')
```

Query for Flow Metrics

This endpoint returns the list of metrics, for example, byte count and packet count, associated with flow observations.

```
GET /openapi/v1/flowsearch/metrics
```

Parameters: None

Response object:

Name	Type	Description
metrics	List of strings.	List of available metrics.

Sample python code

```
restclient.get('/flowsearch/metrics')
```

Query for Flows

This endpoint returns the list of flows matching the filter criteria. Each flow object in the result has attributes that are a union of flow dimensions (returned by the flow dimensions API above) as well as the flow metrics (returned by the flow metrics API above).

```
POST /openapi/v1/flowsearch
```

The list of columns that can be specified in the filter criteria can be obtained by `/openapi/v1/flowsearch/dimensions` API.

Parameters: The query body consists of a JSON body with the following keys.

Name	Type	Description
t0	integer or string	Flow search start time (epoch or ISO 8601)
t1	integer or string	Flow search end time (epoch or ISO 8601)
filter	JSON	Query filter. If filter is empty (i.e. {}), query matches all flows.
scopeName	string	Full name of the scope to which query is restricted.
dimensions	array	(Optional) List of dimension names to be returned in the result of flowsearch API. This is an optional parameter. If unspecified, flowsearch results return all the available dimensions. This option is useful to specify a subset of the available dimensions when caller does not care about the rest of the dimensions.
metrics	array	(Optional) List of metric names to be returned in the result of flowsearch API. This is an optional parameter. If unspecified, flowsearch results return all the available metrics. This option is useful to specify a subset of the available metrics when caller does not care about the rest of the metrics.
limit	integer	(Optional) Number of response flows limit.

Name	Type	Description
offset	string	(Optional) Offset object received from previous response.
descending	boolean	(Optional) If this parameter is false or left unspecified, results are in ascending order of timestamps. If parameter value is true, results are in descending order of timestamps.

The body of the request should be a JSON formatted query. An example of a query body is shown below.

```
{
    "t0": "2016-06-17T09:00:00-0700",
    "t1": "2016-06-17T17:00:00-0700",
    "filter": {
        "type": "and",
        "filters": [
            {
                "type": "contains",
                "field": "dst_hostname",
                "value": "prod"
            },
            {
                "type": "in",
                "field": "dst_port",
                "values": ["80", "443"]
            }
        ]
    },
    "scopeName": "Default:Production:Web",
    "limit": 100,
    "offset": <offset-object>
}
```

Filters

The filter supports primitive filters and logical filters (“not”, “and”, “or”) comprised of one or more primitive filters. Format of primitive filter is as follows:

```
{"type" : "<OPERATOR>", "field": "<COLUMN_NAME>", "value": "<COLUMN_VALUE>"}
```

For primitive filters, operator can be a comparison operator like `eq, ne, lt, lte, gt` or `gte`. Operator could also be `in, regex, subnet, contains` or `range`.

Some examples of primitive filters might include:

```
{"type": "eq", "field": "src_address", "value": "7.7.7.7"}

{"type": "regex", "field": "src_hostname", "value": "prod.*"}

{"type": "subnet", "field": "src_addr", "value": "1.1.11.0/24"}

# Note, 'in' clause uses 'values' key instead of 'value'
{"type": "in", "field": "src_port", "values": [80, 443]}
```

You can also specify complex filters using boolean operations like not, and or or. Following are some examples of these type of filters:

```
# "and" and "or" operators need to specify list of "filters"
{"type": "and",
    "filters": [
        {"type": "in", "field": "src_port", "values": [80, 443]},
        {"type": "regex", "field": "src_hostname", "value": "prod.*"}
    ]
}

# "not" operator needs to specify a "filter"
{"type": "not",
    "filter": {"type": "subnet", "field": "src_addr", "value": "1.1.11.0/24"}
}
```

More formally, schema of `filter` in the flow search request is as follows:

Keys	Values
type	Filter type
field	Filter field column for primitive filters
filter	Filter object (only used for `not` filter type)
filters	List of filter objects (used for `and` and `or` filter types)
value	Value for primitive filters
values	List of values for primitive filters with filter type `in` or `range`

Primitive Filter Types

eq, ne—Searches flows for equality or inequality respectively in column specified by "`field`" with value specified by "`value`". Supports the following fields: `src_hostname, dst_hostname, src_address, dst_address, src_port, dst_port, src_scope_name, dst_scope_name, vrf_name, src_enforcement_epg_name, dst_enforcement_epg_name, proto`. These operators also work on user labelled columns.

lt, lte, gt, gte—Searches flows where values of column specified by "`field`" are less than, less than equal to, greater than or greater than equal to (as applicable) the value specified by "`value`". Supports the following fields: `[src_port, dst_port]`.

range—Searches flows for values of column specified by "field" between range start and range end specified by "values" list (this list must be of size 2 for *"range"* filter type – first value is the range start and second is the range end). Supports the following fields: [src_port, dst_port].

in—Searches flows for membership in column specified by "`field`" with membership list specified by "`values`". Supports the following fields: `src_hostname, dst_hostname, src_address, dst_address, src_port, dst_port, src_scope_name, dst_scope_name, vrf_name, src_enforcement_epg_name, dst_enforcement_epg_name, proto`. This operator also works on user labelled columns.

regex, contains—Searches flows for regex matches or containment matches respectively in col- umn specified by "`field`" with regex specified by "`value`". Supports the following fields: `src_hostname, dst_hostname, src_scope_name, dst_scope_name, vrf_name, src_enforcement_epg_name, dst_enforcement_epg_name.`

These operators also work on user labelled columns. Filters with `regex` type must use Java style regex patterns as "`value`".

subnet—Searches flows for subnet membership specified by "`field`" as a string in CIDR notation. Supports the following fields: `["src_address", "dst_address"]`

Logical Filter Types

- **not**—Logical "not" filter of object specified by "`filter`".
- **and**—Logical "and" filter of list of filter objects specified by "`filters`".
- **or**—Logical "or" filter of list of filter objects specified by "`filters`".

Response object:

Keys	Values
offset	Response offset to be passed for the next page of results
results	List of results

To generate the next page of results, take the object received by the response in `offset` and pass it as the value for the `offset` of the next query.

Sample python code

```
req_payload = {"t0": "2016-11-07T09:00:00-0700",
               "t1": "2016-11-07T19:00:00-0700",
               "scopeName": "Default:Prod:Web",
               "limit": 10,
               "filter": {"type": "and",
                   "filters": [
                    {"type": "subnet", "field": "src_address", "value": "1.1.11.0/24"},

                       {"type": "regex", "field": "src_hostname", "value": "web*"}
                    ]
               }
 }

 resp = restclient.post('/flowsearch', json_body=json.dumps(req_payload))
 print resp.status_code
 if resp.status_code == 200:
     parsed_resp = json.loads(resp.content)
     print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

TopN Query for Flows

This endpoint returns a top N sorted list of values of specified dimension where rank in the list is determined by the aggregate of specified metric.

`POST /openapi/v1/flowsearch/topn`

Parameters:

The list of columns that can be specified in the filter criteria can be obtained by `/openapi/v1/flowsearch/dimensions` API. The body of the request should be a JSON formatted query. An example of a query body is shown below. Parameters t0 and t1 in the request body can be in epoch format or in ISO 8601 format. TopN API only allows querying maximum time range of one day. The dimension on which the grouping has to be done should be specified through dimension. The metric by which top N results need to ranked should be specified in metric field in the JSON body. You should specify a threshold with a minimum value of 1 which signifies the 'N' in 'TopN'. The maximum value of this threshold is 1000. Even if the user specify more than 1000 the API returns only a maximum of 1000 results. In addition, you must specify a parameter called scopeName which is the full name of the scope to which you want to restrict the search. The filter is same as that of filter of Flow Search Filters, on page 812 . If the filter is not mentioned, the topN is applied on all the flow entries.

```
{
  "t0": "2016-06-17T09:00:00-0700",    # t0 can also be 1466179200
  "t1": "2016-06-17T17:00:00-0700",    # t1 can also be 1466208000
  "dimension": "src_address",
  "metric": "fwd_pkts",
 "filter": {"type": "eq", "field": "src_address", "value": "172.29.203.193"},  #optional

  "threshold": 5,
  "scopeName": "Default"
}
```

The query body consists of a JSON body with the following keys.

Keys	Values
t0	Start time of the Flow (epoch or ISO 8601)
t1	End time of the Flow (epoch or ISO 8601)
filter	Query filter. If filter is empty (i.e. {}),or filter is absent (optional) then topN query is applied on all flow entries
scopeName	Full name of the scope to which query is restricted to
dimension	The dimension is a field on which we are grouping.
metric	The metric is the total count of values of the dimension.
threshold	Threshold is N in the topN.

Response object:

Keys	Values
result	Array of the top N entries

Sample python code

```
req_payload = {
    "t0": "2017-06-07T08:20:00-07:00",
    "t1": "2017-06-07T14:20:00-07:00",
    "dimension": "src_address",
    "metric": "fwd_pkts",
    "filter": {"type": "ne", "field": "src_address", "value": "172.29.203.193"},
    "threshold": 5,
    "scopeName": "Default"
}
resp = rc.post('/flowsearch/topn',
               json_body=json.dumps(req_payload))
print resp.status_code
if resp.status_code == 200:
   parsed_resp = json.loads(resp.content)
   print json.dumps(parsed_resp)
```

Sample response

```
[
  { "result": [
    {"src_address": "172.31.239.163", "fwd_pkts": 23104},
    {"src_address": "172.31.239.162", "fwd_pkts": 22410},
    {"src_address": "172.31.239.166", "fwd_pkts": 16185},
    {"src_address": "172.31.239.168", "fwd_pkts": 15197},
    {"src_address": "172.31.239.169", "fwd_pkts": 15116}
    ]
  }
]
```

Flow Count

This endpoint returns the number of flow observations matching the specified criteria.

`POST /openapi/v1/flowsearch/count`

Parameters:

The body of the request should be a JSON formatted query. An example of a query body is shown below. Parameters `t0` and `t1` in the request body can be in epoch format or in ISO 8601 format. This API only allows querying maximum time range of one day. In addition, you need to specify the `scopeName` parameter which is the full name of the scope to which you want to restrict the search. If this parameter is not specified, flow observation count API request applies to all scopes to which you have read access. The `filter` is same as that of filter of Flow Search Filters .

```
{
  "t0": "2016-06-17T09:00:00-0700",    # t0 can also be 1466179200
  "t1": "2016-06-17T17:00:00-0700",    # t1 can also be 1466208000
  "filter": {"type": "eq", "field": "src_address", "value": "172.29.203.193"},
  "scopeName": "Default"
}
```

The query body consists of a JSON body with the following keys.

Keys	Values
t0	Start time of the flow (epoch or ISO 8601)
t1	End time of the flow (epoch or ISO 8601)
filter	Query filter. If filter is empty (i.e. {}) then query matches all flows.
scopeName	Full name of the scope to which query is restricted to

Response object:

Keys	Values
count	The number of flow observations matching the flow search criteria.

Sample python code

```
req_payload = {
      "t0": "2017-07-20T08:20:00-07:00",
      "t1": "2017-07-20T10:20:00-07:00",
      "scopeName": "Tetration",
      "filter": {
                  "type": "eq",
                  "field": "dst_port",
                  "value": "5642"
          }
}
resp = rc.post('/flowsearch/count',
               json_body=json.dumps(req_payload))
print resp.status_code
if resp.status_code == 200:
   parsed_resp = json.loads(resp.content)
   print json.dumps(parsed_resp)
```

Sample response

```
{"count":508767}
```

Inventory

The inventory search APIs provide similar functionality as described in inventory search. These set of APIs require the `flow_inventory_query` capability associated with the API key.

Query for inventory dimensions

This endpoint returns the list of inventory columns on which search criteria (or *filters*) can be specified for inventory search queries.

`GET /openapi/v1/inventory/search/dimensions`

Inventory search

This endpoint returns the list of inventory items matching the specified criteria.

`POST /openapi/v1/inventory/search`

The list of columns that can be specified in the filter criteria can be obtained with the /openapi/v1/inventory/search/dimensions API.

Parameters:

Name	Type	Description
filter	JSON	A filter query.

Name	Type	Description
scopeName	string	(optional) Name of the scope by which to limit results.
limit	integer	(optional) Max number of results to return.
offset	integer	(optional) Offset from the previous request to get the next page.

The body of the request must be a JSON formatted query. An example of a query body is shown below.

```
{
    "filter": {
        "type": "contains",
        "field": "hostname",
        "value": "collector"
    },
    "scopeName": "Default:Production:Web",  // optional
    "limit": 100,
    "offset": "<offset-object>"               // optional
}
```

To get the different types of filters supported refer to Filters, on page 812

The query body consists of a JSON body with the following keys.

Keys	Values
filter	Query filter. If filter is empty (i.e. {}), then query matches all inventory items.
scopeName	Full name of the scope to which query is restricted to (optional)
dimensions	List of dimension names to be returned in the result of inventory search API. This is an optional parameter. If unspecified, results return all the available dimensions. This option is useful to specify a subset of the available dimensions when caller does not care about the rest of the dimensions.
limit	Number of response items limit (optional)
offset	Offset object received from previous response (optional)

Response

The response is a JSON object in the body with the following properties.

Name	Type	Description
offset	integer	Response offset to be passed for the next page of results.

Name	Type	Description
results	array of objects	List of results.

The response may contain an `offset` field for paginated responses. Users will need to specify the same offset in the subsequent request to get the next set of results.

Sample Python code

```
req_payload = {
  "scopeName": "Tetration", # optional
  "limit": 2,
  "filter": {"type": "and",
     "filters": [
        {"type": "eq", "field": "vrf_name", "value": "Tetration"},
        {"type": "subnet", "field": "ip", "value": "1.1.1.0/24"},
        {"type": "contains", "field": "hostname", "value": "collector"}
     ]
  }
}

resp = restclient.post('/inventory/search', json_body=json.dumps(req_payload))
print resp.status_code
if resp.status_code == 200:
   parsed_resp = json.loads(resp.content)
   print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

Inventory Statistics

This endpoint returns statistics for inventory items.

```
GET /openapi/v1/inventory/{id}/stats?t0=<t0>&t1=<t1>&td=<td>
```

Table 48:

Path Parameter	Description
id	Inventory item id as `{ip}-{vrf_id}` such as `1.1.1.1-123`

Query Parameter	Description
t0	Start time for statistics in epoch time
t1	End time for statistics in epoch time
td	Granularity for statistic aggregations. An integer specifies number of seconds. Strings may be passed such as “minute”, “hour”, and “day”.

Sample Python code

```
resp = restclient.get('/inventory/1.1.1.1-123/stats?t0=1483228800&t1=1485907200&td=day')
```

Inventory count

This endpoint returns the count of inventory items matching the specified criteria.

```
POST /openapi/v1/inventory/count
```

The list of columns that can be specified in the filter criteria can be obtained with the `/openapi/v1/inventory/search/dimensions` API.

Parameters:

Name	Type	Description
filter	JSON	A filter query.
scopeName	string	(optional) Name of the scope by which to limit results.

The body of the request must be a JSON formatted query. An example of a query body is shown below.

```
{
    "filter": {
        "type": "and",
        "filters": [
            {
                "type": "contains",
                "field": "hostname",
                "value": "prod"
            },
            {
                "type": "subnet",
                "field": "ip"
                "value": "6.6.6.0/24"
            }
        ]
    },
    "scopeName": "Default:Production:Web",  # optional
}
```

Response

The response is a JSON object in the body with the following properties.

Table 49:

Keys	Values
count	Number of inventory items matching the filter Criteria

Sample python code

```
req_payload = {
  "scopeName": "Tetration", # optional
  "filter": {"type": "and",
     "filters": [
        {"type": "eq", "field": "vrf_name", "value": "Tetration"},
        {"type": "subnet", "field": "ip", "value": "1.1.1.0/24"},
        {"type": "contains", "field": "hostname", "value": "collector"}
     ]
```

```
    }
  }

  resp = restclient.post('/inventory/count', json_body=json.dumps(req_payload))
  print resp.status_code
  if resp.status_code == 200:
     parsed_resp = json.loads(resp.content)
     print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

Inventory vulnerability

This endpoint returns CVEs corresponding to IP addresses associate with vulnerable workloads.

This API is only available to users with a minimum read access to root scope.

`POST /openapi/v1/inventory/cves/{rootScopeID}`

Parameters:

Name	Type	Description
ips	list of strings	List of IPs to fetch CVE information.

The body of the request must be a JSON formatted query. An example of a query body is shown below.

```
    {
        "ips": [
            "10.18.187.72",
            "10.18.187.73"
        ]
    }
```

Response

The response is an array of JSON objects in the body with the following properties.

Name	Type	Description
ip	string	IP address
cve_ids	list of strings	List of CVE IDs on the inventory with the ip address.

Sample Python code

```
  root_scope_id = "5fa0d242497d4f7d968c669b"
  req_payload = {
    "ips":["10.18.187.72", "10.18.187.73"]
  }

  resp = restclient.post('/inventory/cves/' + root_scope_id,
json_body=json.dumps(req_payload))
  print resp.status_code
  if resp.status_code == 200:
     parsed_resp = json.loads(resp.content)
     print json.dumps(parsed_resp, indent=4, sort_keys=True)
```

Workload

The workload APIs provides programmatic access to the contents of the Workload Profile page. This set of APIs requires `sensor_management or flow_inventory_query` capability associated with the API key.

Workload details

This endpoint returns the specific workload given agent UUID.

```
GET /openapi/v1/workload/{uuid}
```

Path Parameter	Description
uuid	Agent UUID

Response

The response is a workload object associated with the specified UUID. The workload object's attributes schema is described below:

Table 50:

Attribute	Type	Description
agent_type	integer	Agent type in enum
agent_type_str	string	Agent type in plain text
auto_upgrade_opt_out	boolean	If true, agents do not get automatically upgraded on cluster upgrade
cpu_quota_mode	integer	CPU quota control
cpu_quota_us	integer	CPU quota usage
current_sw_version	string	Version of agent software running on the workload
data_plane_disabled	boolean	If true, flow telemetry data is not exported from the agent to the cluster
desired_sw_version	string	Version of agent software intended to be running on the workload
enable_conversation_mode	boolean	If true, conversation mode is enabled
enable_cache_sidechannel	boolean	If true, side channel attack detection is enabled
enable_forensics	boolean	If true, forensics is enabled

Attribute	Type	Description
enable_meltdown	boolean	If true, meltdown exploit detection is enabled
enable_pid_lookup	boolean	If true, process lookup is enabled
forensics_cpu_quota_mode	integer	Forensics CPU quota control
forensics_cpu_quota_us	integer	Forensics quota usage
forensics_mem_quota_bytes	integer	Forensics memory quota in bytes
host_name	string	Host name on the workload
interfaces	array	Array of Interface objects
kernel_version	string	Kernel version
last_config_fetch_at	integer	Last config fetched at
last_software_update_at	integer	Last software is the timestamp at which agent reported its current version
max_rss_limit	integer	Max memory limit
platform	string	Platform of the workload
uuid	string	Unique ID of the agent
windows_enforcement_mode	string	Type of Windows enforcement mode, WAF(Windows Advanced Firewall) or WFP(Windows Filtering Platform)

Sample Python code

```
agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
resp = restclient.get('/workload/%s' % (agent_uuid))
```

Workload Statistics

This endpoint returns statistics for a workload.

```
GET /openapi/v1/workload/{uuid}/stats?t0=<t0>&t1=<t1>&td=<td>
```

Path Parameter	Description
uuid	Agent UUID

The query URL contains the following parameters

Query Parameter	Description
t0	Start time for statistics in epoch time
t1	End time for statistics in epoch time. The end time cannot exceed the start time by more . than a day.
td	Granularity for statistic aggregations. An integer specifies number of seconds. Strings may be passed such as “minute”, “hour”, and “day”.

Response

The response is a JSON object in the body with the following properties.

Name	Type	Description
timestamp	string	Time at which metrics were gathered (epoch or ISO 8601)
results	object	Metrics

Metrics is a JSON object with the following properties

Name	Type	Description
flow_count	integer	Number of flows.
rx_byte_count	integer	Number of received bytes.
rx_packet_count	integer	Number of received packets.
tx_byte_count	integer	Number of transmitted bytes.
tx_packet_count	integer	Number of transmitted packets.

Sample Python code

```
  agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
  td = 15 * 60 # 15 minutes
 resp = restclient.get('/workload/%s/stats?t0=1483228800&t1=1485907200&td=%d' % (agent_uuid,
td))

  # This code queries workload statistics for a week
  t0 = 1483228800
  for _ in range(7):
    t1 = t0 + 24 * 60 * 60
    resp = restclient.get('/workload/%s/stats?t0=%d&t1=%d&td=day' % (agent_uuid, t0, t1))
    t0 = t1
```

Installed Software Packages

This endpoint returns list of packages installed on the workload.

```
GET /openapi/v1/workload/{uuid}/packages
```

Path Parameter	Description
uuid	Agent UUID

Response

Thw respone is an array of package JSON objects. The package object’s schema is described below:

Attribute	Type	Description
architecture	string	Architecture of the package
name	string	Name of the package
publisher	string	Publisher of the package
version	string	Version of the package

Sample Python code

```
agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
resp = restclient.get('/workload/%s/packages' % (agent_uuid))
```

Workload Vulnerabilities

This endpoint returns list of vulnerabilities observed on the workload.

`GET /openapi/v1/workload/{uuid}/vulnerabilities`

The vulnerabilities object consists of a JSON body with the following keys.

Path Parameter	Description
uuid	Agent UUID

Response

The respone is an array of vulnerability JSON objects. The vulnerability object’s schema is described below:

Attribute	Type	Description
cve_id	string	Common Vulnerability Exposure ID
package_infos	array	Array of Package Info objects
v2_score	float	CVSS V2 Score
v2_access_complexity	string	CVSS V2 Access Compleixty
v2_access_vector	string	CVSS V2 Access Vector
v2_authentication	string	CVSS V2 Authentication
v2_availability_impact	string	CVSS V2 Availability Impact

Attribute	Type	Description
v2_confidentiality_impact	string	CVSS V2 Confidentiality Impact
v2_integrity_impact	string	CVSS V2 Intergrity Impact
v2_severity	string	CVSS V2 Severity
v3_score	float	CVSS V3 Score
v3_attack_complexity	string	CVSS V3 Attack Compleixty
v3_attack_vector	string	CVSS V3 Attack Vector
v3_availability_impact	string	CVSS V3 Availability Impact
v3_base_severity	string	CVSS V3 Base Severity
v3_confidentiality_impact	string	CVSS V2 Confidentiality Impact
v3_integrity_impact	string	CVSS V3 Intergrity Impact
v3_privileges_required	string	CVSS V3 Privileges Required
v3_scope	string	CVSS V3 Scope
v3_user_interaction	string	CVSS V3 User Interaction

Sample Python code

```
agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
resp = restclient.get('/workload/%s/vulnerabilities' % (agent_uuid))
```

Workload Long Running Processes

This endpoint returns list of long running processes on the workload. Long running processes are defined as processes that have at least 5 minutes uptime.

```
GET /openapi/v1/workload/{uuid}/process/list
```

Path Parameter	Description
uuid	Agent UUID

Response

The respone is a list of processes JSON objects.

Attribute	Type	Description
cmd	string	Command string of the process
binary_hash	string	Sha256 of the process binary in hex
ctime	long	ctime of the process binary in us

Attribute	Type	Description
mtime	long	mtime of the process binary in us
exec_path	string	Process executable path
exit_usec	long	Time when the process exited in us
num_libs	integer	Number of libs the process loads
pid	integer	Process ID
ppid	integer	Parent process ID
pkg_info_name	string	Name of the package associated with the process
pkg_info_version	string	Version of the package associated with the process
proc_state	string	Process state
uptime	long	Uptime of the process in us
username	string	Username of the process
resource_usage	array	Array of Resource Usage object

Sample Python code

```
agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
resp = restclient.get('/openapi/v1/workload/%s/process/list' % (agent_uuid))
```

Workload Process Snapshot Summary

This endpoint returns process snapshot summary on this workload. A process snapshot contains all the processes that are captured by the workload at a given time. Currently one copy of the latest process snapshot is retained. The endpoint supports POST method with empty payload to enable easier future expansion.

```
POST /openapi/v1/workload/{uuid}/process/tree/ids
```

Path Parameter	Description
uuid	Agent UUID

Response

The respone is a list of process snapshot summary JSON objects.

Attribute	Type	Description
sensor_uuid	string	Agent UUID

Attribute	Type	Description
handle	string	Handle to the process snapshot to be retrieved
process_count	integer	Number of processes in the snapshot
ts_usec	integer	Timestamp when the snapshot is captured

Sample Python code

```
agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
payload = {
}
resp = restclient.post('/openapi/v1/workload/%s/process/tree/ids' %
                       agent_uuid, json_body=json.dumps(payload))
```

Workload Process Snapshot

This endpoint returns process snapshot on this workload. A process snapshot contains all the processes that are captured by the workload at a given time. Currently one copy of the latest process snapshot is retained. This endpoint needs to be used together with the workload process snapshot summary endpoint.

`POST /openapi/v1/workload/{uuid}/process/tree/details`

Path Parameter	Description
uuid	Agent UUID

Payload Field	Type	Description
handle	string	Handle to the process snapshot to be retrieved

Response

The respone is a list of processes belonging to the snapshot in JSON.

Attribute	Type	Description
command_string	string	Tokenized command string
command_string_raw	string	Raw command string
binary_hash	string	Sha256 of the process binary in hex
ctime	long	ctime of the process binary in us
mtime	long	mtime of the process binary in us
exec_path	string	Process executable path
process_id	integer	Process ID

Attribute	Type	Description
parent_process_id	integer	Parent process ID
process_key	integer	Unique key to the process
parent_process_key	integer	Unique key to the parent process
pkg_info_name	string	Name of the package associated with the process
pkg_info_version	string	Version of the package associated with the process
proc_state	string	Process state
uptime	long	Uptime of the process in us
username	string	Username of the process
cve_ids	array	Array of CVEID object

Sample Python code

```
agent_uuid = 'aa28b304f5c79b2f22d87a5af936f4a8fa555894'
payload = {
}
resp = restclient.post('/openapi/v1/workload/%s/process/tree/ids' %
            agent_uuid, json_body=json.dumps(payload))
handle = json.loads(resp.text)['process_summary'][0]['summary'][0]['handle']
payload = {
  "handle": handle,
}
resp = restclient.post('/openapi/v1/workload/%s/process/tree/details' %
            agent_uuid, json_body=json.dumps(payload))
```

JSON Object Definitions

Interface

Attribute	Type	Description
ip	string	IP Address of the interface
mac	string	Mac Address of the interface
name	string	Name of the interface
netmask	string	Netmask of the interface
pcap_opened	boolean	If false, packet captures are not enabled for the interface
tags_scope_id	array	Scope IDs associated with the interface

Attribute	Type	Description
vrf	string	VRF Name
vrf_id	integer	VRF ID

Package Info

Attribute	Type	Description
name	string	Package name
version	string	Package version

Resource Usage

Attribute	Type	Description
cpu_usage	float	CPU usage
memory_usage_kb	integer	Memory usage
ts_usec	long	Timestamp in us when the resource usage is captured

CVE ID

Attribute	Type	Description
cve_id	string	cve ID
impact__cvss_v2__access_complexity	string	CVE access complexity
impact__cvss_v2__access_vector	string	CVE access vector

Default Policy Generation Config

This set of APIs is used to read and update the default policy generation config for a root scope.

The APIs require the `app_policy_management` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

- Policy Generation Config object, on page 831
- Get the Default Policy Generation Config, on page 832
- Set the Default Policy Generation Config, on page 832

Policy Generation Config object

Attribute	Type	Description
carry_over_policies	boolean	Any policy marked as approved will be maintained, if possible
deep_policy_generation	boolean	creates policies for the whole scope tree under give scope, includes all the members in the give scope
skip_clustering	boolean	set to true to skip clustering, will generate policies with existing approved clusters and scopes
auto_accept_policy_connectors	boolean	auto accepts all outgoing policy connectors
enable_exclusion_filter	boolean	apply exclusion filters to input flow data
enable_default_exclusion_filter	boolean	apply default exclusion filters to input flow data
remove_redundant_policies	boolean	remove redundant policies during deep policy generation
enable_service_discovery	boolean	setting false skips policy generation based on ephemeral port range in adm pipeline reported by the sensor, currently used for generating policies for Windows Active Directory.
externals	array	ordered list of external dependency objects
clustering_granularity	string	one of VERY_COARSE, COARSE, MEDIUM, FINE, VERY_FINE
policy_compression	string	one of DISABLED, CONSERVATIVE, MODERATE, AGGRESSIVE, VERY_AGGRESSIVE
port_generalization	string	one of DISABLED, CONSERVATIVE, MODERATE, AGGRESSIVE, VERY_AGGRESSIVE
sim_policy	integer	1 => flows, 2 => processes, 5 => both

The External Dependency object

Name	Type	Description
id	string	id of the filter
filter_type	string	AppScope or UserInventoryFilter

Name	Type	Description
incluce	array	object with user_filters boolean to enable and user_filter_list for the ordered list of provided service inventory filters

-

Get the Default Policy Generation Config

This endpoint returns the current default policy generation config. Can return an empty object if none has been created.

```
GET /openapi/v1/app_scopes/default_adm_run_config
```

Parameters:

The request URL contains the following parameters

Name	Type	Description
root_app_scope_id	string	The unique identifier of the root scope to which this default config applies

Response object: Returns the current default policy generation config or an empty object if none has been created

Set the Default Policy Generation Config

This endpoint sets the default policy generation config.

```
PUT /openapi/v1/app_scopes/default_adm_run_config
```

Parameters in addition to the values of the policy generation config object list above.

Name	Type	Description
root_app_scope_id	string	The unique identifier of the root scope to which this default config applies

Response object: Returns the default policy generation config.Response object: Returns the default policy generation config.

Forensics Intent

The software agents APIs are associated with managing forensic intents.

Forensic intents link a forensic profile with the group of agents it applies to. The group of agents is defined using an inventory filter.

These set of APIs require the `sensor_management` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

Forensic intent object

Attribute	Type	Description
id	string	unique identifier of the intent
name	string	name of the intent
inventory_filter_id	array	id of the inventory filter associated with the intent
forensic_config_profile_id	integer	id of the profile associated with this intent
created_at	integer	Unix timestamp of when the intent was created
updated_at	integer	Unix timestamp of when the intent was last updated

Listing a forensic intents

This endpoint lists all existing forensic profiles

```
GET /openapi/v1/inventory_config/forensic_intents
```

Parameters: None

This endpoint returns an array of forensic intent object summaries.

Retrieving a Single Forensic Intent

```
GET /openapi/v1/inventory_config/forensic_intents/{intent_id}
```

Parameters:

Name	Type	Description
intent_id	string	id of the intent

Returns a detailed representation of the forensic intent object.

Creating a Forensic Intent

```
POST /openapi/v1/inventory_config/forensic_intents
```

Parameters:

Name	Type	Description
name	string	name of the intent
inventory_filter_id	string	id of the inventory filter associated with the intent
forensic_config_profile_id	string	id of the forensic profile associated with the intent

Returns a forensic intent object.

Update a Forensic Intent

```
PUT /openapi/v1/inventory_config/forensic_intents/{intent_id}
```

Parameters:

Name	Type	Description
intent_id	string	id of the intent
name	string	name of the intent
inventory_filter_id	string	id of the inventory filter associated with the intent
forensic_config_profile_id	string	id of the forensic profile associated with the intent

Returns a forensic intent object.

Delete a Forensic Intent

```
DELETE /openapi/v1/inventory_config/forensic_intents/{intent_id}
```

Parameters:

Name	Type	Description
intent_id	string	id of the intent

Returns a 200 on success.

Forensics Intent Orders

The software agents APIs are associated with managing forensic intent orders.

Forensic profiles are applied to agents using intent. The intents use inventory filters to define the groups of agents. If the filters overlap we need know which to apply. We use the order to define intent priority.

These set of APIs require the `'sensor_management'` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

- Forensic Intent Order Object, on page 835
- Retrieve the Current Forensic Intent Order, on page 835
- Creating a Forensic Intent, on page 833

Forensic Intent Order Object

Attribute	Type	Description
version	string	version of the current ordering
intents	array	name of the intent objects in order
intent_ids	array	array of forensic intent ids

Retrieve the Current Forensic Intent Order

This endpoint returns the current forensic intent order.

```
GET /openapi/v1/inventory_config/forensic_orders
```

Parameters: None

This endpoint returns the current forensic intent order object.

Creating a Forensic Intent Order

```
POST /openapi/v1/inventory_config/forensic_orders
```

Parameters:

Name	Type	Description
version	string	must match the current order
intent_ids	array	array of the intent ids

Returns a forensic intent order object.

Forensics Profiles

The software agents APIs are associated with managing forensic profiles.

Forensic profiles are collections of rules that can be applied to groups of agents using forensic intents.

These set of APIs require the `'sensor_management'` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

Forensic Profile Object

Attribute	Type	Description
id	string	unique identifier of the profile
name	string	name of the profile
forensic_rules	array	array of the rules associated with the profile
created_at	integer	Unix timestamp of when the profile was created
updated_at	integer	Unix timestamp of when the profile was last updated
is_readonly	boolean	indicates if the profile is read only
root_app_scope_id	string	id of the root scope to which the profile belongs

Listing Forensic Profiles

This endpoint lists all existing forensic profiles

```
GET /openapi/v1/inventory_config/forensic_profiles
```

Parameters: None

This endpoint returns an array of forensic profile object summaries.

Retrieving a Single Forensic Profile

```
GET /openapi/v1/inventory_config/forensic_profiles/{profile_id}
```

Parameters:

Name	Type	Description
profile_id	string	id of the profile

Returns a detailed representation of the forensic profile object.

Creating a Forensic Profile

```
POST /openapi/v1/inventory_config/forensic_profiles
```

Parameters:

Name	Type	Description
name	string	name of the profile
root_app_scope_id	string	id of the root scope to which the profile belongs
forensic_rule_ids	array	array of forensic rule ids to be associated with this profile

Returns a forensic profile object.

Update a Forensic Profile

```
PUT /openapi/v1/inventory_config/forensic_profiles/{id}
```

Parameters:

Name	Type	Description
profile_id	string	id of the profile
name	string	name of the profile
forensic_rule_ids	array	array of forensic rule ids to be associated with this profile

Returns a forensic profile object.

Delete a Forensic Profile

```
DELETE /openapi/v1/inventory_config/forensic_profiles/{profile_id}
```

Parameters:

Name	Type	Description
profile_id	string	id of the profile

Returns a 200 on success.

Forensics Rules

The software agents APIs are associated with managing forensic rules.

Forensic rules are used in forensic profiles which are then applied to groups of agents.

These set of APIs require the `'sensor_management'` capability associated with the API key.

Note These APIs are only available to site admins and owners of root scopes.

Forensic Rule Object

Attribute	Type	Description
id	string	unique identifier of the rule
name	string	name of the rule
description	string	description of the rule
type	string	PREDEFINED or USER_DEFINED
eval_group_type	string	AS_INDIVIDUAL or AS_GROUP
severity	string	one of IMMEDIATE_ACTION, CRITICAL, HIGH, MEDIUM, LOW
actions	array	array or ALERT or REPORT strings
created_at	integer	Unix timestamp of when the rule was created
updated_at	integer	Unix timestamp of when the rule was last updated

Listing a Forensic Rules

This endpoint lists all existing forensic rules

```
GET /openapi/v1/inventory_config/forensic_rules
```

Parameters: None

This endpoint returns an array of forensic rule object summaries.

Retrieving a Single Forensic Rule

```
GET /openapi/v1/inventory_config/forensic_rules/{rule_id}
```

Parameters:

Name	Type	Description
rule_id	string	id of the rule

Returns a detailed representation of the forensic rule object.

Creating a Forensic Rule

```
POST /openapi/v1/inventory_config/forensic_rules
```

Parameters:

Name	Type	Description
root_app_scope_id	string	id of the root scope to which this rule belongs
name	string	name of the rule
description	string	description of the rule
eval_group_type	string	type of the rule
severity	string	severity of the rule
actions	array	array or ALERT or REPORT strings
clause	string	the query clause of the rule.

Returns a forensic rule object.

Update a Forensic Rule

```
PUT /openapi/v1/inventory_config/forensic_rules/{rule_id}
```

Parameters:

Name	Type	Description
rule_id	string	id of the rule
name	string	name of the rule
description	string	description of the rule
eval_group_type	string	type of the rule
severity	string	severity of the rule
actions	array	array or ALERT or REPORT strings
clause	string	the query clause of the rule.

Returns a forensic rule object.

Delete a Forensic Rule

```
DELETE /openapi/v1/inventory_config/forensic_rules/{rule_id}
```

Parameters:

Name	Type	Description
rule_id	string	id of the rule

Returns a 200 on success.

Enforcement

Policy enforcement is the feature where generated policies are pushed to the assets in the scope associated with a workspace and new firewall rules are written. More information can be found in the Enforce Policies documentation. This set of APIs requires the `app_policy_management` capability associated with the API key.

Agent Network Policy Config

This endpoint returns an Agent object according to the agent ID. It is useful for fetching the network policy, agent configuration, its version, etc.

```
GET /openapi/v1/enforcement/agents/{aid}/network_policy_config
```

Parameters:

The request URL contains the following parameters

Name	Type	Description
aid	string	Agent UUID for network policy config.

The JSON query body contains the following keys

Name	Type	Description
include_filter_names	boolean	Includes filter names and ID's in network policies.
inject_versions	boolean	Includes ADM workspace versions in network policies.

Response

The response of this endpoint is an Agent object.

Concrete Policy Statistics

This endpoint returns statistics for concrete policies given the agent ID and the concrete policy ID. The endpoint returns an array of Timeseries Concrete Policy Result objects.

```
GET /openapi/v1/enforcement/agents/{aid}/concrete_policies/{cid}/stats?t0=<t0>&t1=<t1>
→&td=<td>
```

Parameters:

The request URL contains the following parameters

Name	Type	Description
aid	string	Agent UUID for statistics.
cid	string	Concrete Policy UUID for statistics.

The JSON query body contains the following keys

Table 51:

Name	Type	Description
t0	integer	Start time for statistics in epoch time
t1	integer	End time for statistics in epoch time
td	integer or string	Granularity for statistic aggregations. An integer specifies number of seconds. Strings may be passed such as "minute", "hour", and "day".

JSON Object Definitions

Agent

Attribute	Type	Description
agent_uuid	string	Agent UUID.
agent_config	object	Agent Config
agent_config_status	object	Agent Config Status
desired_network_policy_config	object	Network Policy Configuration
provisioned_network_policy_config	object	Provisioned Network Policy Config
provisioned_state_update_timestamp	integer	epoch timestamp in seconds when agent acknowledged the above provisioned policy.
desired_policy_update_timestamp	integer	epoch timestamp in seconds when desired_network_policy_config is generated.
agent_info	object	Agent Info
skipped	boolean	true, when concrete policy generation is skipped.
message	string	Reason why concrete policy generation is skipped.

Agent Config

Attribute	Type	Description
agent_uuid	string	Agent UUID.
enforcement_enabled	boolean	Config stating is enforcement is enabled on Agent.
fail_mode	string	Fail Mode.
version	number	Agent config version number.
control_tet_rules_only	boolean	Control tet rules only config.
allow_broadcast	boolean	Allow Broadcast config.
allow_multicast	boolean	Allow Multicast config.
allow_link_local	boolean	Allow Link Local config.

Attribute	Type	Description
enforcement_cpu_quota_mode	string	Enforcement Agent CPU quota mode.
enforcement_cpu_quota_us	string	Enforcement Agent CPU quota micros sec.
enforcement_max_rss_limit	number	Enforcement Agent Max RSS limit.

Network Policy Configuration

Attribute	Type	Description
version	string	Version number.
network_policy	array	Array of Network Policy objects.
address_sets	array	Array of Address Set objects for IP set feature.
container_network_policy	array	Array of ContainerNetworkPolicy objects.

Network Policy

Attribute	Type	Description
priority	string	Priority of concrete policy.
enforcement_intent_id	string	Enforcement Intent ID.
concrete_policy_id	string	Concrete Policy ID.
match	object	Match criteria for policy. This field is deprecated.
action	object	Action for policy match.
workspace_id	string	ID for a workspace.
adm_data_set_id	string	Automatic policy discovery data set id of workspace.
adm_data_set_version	string	Automatic policy discovery data set version of the workspace. Set only when inject_versions=true is passed in params.
cluster_edge_id	string	Cluster Edge ID.
policy_intent_group_id	string	Policy intent group ID.

Attribute	Type	Description
match_set	object	Match Set object for IP set support. Exactly one of match or match_set will be present.
src_filter_id	string	Source inventory filter ID. This will be set when include_filter_names=true passed as params.
src_filter_name	string	Source inventory filter name. This will be set when include_filter_names=true passed as params.
dst_filter_id	string	Destination inventory filter ID. This will be set when include_filter_names=true passed as params.
dst_filter_name	string	Destination Inventory filter name. This will be set when include_filter_names=true passed as params.

ContainerNetworkPolicy

Attribute	Type	Description
pod_id	string	POD ID.
network_policy	array	Array of Network Policy objects.
deployment	string	Deployment Name.
service_endpoint	array	List of service endpoint names.

Match

Attribute	Type	Description
src_addr	object	Subnet object for source address.
dst_addr	object	Subnet object for destination address.
src_port_range_start	int	Source port range start.
src_port_range_end	int	Source port range end.
dst_port_range_start	int	Destination port range start.

Attribute	Type	Description
dst_port_range_end	int	Destination port range end.
ip_protocol	string	IP Protocol.
address_family	string	IPv4 or IPv6 address family.
direction	string	Direction of match, INGRESS or EGRESS.
src_addr_range	object	Address Range object for source address.
dst_add_range	object	Address Range object for destination address.

Action

Attribute	Type	Description
type	string	Action type.

Match Set

Attribute	Type	Description
src_set_id	string	Source set ID of Address Set object in the Network Policy Configuration `address_sets` array.
dst_set_id	string	Destination set ID of Address Set object in the Network Policy Configuration `address_sets` array.
src_ports	ar- ray	Array of Port Range objects for source ports.
dst_ports	ar- ray	Array of Port Range objects for destination ports.
ip_protocol	string	IP Protocol.
address_family	string	IPv4 or IPv6 address family.
direction	string	Direction of match, INGRESS or EGRESS.

Address Set

Attribute	Type	Description
set_id	string	Address set ID.
addr_ranges	array	Array of Address Range objects.
subnets	array	Array of Subnet objects.
addr_family	string	IPv4 or IPv6 address family.

Subnet

Attribute	Type	Description
ip_addr	string	IP address.
prefix_length	int	Prefix length for subnet.

Address Range

Attribute	Type	Description
start_ip_addr	string	Start IP address for range.
end_ip_addr	string	End IP address for range.

Port Range

Attribute	Type	Description
start_port	int	Start port for range.
end_port	int	End port for range.

Agent Config Status

Attribute	Type	Description
disabled	boolean	Config stating is enforcement is disabled on Agent.
current_version	number	Current Agent config version applied on Agent.
highest_seen_version	number	Highest version of agent config received by Agent.

Provisioned Network Policy Config

Attribute	Type	Description
version	string	Network policy config version provisioned by Agent.
error_reason	string	CONFIG_SUCCESS when Agent successfully applied policies else error reason.
disabled	boolean	Config stating is enforcement is disabled on Agent.
current_version	number	Current NPC version applied on Agent.
highest_seen_version	number	Highest version of NPC received by Agent.
policy_status	object	Every network policy status.

Agent Info

Attribute	Type	Description
agent_info_supported	boolean	Agent capability if agent_info is supported.
ipset_supported	boolean	Agent capability if ipsets are supported.

Concrete Policy Result

Attribute	Type	Description
byte_count	int	Byte count for concrete policy hits.
pkt_count	int	Packet count for concrete policy hits.

Timeseries Concrete Policy Result

Attribute	Type	Description
timestamp	string	Timestamp string for aggregation of results.
result	object	Concrete Policy Result

Client Server configuration

Detecting client and server relationships is central to various features in Secure Workload which is why we recommend using the Software Agent whenever possible as it can report the ground truth. Any telemetry monitoring point in the network cannot guarantee to observe every packet for a given flow - due to a wide range of circumstances, for example: two unidirectional halves of a TCP flow may take unique paths through the network - therefore will always unavoidably affected by a level of error.

Secure Workload attempts to detect and minimize these errors without any user interaction by applying machine learning algorithms to each flow, building a statistical model which provides a judgement when inconsistent telemetry is reported. For the majority of cases, users do not need to worry about this set of APIs. However, in some minority of cases the client server detection algorithm does not get the flow direction correct. Features which rely on flow direction, for example, automatic policy discovery may exhibit undesired behavior like opening unnecessary ports.

A set of APIs are provided that can be used to provide hints about known server ports to Secure Workload algorithms. This set of APIs is available to users with root scope ownership role and requires the `app_policy_management` capability associated with the API key for those users.

There are 2 options for Client Server configuration:

Host Config

Configuration of known server ports that are applicable to a specific subset of IP addresses within a root scope

Add server port configuration

This API can be used to provide hints to Secure Workload algorithms about known server ports for a given root scope. You can provide a list of known TCP/UDP server ports for a set of IP addresses belonging to a root scope to aid Secure Workload algorithms with figuring out client server direction correct in flows.

```
POST /openapi/v1/adm/{root_scope_id}/server_ports
```

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Unique identifier for the root scope.

Additionally, a text file provided as input to this API contains the endpoint server port configuration in the following format:

Endpoint server port configuration

Attribute	Type	Description
ip_address	string	IP Address (can be ipv4 or ipv6 address). Subnets are not allowed.
tcp_server_ports	List of int	List of known TCP server ports corresponding to the ip_address.

Attribute	Type	Description
udp_server_ports	List of int	List of known UDP server ports corresponding to the ip_address.

Bulk server port configuration

Attribute	Type	Description
host_config	List of Endpoint server port configuration objects.	List of IP addresses with associated known server ports.

Sample python code

```
# contents of below file:
# {"host_config": [
#    {"ip_address": "1.1.1.1",
#     "tcp_server_ports": [100, 101, 102],
#     "udp_server_ports": [103]
#    },
#    {"ip_address": "1.1.1.2",
#     "tcp_server_ports": [200, 201, 202]
#    }
#  ]
# }

file_path = '/<path_to_file>/server_ports.txt'
root_scope_id = '<root-scope-id>'
restclient.upload(file_path,
                  '/adm/%s/server_ports' % root_scope_id,
                  timeout=200) # seconds
```

Note Above API overwrites the full state of known server port configuration in the backend. If you need to modify anything, they need re-upload the full configuration after modifications.

Get server port configuration

This API returns list of known uploaded server ports for endpoints in a root scope.

`GET /openapi/v1/adm/{root_scope_id}/server_ports`

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Unique identifier for the root scope.

Response object: A list of ref:*ServerPortConfig* objects.

Sample python code

```
root_scope_id = '<root-scope-id>'
restclient.get('/adm/%s/server_ports' % root_scope_id)
```

Delete server port configuration

This API deletes server port configuration for specified root scope.

```
DELETE /openapi/v1/adm/{root_scope_id}/server_ports
```

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Unique identifier for the root scope.

Response object: None.

Sample python code

```
root_scope_id = '<root-scope-id>'
restclient.delete('/adm/%s/server_ports' % root_scope_id)
```

Port Config

Configuration of known server ports that are applicable to all IP addresses that belong to a root scope

Push server port configuration

This API can be used to provide hints to Secure Workload algorithms about known server ports for a given root scope. Users can provide a list of known TCP/UDP server ports for a given root scope to aid Secure Workload algorithms with figuring out client server direction correct in flows. Users also have the option of specifying a service name associated with each server port.

There is also a default list of known services that are applicable to all root scopes(hereafter referred to as global services). This list can be overridden at any point by the user.

Service configuration

A service is defined to be a (port, name) pair.

Attribute	Type	Description
port	int	TCP/UDP server port number
name	string	Service name associated with this port (optional)
override_in_conflicts	boolean	Force host to be provider in case of a conflict (optional)

Bulk service configuration

Attribute	Sub-Attribute	Type	Description
server_ports_config	tcp_service_list	List of *Service configuration* objects.	List of known TCP services
	udp_service_list	List of *Service configuration*objects.	List of known UDP services

```
Push services per root scope:

POST /openapi/v1/adm/{root_scope_id}/server_ports_config
```

Sample python code

```
# contents of below file:
#{"server_ports_config":
#    {
#        "tcp_service_list": [
#                {
#                        "port": 80,
#                        "name" : "http"
#
#                },
#                {
#                        "port": 53,
#                        "name" : "dns"
#                },
#                {
#                        "port": 514,
#                        "name" : "syslog",
#                        "override_in_conflicts": true
#                }
#        ],
#        "udp_service_list": [
#                {
#                        "port": 161
#                },
#                {
#                        "port": 53,
#                        "name": "dns"
#                }
#        ]
#    }
#}

file_path = '/<path_to_file>/server_ports.json'

# Updating service list for a given root scope
#restclient.upload(file_path,
#                  '/openapi/v1/adm/{root_scope_id}/server_ports_config',
#                  timeout=200) # seconds
```

Note Above API overwrites the full state of known server port configuration in the backend. If user needs to modify anything, they need re-upload the full configuration after modifications.

Retrieve server port configuration

This API returns list of known server ports in a root scope uploaded by the user. Response is *Bulk service configuration.*

```
Retrieve configured services per root scope:
    GET /openapi/v1/adm/{root_scope_id}/server_ports_config

Retrieve configured global services:
    GET /openapi/v1/adm/server_ports_config
```

Remove server port configuration

This API deletes server port configuration for specified root scope.

```
Remove configured services per root scope:
    DELETE /openapi/v1/adm/{root_scope_id}/server_ports_config
```

Software Agents

Agent APIs

The software agents APIs are associated with managing Secure Workload software agents. These set of APIs require the `sensor_management` capability associated with the API key. *GET* APIs below are also available with `flow_inventory_query` capability associated with the API key.

Get software agents

This endpoint returns a list of software agents. Each software agent has two fields to describe its agent type, `agent_type_str` is in plain text while `agent_type` is an enum.

```
GET /openapi/v1/sensors
```

Parameters:

Name	Type	Description
limit	integer	Limits the number of results returned (optional)
offset	string	Offset is used for paginated requests. If response returns offset then subsequent re- quest must use the same offset to get more results in the next page. (optional)

Get specific software agent

This endpoint returns attributes for the software agent agent whose UUID is part of the URI. Each software agent has two fields to describe its agent type, <agent_type_str> is in plain text while <agent_type> is an enum.

```
GET /openapi/v1/sensors/{uuid}
```

Deleting software agent

This endpoint is used to decommission a software agent given its UUID.

Use the API with caution; once an agent is deleted, it is no longer available in the Secure Workload dashboard and if the agent is active, flow exports from the agent are not allowed in Secure Workload.

```
DELETE /openapi/v1/sensors/{uuid}
```

Software agent configuration using Intents

This API workflow uses few REST endpoints defined below.

Creating an inventory filter

This endpoint is used to specify criteria that match agent hosts on which user wants to configure software agents.

```
POST /openapi/v1/filters/inventories
```

Parameters:

Name	Type	Description
app_scope_id	string	The scope ID to assign to the inventory filter.
name	string	A name for the inventory filter.
query	json	Filter or match criteria for agent host.

Sample python code

```
# app_scope_id can be retrieved by /app_scopes API
req_payload = {
   "app_scope_id": <app_scope_id>,
   "name": "sensor_config_inventory_filter",
   "query": {
      "type": "eq",
      "field": "ip",
      "value": <sensor_interface_ip>
   }
}
resp = restclient.post('/filters/inventories',
               json_body=json.dumps(req_payload)))
print resp.status_code
# returned response will contain the created filter and it's ID.
```

Creating a software agent configuration profile

This endpoint is used to specify the set of configuration options to apply to target set of software agents.

```
POST /openapi/v1/inventory_config/profiles
```

Following configuration options can be specified as part of agent configuration profile:

- allow_broadcast: option to allow/disallow broadcast traffic (default value of this option is True).
- allow_multicast: option to allow/disallow multicast traffic (default value of this option is True).
- allow_link_local: option to allow/disallow link local traffic (default value of this option is True).
- auto_upgrade_opt_out: if true, agents are not auto-upgraded during upgrade of Secure Workload cluster.
- cpu_quota_mode & cpu_quota_usec: these options are used to police the amount of CPU quota to give to agent on the end host.
- data_plane_disabled: if true, agent stops reporting flows to Secure Workload.
- enable_conversation_mode: option to enable conversation mode on all sensors.
- enable_forensics: option to enable collection of forensic events on the workload (agent uses more CPU as a result).
- enable_meltdown: enables Meltdown Exploit detection on the workload (agent uses more CPU as a result).
- enable_pid_lookup: if true, agent tries to attach process information to flows. Note this config option uses more CPU on the end host.
- enforcement_disabled: can be used to disable enforcement on hosts running enforcement agents.
- preserve_existing_rules: option to specify whether to preserve existing iptable rules.
- windows_enforcement_mode: option to use WAF (Windows Advanced Firewall) or WFP (Windows Filtering Platform) (default option is WAF).

For more details about the configuration options, refer to Software Agent Config

Sample python code

```
# Define profile to disable data_plane on agent
req_payload = {
   "root_app_scope_id": <root_app_scope_id>,
   "data_plane_disabled": True,
   "name": "sensor_config_profile_1",
   "enable_pid_lookup": True,
   "enforcement_disabled": False
}
resp = restclient.post('/inventory_config/profiles',
               json_body=json.dumps(req_payload))
print resp.status_code
# returned response will contain the created profile and it's ID.
parsed_resp = json.loads(resp.content)
```

Get software agent configuration profiles

This endpoint returns a list of software agent configuration profiles visible to the user.

```
GET /openapi/v1/inventory_config/profiles
```

Parameters: None

Get specific software agent configuration profile

This endpoint returns an instance of software agent configuration profile.

```
GET /openapi/v1/inventory_config/profiles/{profile_id}
```

Returns the software agent configuration profile object associated with the specified ID.

Update a software agent configuration profile

This endpoint updates a software agent configuration profile.

```
PUT /openapi/v1/inventory_config/profiles/{profile_id}
```

Following configuration options can be specified as part of agent configuration profile:

- allow_broadcast: option to allow/disallow broadcast traffic (default value of this option is True).
- allow_multicast: option to allow/disallow multicast traffic (default value of this option is True).
- allow_link_local: option to allow/disallow link local traffic (default value of this option is True).
- auto_upgrade_opt_out: if true, agents are not auto-upgraded during upgrade of Secure Workload cluster.
- cpu_quota_mode & cpu_quota_usec: these options are used to police the amount of CPU quota to give to agent on the end host.
- data_plane_disabled: if true, agent stops reporting flows to Secure Workload.
- enable_conversation_mode: option to enable conversation mode on all sensors.
- enable_forensics: option to enable collection of forensic events on the workload (agent uses more CPU as a result).
- enable_meltdown: enables Meltdown Exploit detection on the workload (agent uses more CPU as a result).
- enable_pid_lookup: if true, agent tries to attach process information to flows. Note this config option uses more CPU on the end host.
- enforcement_disabled: can be used to disable enforcement on hosts running enforcement agents.
- preserve_existing_rules: option to specify whether to preserve existing iptable rules.
- windows_enforcement_mode: option to use WAF (Windows Advanced Firewall) or WFP (Windows Filtering Platform) (default option is WAF).

For more details about the configuration options, refer to Software Agent Config

Returns the modified software agent configuration profile object associate with the specified ID.

Delete a software agent configuration profile

This endpoint deletes the specified software agent configuration profile.

```
DELETE /openapi/v1/inventory_config/profiles/{profile_id}
```

Creating a software agent configuration intent

This endpoint is used to specify the intent to apply set of configuration options to specified set of software agents. This will create the intent and updates the intent order by adding the newly created intent to the order.

```
POST /openapi/v1/inventory_config/intents
```

Sample python code

```
  req_payload = {
    "inventory_config_profile_id": <>,
    "inventory_filter_id": <>
  }
  resp = restclient.post('/inventory_config/intents',
                 json_body=json.dumps(req_payload))
  print resp.status_code
  # returned response will contain the created intent object and it's ID.
```

Specifying order of intents

This endpoint is used to specify the ordering of various software agent configuration intents. For example, there could be two intents – one to enable process ID lookup on development machines and second one to disable process ID lookup on windows machines. If the first intent has higher priority, then development windows machines will have process ID lookup enabled. NOTE: By default, when intent is created, it is added to the beginning of intent orders list. This endpoint is only to be used if end user needs to modify the existing order of intents.

```
POST /openapi/v1/inventory_config/orders
```

Sample python code

```
  # Read the agent config intents ordered list
  resp = restclient.get('/inventory_config/orders')
  order_result_json = json.loads(resp.content)

  # Modify the list by prepending the new intent in the list
  order_rslt_json['intent_ids'].insert(0,<intent_id>)

  # Post the new ordering back to the server
  resp = restclient.post('/inventory_config/orders',
                 json_body=json.dumps(order_rslt_json))
```

Remove agent config intent

This endpoint is used to remove a specific agent configuration intent.

```
DELETE /openapi/v1/inventory_config/intents/{intent_id}
```

Sample python code

```
  intent_id = '588a51dcb5b30d0ee6da084a'
  resp = restclient.delete('/inventory_config/intents/%s' % intent_id)
```

Interface Config Intents

The recommended way to assign VRFs to agents is using Remote VRF configuration settings. In rare cases, when agent hosts may have multiple interfaces that need to be assigned different VRFs, users can choose to assign them VRFs using Interface Config Intents. Go to **Manage** > **Agents** and click the **Configure** tab.

Inventory Config Intent Object

The GET and POST methods return an array of inventory config intent JSON objects. The object’s attributes are described below:

Attribute	Type	Description
vrf_id	integer	VRF ID integer
vrf_name	string	VRF Name
inventory_filter_id	string	Inventory Filter ID
inventory_filter	JSON	Inventory filter. See OpenAPI > Inventory Filters for more details.

Get Interface Config Intents

This endpoint returns a list of inventory config intents to the user.

```
GET /openapi/v1/inventory_config/interface_intents
```

Parameters: None

Create or Update list of Interface Config Intents

This endpoint is used to create or modify list of interface config intents. The API takes an ordered list of intents. To remove an intent in this list, users would need to read the existing list of intents, modify the list and write the modified list back.

```
POST /openapi/v1/inventory_config/interface_intents
```

Parameters:

Name	Type	Description
inventory_filter_id	string	Inventory filter ID to match interface
vrf_id	integer	VRF ID to assign interface

Sample python code

```
  req_payload = {
    "intents": [
      {"inventory_filter_id": <inventory_filter_id_1>, "vrf_id": <vrf_id_1>},
      {"inventory_filter_id": <inventory_filter_id_1>, "vrf_id": <vrf_id_2>}
    ]
  }
  resp = restclient.post('/inventory_config/interface_intents',
json_body=json.dumps(req_payload))
```

VRF configuration for agents behind NAT

Following set of APIs are useful to specify policies to assign VRFs to agents behind NAT boxes. These set of APIs require the `sensor_management` capability associated with the API key and are only available to site admin users.

List VRF configuration rules for agents behind NAT

This endpoint returns a list of VRF configuration rules applicable to agents behind NAT.

```
GET /openapi/v1/agentnatconfig
```

Create a new VRF configuration applicable to agents behind NAT

This endpoint is used to specify criteria for VRF labeling for hosts based on their source IP and source port as seen by Secure Workload appliance.

```
POST /openapi/v1/agentnatconfig
```

Parameters:

Name	Type	Description
src_subnet	string	Subnet to which source IP can belong to (CIDR notation).
src_port_range_start	integer	Lower bound of source port range (0-65535).
src_port_range_end	integer	Upper bound of source port range (0-65535).
vrf_id	integer	VRF ID to use for labeling flows for agents whose source address and port falls in the above specified range.

Sample python code

```
req_payload = {
    src_subnet: 10.1.1.0/24,          # src IP range for sensors
    src_port_range_start: 0,
    src_port_range_end: 65535,
    vrf_id: 676767                    # VRF ID to assign
}

resp = rc.post('/agentnatconfig', json_body=json.dumps(req_payload))
print resp.status_code
```

Delete existing VRF configuration

```
DELETE /openapi/v1/agentnatconfig/{nat_config_id}
```

Secure Workload software download

The Secure Workload software download feature provides a way to download software packages for Secure Workload agents. These set of APIs require the `software_download` capability associated with the API key. This capability is only available to site admin users, root scope owners and users with agent installer roles.

API to get supported platforms

This end point returns the list of supported platforms.

```
GET /openapi/v1/sw_assets/platforms
```

Parameters: None

Reponse object: Returns the list of supported platforms.

Sample python code

The sample code below retrieves all the supported platforms.

```
resp = restclient.get('/sw_assets/platforms')
if resp.status_code == 200:
   parsed_resp = json.loads(resp.content)
   print json.dumps(parsed_resp)
```

Sample response

```
{"results": [{"platform": "OracleServer-6.3", "agent_type": "enforcer", "arch": "x86_64"},
 {"platform": "MSWindows8Enterprise", "agent_type": "legacy_sensor", "arch": "x86_64"}]}
```

API to get supported software version

This endpoint returns the list of supported software version for specified “agent_type”, “package_type”, “platform” and “architecture”.

```
GET
/openapi/v1/sw_assets/download?platform=<platform>&agent_type=<agent_type>&pkg_type=<pkg_type>&arch=<arch>&list_version=<list_version>&installation_id=<installer_id>
```

where <agent_type>, <platform> and <arch> can be any one of the results retrieved from the **API to get supported platforms**, and <pkg_type> can be either “sensor_w_cfg” or “sensor_bin_pkg”. Both <pkg_type> and <agent_type> are optional but at least one of them should be specified. <list_version> must be “True” to enable this API.

Parameters: The request URL contains the following parameters.

Name	Type	Description
platform	string	Specify the platform.
agent_type	string	(optional) Specify the agent type.
pkg_type	string	(optional) Specify the package type, the value can be either “sensor_w_cfg” or “sensor_bin_pkg”.
arch	string	Specify the architecture.
list_version	string	Set to “True” to enable software version search.

Response object: Returns a list of supported software version.

Sample python code

```
resp =
restclient.get('/sw_assets/download?platform=OracleServer-6.3&pkg_type=sensor_w_cfg&arch=x86_64&list_version=True')
if resp.status_code == 200:
   print resp.content
```

```
resp =
restclient.get('/sw_assets/download?platform=OracleServer-6.3&pkg_type=sensor_w_cfg&arch=x86_64&installation_id=[illegible]')
if resp.status_code == 200:
   print resp.content
```

Sample response

```
3.3.1.30.devel
3.3.1.31.devel
```

API to create installer ID

This endpoint creates an installer ID for API to download Secure Workload software.

```
GET /openapi/v1/sw_assets/installation_id
```

Response object: Returns an installer ID that can be used in API to download Secure Workload software.

Sample python code

```
resp = restclient.get('/sw_assets/installation_id')
if resp.status_code == 200:
   parsed_resp = json.loads(resp.content)
   print json.dumps(parsed_resp)
```

Sample response

```
"[illegible]"
```

API to download Secure Workload software

This endpoint enables clients to download the software for specified “agent_type”, “package_type”, “platform”, “ar- chitecture” and “sensor_version”.

```
GET
/openapi/v1/sw_assets/download?platform=<platform>&agent_type=<agent_type>&pkg_type=<pkg_type>&arch=<arch>&sensor_verion=<sensor_version>&installation_id=<installer_id>
```

where <agent_type>, <platform> and <arch> can be any one of the results retrieved from the **API to get supported platforms**, and <pkg_type> can be either “sensor_w_cfg” or “sensor_bin_pkg”. Both <pkg_type> and <agent_type> are optional but at least one of them should be specified. <sensor_version> can be any one of the results retrieved from the **API to get supported software version**. If “sensor_version” is not specified, it will download the **latest** software.

Parameters: The request URL contains the following parameters.

Name	Type	Description
platform	string	Specify the platform.
agent_type	string	(optional) Specify the agent type.
pkg_type	string	(optional) Specify the package type, the value can be either “sensor_w_cfg” or “sensor_bin_pkg”.

Name	Type	Description
arch	string	Specify the architecture.
sensor_version	string	(optional) Specify the software version, defaults to empty string.

Response object: Returns the Secure Workload software for the given parameters.

Sample python code

```
resp =
[illegible]
if resp.status_code == 200:
   print 'file downloaded successfully'
```

Secure Workload Agents Upgrade

The Secure Workload agents upgrade feature provides a way to upgrade installed Secure Workload agents to spe- cific version. It only updates the metadata, actual upgrade will happen during next check-in. The API requires the `software_download` capability associated with the API key. This capability is only available to site admin users, root scope owners or users with agent installer roles.

API to upgrade an agent to specific version

This end point triggers the agent given its “UUID” upgrade to specific “sensor_version”, the latest version will be applied if “sensor_version” is not provided. This API won’t proceed downgrade requests.

```
POST /openapi/v1/sensors/{UUID}/upgrade?sensor_version=<sensor_version>
```

where <sensor_version> can be any one of the results retrieved from the API to get supported software version
.

Parameters: The request URL contains the following parameters

Name	Type	Description
sensor_version	string	(optional) Specify the desired version, the latest version will be applied by default

Returns the status for this upgrade request.

Sample python code

```
resp = restclient.post('/openapi/v1/sensors/{UUID}/upgrade?sensor_version=3.4.1.1.devel')

if resp.status_code == 200:
  print 'agent upgrade was triggered successfully and in progress'
elif resp.status_code == 304:
  print 'provided version is not newer than current version'
elif resp.status_code == 400:
  print 'provided version is invalid'
elif resp.status_code == 403:
  print 'user does not have required capability'
elif resp.status_code == 404:
  print 'agent with {UUID} does not exist'
```

User Uploaded Filehashes

Users can upload a list of filehashes to Secure Workload and specify whether those hashes are benign or flagged. Secure Workload flags processes with the respective binary hashes accordingly.

This set of APIs can be used to upload or remove a list of filehashes to Secure Workload. To call these APIs, use an API key with the `user_data_upload` capability.

Note You can have up to 1 million file hashes per root scope. 500000 for both benign and flagged hashes each.

The following APIs are available to scope owners and site admins and are used to upload/download/remove filehashes in a single root scope on the |product| appliance.

User Filehash Upload

This endpoint is used to upload a CSV file with filehash for a root scope on the Secure Workload appliance. The column headers `HashType` and `FileHash` must appear in the CSV file. `HashType` should be `SHA-1` or `SHA-256`, FileHash must not be empty and must be in the format of 40-hex SHA1 or 64-hex SHA256.

`FileName` and `Notes` headers are optional. Given file name should not exceed maximum length of 150 characters and given notes should not exceed maximum length of 1024 characters.

`POST /openapi/v1/assets/user_filehash/upload/{rootAppScopeNameOrID}/{benignOrflagged}`

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeNameOrID	string	Root scope name or ID.
benignOrflagged	string	Can be one of `benign` or `flagged`.

Response object: None

Sample python code

```
  # Sample CSV File
  # HashType,FileHash,FileName,Notes
  # SHA-1,1AF17E73721DBE0C40011B82ED4BB1A7DBE3CE29,application_1.exe,Sample Notes
  #
SHA-256,8F434346648F6B96DF89DDA901C5176B10A6D83961DD3C1AC88B59B2DC327AA4,application_2.exe,Sample
 Notes

  file_path = '/<path_to_file>/user_filehash.csv'
  root_app_scope_name = 'Tetration'
 restclient.upload(file_path, '/assets/user_filehash/upload/%s/benign' % root_app_scope_name)
```

User Filehash Delete

This endpoint is used to upload a CSV file to delete filehashes from the root scope on the Secure Workload appliance. CSV file must have `FileHash` as a header.

```
POST /openapi/v1/assets/user_filehash/delete/{rootAppScopeNameOrID}/{benignOrflagged}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeNameOrID	string	Root scope name or ID.
benignOrflagged	string	Can be one of `benign` and `flagged`.

Response object: None

Sample python code

```
  # Sample CSV File
  # FileHash
  # 1AF17E73721DBE0C40011B82ED4BB1A7DBE3CE29
  # 8F434346648F6B96DF89DDA901C5176B10A6D83961DD3C1AC88B59B2DC327AA4

  file_path = '/<path_to_file>/user_filehash.csv'
  root_app_scope_name = 'Tetration'
  restclient.upload(file_path, '/assets/user_filehash/delete/' + root_app_scope_name +
'/benign')
```

User Filehash Download

This endpoint returns the user file hash for the given root scope on the Secure Workload appliance as a CSV file. The CSV file has the headers `HashType, FileHash, FileName` and `Notes` in the respective order.

```
GET /openapi/v1/assets/user_filehash/download/{rootAppScopeNameOrID}/{benignOrflagged}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeNameOrID	string	Root scope name or ID.
benignOrflagged	string	Can be one of benign or flagged.

Response object: None

Sample python code

```
  file_path = '/<path_to_file>/output_user_filehash.csv'
  root_app_scope_name = 'Tetration'
  restclient.download(file_path, '/assets/user_filehash/download/%s/benign' %
root_app_scope_name)
```

User-Defined Labels

These APIs are used to add or remove user-defined labels that label flows and inventory items on the Secure Workload appliance. To call these APIs, use an API key with the `user_data_upload` capability. See the Label Key Schema section of the UI user guide for guidelines governing keys and values that are used for labeling flows and inventory items.

Note Refer to Importing Custom Labels for instructions on accessing this functionality via the UI.

Note Refer to Label Limits for limits on the number of IPv4/IPv6 addresses or subnets that can be uploaded.

Scope-Dependent APIs

The following APIs are used to get/set/delete labels in a root scope on the Secure Workload appliance. They are available to root **scope owners** and **site admins**. Also, the GET API calls are available to users with **read access** to the root scope.

Get Inventory Label

This endpoint returns labels for an IPv4/IPv6 address or subnet in root scope on the Secure Workload appliance. The address/subnet used to query this endpoint must exactly match the one used for uploading labels.

```
GET /openapi/v1/inventory/tags/{rootAppScopeName}?ip={IPorSubnet}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.
IPorSubnet	string	IPv4/IPv6 address or subnet.

Response object:

Name	Type	Description
attributes	JSON	Key/value map for labeling matching flows and inventory items

Sample python code

```
root_app_scope_name = 'Tetration'
restclient.get('/inventory/tags/%s' % root_app_scope_name, params={'ip': '10.1.1.1/24'})
```

Search Inventory Label

This endpoint allows for searching labels for an IPv4/IPv6 address or subnet in root scope on the Secure Workload appliance.

```
GET /openapi/v1/inventory/tags/{rootAppScopeName}/search?ip={IPorSubnet}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.
IPorSubnet	string	IPv4/IPv6 address or subnet.

Response object: This API returns a list of objects of the following format

Name	Type	Description
key	string	IPv4/IPv6 address or subnet.
updatedAt	integer	Unix timestamp of when the labels were updated.
value	JSON	Key/value map of attributes for the key.

Sample python code

```
  root_app_scope_name = 'Tetration Scope'
  encoded_root_app_scope_name = urllib.quote(root_app_scope_name, safe='')
  restclient.get('/inventory/tags/%s/search' % encoded_root_app_scope_name, params={'ip':
'10.1.1.1/24'})
```

Set Inventory Label

This endpoint is used to set labels for labeling flows and inventory items in root scope on the Secure Workload appliance.

```
POST /openapi/v1/inventory/tags/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

The JSON query body contains the following keys

Name	Type	Description
ip	string	IPv4/IPv6 address or subnet.
attributes	JSON	Key/value map for labeling matching flows and inventory items

Response object:

Name	Type	Description
warnings	JSON	Key/value map containing warnings that are encountered while setting labels.

Sample python code

```
  root_app_scope_name = 'Tetration'
  req_payload = {'ip': '10.1.1.1/24', 'attributes': {'datacenter': 'SJC', 'location': 'CA'}}

  restclient.post('/inventory/tags/%s' % root_app_scope_name,
json_body=json.dumps(req_payload))
```

Delete Inventory Label

This endpoint deletes labels for an IPv4/IPv6 address or subnet in a root scope on the Secure Workload appliance.

```
DELETE /openapi/v1/inventory/tags/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

The JSON query body contains the following keys

Name	Type	Description
ip	string	IPv4/IPv6 address or subnet

Sample python code

```
  root_app_scope_name = 'Tetration'
  req_payload = {'ip': '10.1.1.1/24'}
  restclient.delete('/inventory/tags/%s' % root_app_scope_name,
json_body=json.dumps(req_payload))
```

Upload Labels

This endpoint is used to upload a CSV file with labels for labeling flows and inventory items in a root scope on the Secure Workload appliance. A column header with name `IP` must appear in the CSV file. Of the remaining column headers, up to 32 can be used to annotate flows and inventory items. To use non-English characters in labels, the uploaded csv file must be in UTF-8 format.

```
POST /openapi/v1/assets/cmdb/upload/{rootAppScopeName}
```

Parameters:

User must provide an operation type `(X-Tetration-Oper)` as a parameter to this API. `X-Tetration-Oper` can be one of the following:

- add: Appends labels to new and existing addresses/subnets. Resolves conflicts by selecting new labels over existing ones. For example, if labels for an address in the database are *{“foo”: “1”, “bar”: “2”}*, and the CSV file contains *{“z”: “1”, “bar”: “3”}*, *add* sets labels for this address to *{“foo”: “1”, “z”: “1”, “bar”: “3”}*.
- overwrite: inserts labels for new addresses/subnets and replaces labels for existing ones. For example, if labels for an address in the database are *{“foo”: “1”, “bar”: “2”}* and the CSV file contains *{“z”: “1”, “bar”: “3”}*, *overwrite* sets labels for this address to *{“z”: “1”, “bar”: “3”}*.
- merge: Merges labels to existing addresses/subnets. Resolves conflicts by selecting nonempty values over empty values. For example, if labels for an address in the database are *{“foo”: “1”, “bar”: “2”, “qux”: “”, “corge”: “4”}*, and the CSV file contains *{“z”: “1”, “bar”: “”, “qux”: “3”, “corge”: “4-updated”}*, *merge* sets that are labels for this address to *{“foo”: “1”, “z”: “1”, “bar”: “2”, “qux”: “3”, “corge”: “4-updated”}*.

Note Value of “bar” in not reset to “”(empty), instead existing value of “bar”=”2” is preserved.

- delete: removes labels for an address/subnet.

Response object:

Name	Type	Description
warnings	JSON	Key/value map containing warnings that are encountered while setting labels.

Sample python code

```
 file_path = '/<path_to_file>/user_annotations.csv'
 root_app_scope_name = 'Tetration'
 req_payload = [tetpyclient.MultiPartOption(key='X-Tetration-Oper', val='add')]
restclient.upload(file_path, '/assets/cmdb/upload/%s' % root_app_scope_name, req_payload)
```

Upload Labels Using JSON Format

This endpoint is used to upload labels for labeling flows and inventory items on the Secure Workload appliance using JSON format. Attributes in ip_tags must be a subset of headers, up to 32 headers can be used to annotate flows and inventory items. To use non-English characters in labels, the json payload must be in UTF-8 format.

```
POST /openapi/v1/multi_inventory/tags/{rootAppScopeName}
```

Parameters: The request URL contains the following parameter

Name	Type	Description
rootAppScopeName	string	Root scope name

Table 52: Payload Parameters

Name	Type	Description
headers	array	Array of strings that specifies the label names
operation	string	Either **add** or **merge**, if not specified it is considered as **add**.
ip_tags	array	Array of ip_tags object

Table 53: ip_tags

Name	Type	Description
ip	string	Valid IPV4/IPV6 Address or Subnet
attributes	JSON	JSON of label, value string pairs; labels must be a subset of headers.

Note

1. If record labels are not a subset of given headers, a warning is generated to alert the user of a discrepancy between the given headers and the labels in the record.

2. This endpoint will only allow user to upload a maximum of 95,000 entries and 36 attributes.

- For add request, *operation* is optional, if not specified, it is considered as **add**.
- For merge request, *operation* must be specified as **merge**.

3. You can upload a maximum of 95,000 entries and 36 attributes.

Sample python code for add request

```
  {
    "headers" : ["key1", "key2"],
    "operation": "add"
    "ip_tags" : [
        {
            "ip": "10.10.10.11",
            "attributes": {
                "key1": "val1",
                "key2": "val2"
            }
        },
        {
            "ip": "10.10.10.12",
            "attributes": {
                "key1": "val111",
                "key2": "val2"
            }
        }
    ]
}
```

Sample python code for merge request

```
  {{
    "headers" : ["key1", "key2"],
    "operation": "merge"
    "ip_tags" : [
        {
            "ip": "10.10.10.11",
            "attributes": {
                "key1": "val1",
                "key2": "val2"
            }
        },
        {
            "ip": "10.10.10.12",
            "attributes": {
                "key1": "val1",
                "key2": "val2"
            }
        }
    ]
}
resp = restclient.post('/multi_inventory/tags/%s' % rootAppScopeName,
json_body=json.dumps(req_payload))
```

Download User Labels

This endpoint returns user-uploaded labels for a root scope on the Secure Workload appliance as a CSV file.

```
GET /openapi/v1/assets/cmdb/download/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

Response:

Content-Type: *text/csv*

CSV file containing user uploaded labels for the scope.

Sample python code

```
  file_path = '/<path_to_file>/output.csv'
  root_app_scope_name = 'Tetration'
  restclient.download(file_path, '/assets/cmdb/download/%s' % root_app_scope_name)
```

Get Column Headers

This endpoint returns a list of column headers for a root scope on the Secure Workload appliance.

```
GET /openapi/v1/assets/cmdb/attributenames/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

Response object: An array of facets available for a label.

Sample python code

```
   root_app_scope_name = 'Tetration'
   resp = restclient.get('/assets/cmdb/attributenames/%s' % root_app_scope_name)
```

Delete Column Header

This endpoint deletes a column header in a root scope on the Secure Workload appliance. Deleting a column header drops it from the list of labeled facets and removes it from existing labels.

`DELETE /openapi/v1/assets/cmdb/attributenames/{rootAppScopeName}/{attributeName}`

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.
attributeName	string	Attribute being deleted.

Response object: None

Sample python code

```
   root_app_scope_name = 'Tetration'
   attribute_name = 'column1'
   resp = restclient.delete('/assets/cmdb/attributenames/%s/%s' % (root_app_scope_name,
attribute_name))
```

Delete Labels Using JSON Format

This endpoint deletes labels for multiple IPv4/IPv6 address or subnet using JSON format.

`DELETE /openapi/v1/multi_inventory/tags/{rootAppScopeName}`

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name

Table 54: Payload Parameters

Name	Type	Description
headers	array	(Optional) array of strings that specifies the label names
ip_tags	array	Array of ip_tags object

Table 55: ip_tags

Name	Type	Description
ip	string	Valid IPV4/IPV6 Address or Subnet
attributes	JSON	(Optional) JSON of label, value string pairs; labels must be a subset of headers.

Sample python code

```
  {
    "ip_tags" : [
        {
            "ip": "10.10.10.11",
          },
        {
            "ip": "10.10.10.12",
            "attributes": {
                "key1": "val1",
                "key2": "val2"
            }
        }
    ]
}
resp = restclient.delete('/multi_inventory/tags/%s' % rootAppScopeName,
json_body=json.dumps(req_payload))
```

Get List of Labeled Facets

This endpoint returns a list of labeled facets for a root scope on the Secure Workload appliance. Labeled facets are a subset of column headers in the uploaded CSV file that is used for annotating flows and inventory items in that scope.

```
GET /openapi/v1/assets/cmdb/annotations/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

Response object: An array of labeled facets for the root scope.

Sample python code

```
   root_app_scope_name = 'Tetration'
   resp = restclient.get('/assets/cmdb/annotations/%s' % root_app_scope_name)
```

Update List of Labeled Facets

This endpoint updates list of facets that are used for annotating flows and inventory items in a root scope on the Secure Workload appliance.

```
PUT /openapi/v1/assets/cmdb/annotations/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

Response object: None

Sample python code

```
# the following list is a subset of column headers in the
# uploaded CSV file
req_payload = ['location', 'region', 'detail']
root_app_scope_name = 'Tetration'
restclient.put('/assets/cmdb/annotations/%s' % root_app_scope_name,
               json_body=json.dumps(req_payload))
```

Flush User Uploaded Labels

This endpoint flushes labels for flows and inventory items in root scope on the Secure Workload appliance. The changes affect new data; older labeled data remains unaltered.

```
POST /openapi/v1/assets/cmdb/flush/{rootAppScopeName}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
rootAppScopeName	string	Root scope name.

Response object: None

Sample python code

```
root_app_scope_name = 'Tetration'
restclient.post('/assets/cmdb/flush/%s' % root_app_scope_name)
```

Scope-Independent APIs

The following APIs can span multiple scopes on the Secure Workload appliance.

Note The number of scope independent and dependent annotated facets must not exceed 32 for any root scope.

Upload Labels

This endpoint is used to upload a CSV file with labels for labeling flows and inventory items on the Secure Workload appliance. Column headers with names `IP` and `VRF` must appear in the CSV file and `VRF` must match the root scope for a label. Of the remaining column headers, up to 32 can be used to annotate flows and inventory items.

```
POST /openapi/v1/assets/cmdb/upload
```

Parameters:

User must provide an operation type `(X-Tetration-Oper)` as a parameter to this API to specify the operation to be performed.

Response object:

Name	Type	Description
warnings	JSON	Key or value map containing warnings that are encountered while setting labels.

Sample python code

```
file_path = '/<path_to_file>/user_annotations.csv'
req_payload = [tetpyclient.MultiPartOption(key='X-Tetration-Oper', val='add')]
restclient.upload(file_path, '/assets/cmdb/upload', req_payload)
```

Download User Labels

This endpoint returns the user-uploaded labels for all scopes on the Secure Workload appliance as a CSV file.

```
GET /openapi/v1/assets/cmdb/download
```

Parameters: None

Response:

Content-Type: *text/csv*

CSV file containing user uploaded labels for the scope.

Sample python code

```
file_path = '/<path_to_file>/output.csv'
restclient.download(file_path, '/assets/cmdb/download')
```

Scope-Independent Labels

These labels are not tied to a particular root scope and apply to all scopes on the appliance.

Get Inventory Label

These endpoints return scope independent labels for an IPv4/IPv6 address or subnet on the Secure Workload appliance. The address or subnet that is used to query this endpoint must exactly match the one used for uploading labels.

```
GET /openapi/v1/si_inventory/tags?ip={IPorSubnet}
```

Parameters: The request URL contains the following parameters.

Name	Type	Description
IPorSubnet	string	IPv4/IPv6 address or subnet.

Response object:

Name	Type	Description
attributes	JSON	Key or value map for labeling matching flows and inventory items

Sample python code

```
restclient.get('/si_inventory/tags', params={'ip': '10.1.1.1/24'})
```

Search Inventory Label

This endpoint allows for searching labels for an IPv4/IPv6 address or subnet on the Secure Workload appliance.

`GET /openapi/v1/si_inventory/tags/search?ip={IPorSubnet}`

Parameters: The request URL contains the following parameters

Name	Type	Description
IPorSubnet	string	IPv4/IPv6 address or subnet.

Response object: This API returns a list of objects of the following format

Name	Type	Description
key	string	IPv4/IPv6 address or subnet.
updatedAt	integer	Unix timestamp of when the labels were updated.
value	JSON	Key or value map of attributes for the key.

Sample python code

```
restclient.get('/si_inventory/tags/search', params={'ip': '10.1.1.1/24'})
```

Set Inventory Label

This endpoint is used to set labels for labeling flows and inventory items on the Secure Workload appliance.

`POST /openapi/v1/si_inventory/tags`

Parameters: The JSON query body contains the following keys

Name	Type	Description
ip	string	IPv4/IPv6 address or subnet.
attributes	JSON	Key or value map for labeling matching flows and inventory items.

Response object:

Name	Type	Description
warnings	JSON	Key or value map containing warnings that are encountered while setting labels.

Sample python code

```
req_payload = {'ip': '10.1.1.1/24', 'attributes': {'datacenter': 'SJC', 'location': 'CA'}}

restclient.post('/si_inventory/tags', json_body=json.dumps(req_payload))
```

Delete Inventory Label

This endpoint deletes labels for an IPv4/IPv6 address or subnet on the Secure Workload appliance.

```
DELETE /openapi/v1/si_inventory/tags
```

Parameters: The JSON query body contains the following keys

Name	Type	Description
ip	string	IPv4/IPv6 address or subnet

Sample python code

```
req_payload = {'ip': '10.1.1.1/24'}
restclient.delete('/si_inventory/tags, json_body=json.dumps(req_payload))
```

Get List of Labeled Facets

This endpoint returns a list of scope-independent labeled facets on the Secure Workload appliance. Labeled facets are a subset of column headers that are used for annotating flows and inventory items across all scopes.

Note Exclude the scope name from the request url to view and update the list of annotated scope-independent facets.

```
GET /openapi/v1/assets/cmdb/annotations
```

Response object: An array of scope-independent labeled facets.

Sample python code

```
resp = restclient.get('/assets/cmdb/annotations')
```

Update List of Labeled Facets

This endpoint updates list of scope-independent facets that are used for annotating flows and inventory items on the Secure Workload appliance.

```
PUT /openapi/v1/assets/cmdb/annotations
```

Response object: None

Sample python code

```
# the following list is a subset of column headers in the
# uploaded CSV file
req_payload = ['location', 'region', 'detail']
restclient.put('/assets/cmdb/annotations',
               json_body=json.dumps(req_payload))
```

Virtual Routing and Forwarding

This set of APIs manages Virtual Routing and Forwarding (VRF).

Note These APIs are only available to site admins.

VRF Object

The VRF object attributes are described below:

Attribute	Type	Description
id	int	Unique identifier for the VRF.
name	string	User specified name of the VRF.
tenant_id	int	ID of parent tenant.
root_app_scope_id	string	ID of associated root scope.
created_at	integer	Unix timestamp when the VRF was created.
updated_at	integer	Unix timestamp when the VRF was last updated.

Get VRFs

This endpoint returns a list of VRFs. This API is available to API keys with `sensor_management or flow_inventory_query` capability.

`GET /openapi/v1/vrfs`

Parameters: None

Response object: Returns a list of VRF objects.

Sample python code

```
resp = restclient.get('/vrfs')
```

Create a VRF

This endpoint is used to create new VRFs. An associated root scope will automatically be created with a query matching the VRF ID. This API is available to API keys with `sensor_management` capability.

```
POST /openapi/v1/vrfs
```

Parameters:

Name	Type	Description
id	int	(optional) Unique identifier for the VRF. If unspecified, Secure Workload cluster will generate a unique ID for the newly created VRF. Best practice is to let Secure Workload generate these IDs instead of caller explicitly specifying unique IDs.
tenant_id	int	(optional) ID of parent tenant.
name	string	User specified name of the VRF.
apply_monitoring_rules	boolean	(optional) Whether collection rules should be applied for the VRF. Defaults to 'false'.

The `tenant_id` is optional. If not provided, the VRF will be added to the tenant with the same id as the VRF, autocreating if necessary. If the `tenant_id` is provided, the tenant will not be automatically created, and an error will be returned if the tenant does not exist.

Response object: Returns the newly created VRF object.

Sample python code

```
req_payload = {
    "tenant_id": <tenant_id>,
    "name": "Test",
    "apply_monitoring_rules": True
}
resp = restclient.post('/vrfs', json_body=json.dumps(req_payload))
```

Get Specific VRF

This endpoint returns information for the specified VRF ID. This API is available to API keys with `sensor_management or flow_inventory_query` capability.

```
GET /openapi/v1/vrfs/{vrf_id}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
vrf_id	int	Unique identifier for the VRF.

Response object: Returns a VRF object that is associated with the specified ID.

Sample python code

```
vrf_id = 676767
resp = restclient.get('/vrfs/%d'% vrf_id)
```

Update a VRF

This endpoint updates a VRF. This API is available to API keys with `sensor_management` capability.

`PUT /openapi/v1/vrfs/{vrf_id}`

Parameters: The request URL contains the following parameters

Name	Type	Description
vrf_id	int	Unique identifier for the VRF.

The JSON request body contains the following parameters

Name	Type	Description
name	string	User specified name of the VRF.
apply_monitoring_rules	boolean	(optional) Whether collection rules should be applied to the VRF.

Response object: Returns the modified VRF object that is associated with the specified ID.

Sample python code

```
vrf_id = 676767
req_payload = {
    "name": "Test",
    "apply_monitoring_rules": True
}
resp = restclient.put('/vrfs/%d'% vrf_id,
                      json_body=json.dumps(req_payload))
```

Delete Specific VRF

This endpoint deletes a VRF. It fails if there is associated root scope. This API is available to API keys with `sensor_management` capability.

`DELETE /openapi/v1/vrfs/{vrf_id}`

Parameters: The following parameter is part of the URL.

Name	Type	Description
vrf_id	int	Unique identifier for the VRF.

Sample python code

```
vrf_id = 676767
resp = restclient.delete('/vrfs/%d'% vrf_id)
```

Orchestrators

This set of APIs can be used to manage external orchestrator inventory learning in Secure Workload cluster deployment. They require the `external_integration` capability associated with the API key.

Currently supported Orchestrator types are ‘vcenter’ (vCenter 6.5 and later), ‘kubernetes’, ‘dns’, ‘f5’, ‘netscaler’, ‘infoblox’ and ‘Cisco FMC’. Supported user interface located at External Orchestrators.

Orchestrator Object

The orchestrator object attributes are described below - some of the fields are applicable only for specific orchestrator types; restrictions are mentioned in the table below.

Attribute	**Type**	**Description**
id	string	Unique identifier for the orchestrator.
name	string	User specified name of the orchestrator.
type	string	Type of orchestrator - supported values (*vcenter, kubernetes, f5, netscaler, infoblox, dns)*
description	string	User specified description of the orchestrator.
username	string	Username for the orchestration endpoint. (unnecessary for *dns*)
password	string	Password for the orchestration endpoint. (unnecessary for *dns*)
certificate	string	Client certificate used for authentication (unnecessary for *dns*)
key	string	Key corresponding to client certificate (unnecessary for *dns*)
ca_certificate	string	CA Certificate to validate orchestration endpoint (unnecessary for *dns*)
auth_token	string	Opaque authentication token (bearer token) (applies only for *kubernetes*)

Attribute	Type	Description
insecure	boolean	Turn off strict SSL verification
delta_interval	integer	Delta polling interval in seconds Secure Workload Inventory manager will perform polling for incremental changes every delta_interval seconds. Note this parameter is not applicable for Infoblox and Secure Firewall Management Center.
full_snapshot_interval	integer	Full snapshot interval in seconds Secure Workload Inventory manager will perform a full refresh poll from the or- chestrator
verbose_tsdb_metrics	boolean	Per-Endpoint TSDB metrics
hosts_list	Array	Array of { "host_name", port_number} pairs that specify how Secure Workload must connect to the orchestrator
use_secureconnector_tunnel	boolean	Tunnel connections to this orchestrator's hosts through the Secure Connector tunnel
route_domain	integer	Route Domain number to poll on F5 LoadBalancers (applies only for *f5*)
dns_zones	Array	Array of strings containing the DNS zones to poll from the DNS server (only for *dns*). Each DNS Zone entry MUST end with a .
enable_enforcement	boolean	Applicable only for external orchestrators with policy enforcement support such as firewalls and load balancers. Examples are *Secure Firewall Management Center*, *F5 BIGIP* and *Citrix Netscaler*. This flag is false (policy en- forcement is disabled) by default. If true, the external or- chestrator will deploy policies to the given load balancer appliance when policy enforcement is performed for the workspace.
ingress_controllers	object	Array of Ingress Controller objects.

Attribute	Type	Description
fmc_enforcement_mode	string	Applicable only for *Secure Firewall Management Center external orchestrator* and must be either *merge* (default) or *override*. The first instance instructs Secure Firewall Management Center policy enforcer to put all Secure Workload policy rules before any existing prefilter rules, while the latter instance will remove all prefilter rules created by the users.
infoblox_config	object	Applicable only for *Infoblox external orchestrator*. Infoblox Config record type selectors.

Ingress Controller

Attribute	Type	Description
pod_selector	object	Pod Selector
controller_config	object	Controller Config

Pod Selector

Attribute	Type	Description
namespace	string	Namespace where the Ingress controller pod is running.
labels	Array	Array of {“key”, “value”} pairs that specify the labels of ingress controller pods.

Controller Config

Attribute	Type	Description
ingress_class	string	Name of the ingress class which ingress controller satisfies.
namespace	string	Namespace is the name of the namespace which ingress controller satisfies.
http_ports	Array	Array of http ports.

Attribute	Type	Description
https_ports	Array	Array of https ports.

Infoblox Config

enable_network_record	bool	Default value is True. If false *network* type records are disabled.
enable_host_record	bool	Default value is True. If false *host* type records are disabled.
enable_a_record	bool	Default value is True. If false *a* type records are disabled.
enable_aaaa_record	bool	Default value is True. If false *aaaa* type records are disabled.

** Read-only status fields in the Orchestrator object **

Attribute	Type	Description
authentication_failure	bool	Status of the connection to the Secure Workload Orchestrator - *true* indicates a successful connection to the orchestrator. If this field is *false*, the *authentication_failure_error* field will provide a detailed error message explaining the reason for the failure
authentication_failure_error	string	Detailed error message to help debug connectivity or credential failures with orchestrators
scope_id	string	Tenant Root scope id where the inventory will be published and visible

Get Orchestrators

This endpoint returns a list of orchestrators that are known to Secure Workload appliance. This API is available to API keys with the `external_integration` capability.

```
GET /openapi/v1/orchestrator/{scope}
```

Parameters: None

Returns a list of orchestrator objects for the provided root scope. The *scope* MUST be a root scope id.

Create Orchestrators

This endpoint is used to create orchestrators.

```
POST /openapi/v1/orchestrator/{scope}
```

Sample python code for vCenter orchestrators

```
req_payload = {
    "name": "VCenter Orchestrator"
    "type": "vcenter",
    "hosts_list": [ { "host_name": "8.8.8.8", "port_number": 443}],
    "username":"admin",
    "password":"admin"
}
resp = restclient.post('/orchestrator/Default', json_body=json.dumps(req_payload))
```

Sample python code for DNS orchestrators

```
req_payload = {
    "name": "DNS Server"
    "type": "dns",
    "hosts_list": [ { "host_name": "8.8.8.8", "port_number": 53}],
    "dns_zones": [ "lab.corp.com.", "dev.corp.com." ]
}
resp = restclient.post('/orchestrator/Default', json_body=json.dumps(req_payload))
```

Sample python code for Kubernetes orchestrators

```
req_payload = {
    "name": "k8s"
    "type": "kubernetes",
    "hosts_list": [ { "host_name": "8.8.8.8", "port_number": 53}],
    "certificate": "",
    "key": "",
    "ca_certificate": "",
}
resp = restclient.post('/orchestrator/Default', json_body=json.dumps(req_payload))
```

Sample python code for Kubernetes orchestrators with Ingress Controller

See information about the Kubernetes/OpenShift external orchestrator for creating authentication details.

```
req_payload = {
    "name": "k8s",
    "type": "kubernetes",
    "hosts_list": [ { "host_name": "8.8.8.8", "port_number": 53}],
    "certificate": "",
    "key": "",
    "ca_certificate": "",
    "ingress_controllers": [
        {
            "pod_selector": {
                "namespace": "ingress-nginx",
                "labels": [{ "key": "app", "value": "nginx-ingress"}],
            }
        }
    ]
}
resp = restclient.post('/orchestrator/Default', json_body=json.dumps(req_payload))
```

Sample python code for Kubernetes orchestrators with Multiple Ingress Controllers

See information about the Kubernetes/OpenShift external orchestrator for creating authentication details.

```
  req_payload = {
      "name": "k8s",
      "type": "kubernetes",
      "hosts_list": [ { "host_name": "8.8.8.8", "port_number": 53}],
      "certificate": "",
      "key": "",
      "ca_certificate": "",
      "ingress_controllers": [
          {
              "pod_selector": {
                  "namespace": "ingress-nginx",
                  "labels": [{ "key": "app", "value": "nginx-ingress"}],
              },
              "controller_config": {
                  "ingress_class": "nginx-class",
              }
          },
          {
              "pod_selector": {
                  "namespace": "ingress-haproxy",
                  "labels": [{ "key": "app", "value": "haproxy-ingress"}],
              },
              "controller_config": {
                  "ingress_class": "haproxy-class",
                  "http_ports": [8080],
                  "https_ports": [8443],
                  "namespace": "haproxy-watching-namespace"
              }
          }
      ],
  }
  resp = restclient.post('/orchestrator/Default', json_body=json.dumps(req_payload))

  ** Type AWS and EKS are no longer supported in external orchestrators. They have been
ported to
     connectors.
```

Get Specific Orchestrator

This endpoint returns an orchestrator instance.

```
GET /openapi/v1/orchestrator/{scope}/{orchestrator_id}
```

Returns the orchestrator object that is associated with the specified ID.

Update an Orchestrator

This endpoint updates an orchestrator.

```
PUT /openapi/v1/orchestrator/{scope}/{orchestrator_id}
```

Parameters:

Same as POST parameters

Delete Specific Orchestrator

This endpoint deletes the specified orchestrator.

```
DELETE /openapi/v1/orchestrator/{scope}/{orchestrator_id}
```

Orchestrator Golden Rules

This set of APIs can be used to manage Golden Rules for external Kubernetes Orchestrators. Golden Rules are necessary to ensure Kubernetes control plane connectivity in allow list enforcement mode. They require the `external_integration` capability associated with the API key.

Currently supported Orchestrator type for Golden Rules is ‘kubernetes’ only. Requests to this endpoint for non- Kubernetes orchestrators will fail.

Orchestrator Golden Rules Object

The orchestrator object attributes are described below:

Attribute	Type	Description
kubelet_port	integer	Kubelet node-local API port
services	Array	Array of Kubernetes Services objects

Get Orchestrator Golden Rules

This endpoint returns the golden rules that are associated with an orchestrator. This API is available to API keys with the `external_integration` capability.

```
GET /openapi/v1/orchestrator/{scope}/{id}/gr
```

Parameters: None

Returns a single Golden Rules object

Create or Update Golden Rules

This endpoint is used to create or update golden rules for an existing orchestrator.

```
POST /openapi/v1/orchestrator/{scope}/{id}/gr
```

Parameters:

Attribute	Type	Description
kubelet_port	integer	Kubelet node-local API port
services	Array	Array of Kubernetes Services objects

Sample python code

```
  req_payload = {
              "kubelet_port":10255,
              "services": [
                        {
    "description": "kube-dns",
    "addresses":   [ "10.0.1.1:53/TCP", "10.0.1.1:53/UDP" ],
    "consumed_by":  [ "NODES", "PODS"],
   }
             ]
  }
  resp = restclient.post('/orchestrator/{scope_id}/{orchestrator_id}/gr',
json_body=json.dumps(req_payload))
```

FMC Orchestrator Domains

This set of APIs can be used to manage domains for external FMC Orchestrators. FMC Domains are required to enable enforcement on a given FMC Domain. They require the `external_integration` capability associated with the API key.

Currently supported Orchestrator type for FMC Domains is ‘fmc’ only. Requests to this endpoint for non-FMC orchestrators will fail.

Orchestrator FMC Domains Object

The orchestrator object attributes are described below:

Attribute	Type	Description
fmc_domains	Array	Array of FMC Domain objects

FMC Domain object attributes are described below:

Attribute	Type	Description
name	string	Name of FMC Domain
enforcement_enabled	boolean	This flag is set to false by default. If true, the external orchestrator will deploy policies to the domain matching with ‘name’ when policy enforcement is performed for the workspace.

URL attributes are described below:

Attribute	Type	Description
scope	string	Tenant Root scope name or id where the inventory will be published and visible

Attribute	Type	Description
orchestrator_id	string	Orchestrator ID of FMC orchestrator

Get FMC Domains

This endpoint returns the FMC domains that are configured on the FMC that is associated with an FMC orchestrator. This API is available to API keys with the `external_integration` capability.

```
GET /openapi/v1/orchestrator/{scope}/{orchestrator_id}/fmcdomains
```

Parameters: None

Returns a JSON object with a list of FMC Domain object attributes.

Update FMC Domain Configuration for FMC External Orchestrator

This endpoint updates the FMC domain attributes for an existing FMC external orchestrator.

```
PUT /openapi/v1/orchestrator/{scope}/{orchestrator_id}/fmcdomains
```

Parameters:

Attribute	Type	Description
fmc_domains	Array	Array of FMC Domain objects

FMC Domain object attributes are described below:

Attribute	Type	Description
name	string	Name of FMC Domain
enforcement_enabled	boolean	This flag is set to false by default. If true, the external orchestrator deploys policies to the domain matching with ‘name’ when policy enforcement is performed for the workspace.

URL attributes are described below:

Attribute	Type	Description
scope	string	Tenant Root scope name or id where the inventory will be published and visible
orchestrator_id	string	Orchestrator ID of FMC orchestrator

Sample python code

```
  req_payload = {
        "fmc_domains":    [
        {
            "enforcement_enabled": False,
            "name": "Global/Eng"
        },
        {
            "enforcement_enabled": True,
            "name": "Global/Prod"
        }
    ]
  }
  resp = restclient.put('/orchestrator/{scope}/{orchestrator_id}/fmcdomains',
json_body=json.dumps(req_payload))
```

RBAC (Role-Based Access Control) Considerations

Access to orchestrators under a root scope requires that the API Key that is used for the request has the requisite privileges. All orchestrator API calls are scoped and always require the root scope id as part of the URL. Orchestrators always reside at the root scope level and cannot be created under subscopes. Orchestrators created (and inventory that is learned by these orchestrators) under a specific tenant root scope are invisible to other tenants.

In case of F5 load balancers that may have multiple route domains (vrfs) configured, the F5 Route Domain filtering logic scans all entities on the F5 across all partitions but discard entities (services, snat pools, pools, and backends) that do not evaluate to the route domain specified in the F5 orchestrator *route_domain* field.

High Availability and Failover Considerations

The hosts_list parameter allows configuration of multiple server addresses for an orchestrator. Secure Workload server selection logic in the case of multiple server addresses varies for each orchestrator type.

For *vCenter, Kubernetes, DNS, F5, Netscaler, Infoblox*, the selection is on a first healthy endpoint basis. Connections are not persistent (except for *kubernetes*) and thus, every poll period, Secure Connector Orchestrator Manager will scan the hosts and poll the first healthy endpoint encountered in the hosts_list. For *kubernetes*, a persistent event channel is maintained and upon connection failure, a scan of all hosts and subsequent full poll will be performed using the next healthy endpoint.

Kubernetes RBAC Resource Considerations

The Kubernetes client attempts to GET/LIST/WATCH the following resources.

The provided Kubernetes authentication credentials should have a minimum set of privileges to the following resources:

Resources	Verbs
daemonsets	[get list watch]
deployments	[get list watch]

Resources	Verbs
endpoints	[get list watch]
namespaces	[get list watch]
nodes	[get list watch]
pods	[get list watch]
replicasets	[get list watch]
replicationcontrollers	[get list watch]
services	[get list watch]
statefulsets	[get list watch]
daemonsets.apps	[get list watch]
deployments.apps	[get list watch]
endpoints.apps	[get list watch]
namespaces.apps	[get list watch]
nodes.apps	[get list watch]
pods.apps	[get list watch]
replicasets.apps	[get list watch]
replicationcontrollers.apps	[get list watch]
services.apps	[get list watch]
statefulsets.apps	[get list watch]
daemonsets.extensions	[get list watch]
deployments.extensions	[get list watch]
endpoints.extensions	[get list watch]
namespaces.extensions	[get list watch]
nodes.extensions	[get list watch]
pods.extensions	[get list watch]
replicasets.extensions	[get list watch]
replicationcontrollers.extensions	[get list watch]
services.extensions	[get list watch]
statefulsets.extensions	[get list watch]

Service Health

This API can be used to get the health of all services that are used in the Secure Workload cluster along with their dependencies.

Note This API is only available to site admin users.

Get Service Health

This endpoint returns a JSON object with service health information.

```
GET /openapi/v1/service_status
```

Parameters: None

Response object: JSON object with service health information

Sample Python code

```
resp = restclient.get('/service_status')
```

Secure Connector

OpenAPI exposes the endpoints to manage the functions of the Secure Connector. These endpoints require the `external_integration` capability to be associated with the API key.

Note The Secure Connector APIs cannot be used at site level. They can only be used at the root scope level.

Get Status

This endpoint returns the current status of the Secure Connector Tunnel for the specified root scope.

```
GET /openapi/v1/secureconnector/name/{ROOT_SCOPE_NAME}/status
```

```
GET /openapi/v1/secureconnector/{ROOT_SCOPE_ID}/status
```

READ permission to the specified root scope is required.

The returned status is a json object with the following schema:

Key	Type	Value
active	boolean	A Secure Connector tunnel is currently active
peer	string	<ip>:<port> of the Secure Connector client end of the tunnel

Key	Type	Value
start_time	int	Timestamp at which the tunnel was started (epoch time in seconds)
last_heartbeat	int	Timestamp of last heartbeat from the client (epoch time in seconds)

Get Token

This endpoint returns a new single-use limited-time token to be used for bootstrapping a Secure Connector client for the specified root scope.

```
GET /openapi/v1/secureconnector/name/{ROOT_SCOPE_NAME}/token
```

```
GET /openapi/v1/secureconnector/{ROOT_SCOPE_ID}/token
```

OWNER permission to the specified root scope is required.

The returned token is a string which contains a cryptographically signed token that is valid for one hour. A valid token can be used only once to bootstrap a Secure Connector client.

Rotate Certificates

This endpoint forces the creation of a new certificate for the specified root scope. The new certificate will be used by the Secure Connector server and will be used to sign the certificate signing requests from clients for this root scope.

```
POST /openapi/v1/secureconnector/name/{ROOT_SCOPE_NAME}/rotate_certs?invalidate_old=
↪{true|false}
```

```
POST /openapi/v1/secureconnector/{ROOT_SCOPE_ID}/rotate_certs?invalidate_old= ↪{true|false}
```

OWNER permission to the specified root scope is required.

Once this endpoint is called, communication between the client and server for this root scope will immediately transition to using the new certificate.

If *invalidate_old* is set to false, any existing clients will automatically create a new public/private key pair and use their existing certificates to sign a new certificate for the new public key.

If *invalidate_old* is set to true, the existing certificate will be immediately invalidated. Any existing clients will not be able to connect to the server and will have to be bootstrapped once again using a new token. See Secure Connector Deployment for more information.

Kubernetes Vulnerability Scanning

Get Kubernetes Registries used for Pod Vulnerability Scanning

This endpoint returns a list of all Kubernetes registries displayed in the Secure Workload cluster for a given VRF.

```
GET /openapi/kubernetes/{root_scope_name_or_id}/vulnerability_scanning/registry
```

Parameters: The JSON query body contains the following keys

Name	Type	Description
root_scope_name_or_id	string	Root scope name or ID

Response object: Returns an array of registry objects with the following attributes

Attribute	Type	Description
id	string	ID of the registry
clusters	array	Array of Kubernetes cluster objects using the registry
connection_status	string	Defines registry connection status
credential_status	string	Status stating if the credentials are provided
last_scanned	Int64	Last scanner at time in epoch
url	string	URL of the registry

Kubernetes cluster object

Attribute	Type	Description
id	string	ID of the Kubernetes cluster
connector_id	string	ID of the connector used to onboard the Kubernetes cluster
connector_type	string	Type of connector used to onboard the Kubernetes cluster
name	string	Name of the Kubernetes cluster

Sample python code

```
root_app_scope_name = 'Tetration'
restclient.get('/kubernetes/%s/vulnerability_scanning/registry' % root_app_scope_name)
```

Add Credentials to Kubernetes Registry

This endpoint allows you to add credentials for the Kubernetes registry. The accepted credentials are based on the registry type.

For example:

Registry type: AWS; Accepted credential type: aws_auth Credentials object

Registry type: OTHER; Accepted credential type: basic_auth Credentials object

```
PUT /openapi/kubernetes/{root_scope_name_or_id}/vulnerability_scanning/registry/{registry_id}
```

Parameters: The JSON query body contains the following keys:

Name	Type	Description
root_scope_name_or_id	string	Root scope name or ID
registry_id	string	Kubernetes registry ID
registry_credential	object	Credential object

Credential object

Attribute	Type	Description
basic_auth	object	Basic authentication credential object
aws_auth	object	AWS authentication credential object
azure_auth	object	Azure authentication credential object
gcp_auth	object	GCP authentication credential object

basic_auth object

Attribute	Type	Description
username	string	Username
password	string	Password

aws_auth object

Attribute	Type	Description
aws_access_key_id	string	AWS credentials access key
aws_secret_access_key	string	AWS credentials access secret

azure_auth object:

Attribute	Type	Description
azure_tenant_id	string	Azure tenant ID
azure_client_id	string	Azure client ID
azure_client_secret	string	Azure client secret

gcp_auth object:

Attribute	Type	Description
gcp_service_account	object	GCP service account

Sample python code

```
root_app_scope_name = 'Tetration'
registry_id = ‘64cdc7a7362f57192dcc1625’
pay_load = {
        "registry_credential": {
            "basic_auth": {
                "username": "username",
                "password": "password",
            }
        }
    }
restclient.put('/kubernetes/%s/vulnerability_scanning/registry/%s' % root_app_scope_name,
registry_id, json_body=json.dumps(pay_load))
```

Get Kubernetes Pod Scanners

This endpoint returns a list of all Kubernetes pod scanners displayed in the Secure Workload cluster for a given VRF.

```
GET /openapi/kubernetes/{root_scope_name_or_id}/vulnerability_scanning/scanner
```

Parameters: The JSON query body contains the following keys

Name	Type	Description
root_scope_name_or_id	string	Root scope name or ID

Response object: Returns an array of registry objects with the following attributes

Attribute	Type	Description
id	string	ID of the scanner
kubernetes_cluster	object	Add Credentials to Kubernetes Registry
health_status	string	Defines scanner health state
health_object	string	Health status object
scanner_action	string	Notifies if the scanner is ENABLED or DISABLED
name	string	Name of the scanner

Health object

Attribute	Type	Description
last_checkin	string	Last reported at time in epoch

Attribute	Type	Description
scanner_sensor_name	string	Kubernetes node name on which the scanner is running
scanner_sensor_uuid	string	ID of the agent running on the Kubernetes node
status	string	Notifies if health is reported by the scanner

Sample python code

```
root_app_scope_name = 'Tetration'
restclient.get('/kubernetes/%s/vulnerability_scanning/scanner % root_app_scope_name)
```

Edit Scanner Filter Query and Action

This endpoint allows you to edit Kubernetes scanner filter query and action.

`PUT /openapi/kubernetes/{root_scope_name_or_id}/vulnerability_scanning/scanner/{scanner_id}`

Parameters: The JSON query body contains the following keys

Name	Type	Description
rootAppScopeName	string	Root scope name or ID
scanner_id	string	Kubernetes scanner ID
scanner_action	string	To enable or disable the scanner. Expected values are ENABLED or DISABLED
filter_query	object	Validate an inventory filter query to filter pods for vulnerability scanning.

Sample python code

```
root_app_scope_name = 'Tetration'
scanner_id = ‘64cdc7a7362f57192dcc1625’
pay_load = {
        “scanner_action”: “ENABLED”
        "filter_query": {
            "type": "contains",
            "field": "user_orchestrator_system/pod_name",
            "value": "pod"
        }
}
restclient.put('/kubernetes/%s/vulnerability_scanning/scanner/%s' % root_app_scope_name,
scanner_id, json_body=json.dumps(pay_load))
```

Policy Enforcement Status for External Orchestrators

This set of APIs is used to provide policy enforcement status for load balancer external orchestrators such as *F5 BIG-IP* or *Citrix Netscaler*.

Note To use these APIs, you must have access to the scope attached to the VRF.

Get Policy Enforcement Status for All External Orchestrators

This endpoint returns policy enforcement status for all external orchestrators belonging to the given VRF. This API is available to API keys with `external_integration` capability.

```
GET /openapi/v1/tnp_policy_status/{vrfID}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
vrfID	integer	VRF ID for the root scope.

Response object: Returns a list of network policies with the Status as `ENFORCED` or `FAILED` or `IGNORED`.

Sample python code

```
vrf_id = 676767
restclient.get('/tnp_policy_status/%d' % vrf_id)
```

Get Policy Enforcement Status for an External Orchestrator

This endpoint returns policy enforcement status for an external orchestrator belonging to the given VRF. This API is available to API keys with `external_integration` capability.

```
GET /openapi/v1/tnp_policy_status/{vrfID}/{orchestratorID}
```

Parameters: The request URL contains the following parameters

Name	Type	Description
vrfID	integer	VRF ID for the root scope.
orchestratorID	string	External orchestrator ID.

Response object: Returns a list of network policies with the Status as `ENFORCED` or `FAILED` or `IGNORED`.

Sample python code

```
vrf_id = 676767
orchestrator_id = '5ee3c991497d4f3b00f1ee07'
restclient.get('/tnp_policy_status/%d/%s' % (vrf_id, orchestrator_id))
```

Download Certificates for Managed Data Taps and Datasinks

This set of APIs is used to download the certificates for the Managed Data Taps and Datasinks.

Note To use these APIs, you must have access to the scope attached to the VRF.

Get List of Managed Data Taps for a Given VRF ID.

This endpoint returns a list of Managed Data Taps in a given VRF. This API is available to API keys with `external_integration` capability.

```
GET /openapi/v1/mdt/{vrfID}
```

Parameters: None

Returns a list of Managed Data Taps with attributes like Managed Data Tap ID.

Download Managed Data Tap Certificates for a Given MDT ID

This endpoint is used to download the certificates for a given Managed Data Tap ID. The MDT ID can be obtained by using **/openapi/v1/mdt/{vrfID}** endpoint as explained in the above documentation. This API is available to API keys with `external_integration` capability.

```
GET /openapi/v1/mdt/{vrfID}/{mdtID}/certs
```

Parameters:

Name	Type	Description
format	string	The keystore and trust store format. Values: `jks`(default value) or `cert`

Returns a tar.gz file which contains the following files:-

For `jks` format: **truststore.jks, topic.txt, passphrase.txt, keystone.jks, kafkaBrokerIps.txt, consumer_name.txt, consumer_group_id.txt.**.

For `jks` format: **KafkaConsumerCA.cert, KafkaConsumerPrivateKey.key, kafkaCA.cert, kafkaBrokerIps.txt, topic.txt**

KafkaConsumerCA.cert is the Public certificate file and **KafkaConsumerPrivateKey.key** file has the private key. **kafkaCA.cert** has the CA certificate and **kafkaBrokerIps.txt** has the list of the Kafka brokers IP Addresses and Ports. topic.txt file has the name of the topic which should be used to fetch data from MDT. **truststore.jks** and **keystone.jks** are Java keystore files.

Get List of DataSinks for a Given VRF ID

This endpoint returns a list of DataSinks in a given VRF. This API is available to API keys with `external_integration` capability.

```
GET /openapi/v1/datasinks/{vrfID}
```

Parameters: None

Returns a list of DataSinks with attributes like DataSink ID.

Download DataSink Certificates for a Given DataSink ID

This endpoint is used to download the certificates for a given DataSink ID. The DataSink ID can be obtained by using **/openapi/v1/datasinks/{vrfID}** endpoint as explained in the above documentation. This API is available to API keys with `external_integration` capability.

```
GET /openapi/v1/datasinks/{vrfID}/{dsID}/certs
```

Parameters: None

Returns a tar.gz file which contains the following files:- **userCA.cert, userPrivateKey.key, intermediateCA.cert, kafkaCA.cert, kafkaBrokerIps.txt, topic.txt**.

userCA.cert is the Public certificate file and **KafkaConsumerPrivateKey.key** file has the private key. **intermediateCA. cert** and **kafkaCA.cert** has the CA certificate for intermediate and root CA respectively. **kafkaBrokerIps.txt** has the list of the Kafka brokers IP Addresses and Ports. **topic.txt** file has the name of the topic which should be used to fetch data from datasink.

Change Logs

This API provides read access to change log items. This API requires the `user_role_scope_management` capability associated with the API key.

Note This API is only available to site admins and owners of root scopes.

Change Log Object

The descriptions of the change log object attributes are as follows:

Attribute	Type	Description
id	string	Unique identifier for the change log item.
association_chain	array of objects	List of names and ids associated with this change.
scope	string	Scope of change (not the same as a Secure Workload scope).
action	string	Change action.
details	string	Further action details, when available.

Attribute	Type	Description
created_at	integer	Unix timestamp of when change log item was created.
modifier	object	User responsible for change.
modified	object	Modified fields and values.
original	object	Fields and values before modification.
version	integer	Version identifier.

Search

This endpoint returns the list of change log items matching the specified criteria.

```
GET /openapi/v1/change_logs
```

Parameters: The request URL contains the following parameters

Name	Type	Description
root_app_scope_id	string	(optional) Required for root scope owners. Filter results by root scope.
association_name	string	(optional) Required for root scope owners. The item type to return. For example: “H4Users”
history_action	string	(optional) Change action. For example: “update”
details	string	(optional) Action details. For example: “soft-delete”
before_epoch	integer	(optional) Include results created before this unix timestamp.
after_epoch	integer	(optional) Include results created after this unix timestamp.
offset	integer	(optional) Number of results to skip.
limit	integer	(optional) Limit number of results, default 1000.

Response object: Returns a list of change log objects.

Response

The response is a JSON object in the body with the following properties.

Name	Type	Description
total_count	integer	Total number of items matching before applying offset or limit.
items	array of objects	List of results.

Sample python code

Fetch last 100 scope object changes within a given root scope within the last day.

```
root_app_scope_id = '5ce480db497d4f1ca1fc2b2b'
one_day_ago = int(time.time() - 24*60*60)
resp = restclient.get('/change_logs', params={'root_app_scope_id': root_app_scope_id,
                                               'association_name': 'AppScope',
                                               'after_epoch': one_day_ago,
                                               'limit': 100})
```

Fetch the second thousand scope object changes.

```
root_app_scope_id = '5ce480db497d4f1ca1fc2b2b'
resp = restclient.get('/change_logs', params={'root_app_scope_id': root_app_scope_id,
                                              'association_name': 'AppScope',
                                              'offset': 1000})
```

Further refine these results to only show new scope creations.

```
root_app_scope_id = '5ce480db497d4f1ca1fc2b2b'
one_day_ago = int(time.time() - 24 * 60 * 60)
resp = restclient.get('/change_logs', params={'root_app_scope_id': root_app_scope_id,
                                              'association_name': 'AppScope',
                                              'history_action': 'create',
                                              'after_epoch': one_day_ago,
                                              'limit': 100})
```

A site admin could use limit and offset to iteratively fetch all changes across all scopes.

```
resp = restclient.get('/change_logs', params={'offset': 100, 'limit': 100})
```

Non-Routable Endpoints

The following APIs are used to manage nonroutable endpoints, to mark an IP or subnet as nonroutable or get a list of nonroutable endpoints that are marked by a user or to unmark an IP or subnet as nonroutable endpoint. The `user_data_upload` capability that is associated with the API key is required.

Non-Routable Endpoint Object

The descriptions of the Non-Routable Endpoint Object attributes are as follows:

Attribute	Type	Description
id	string	Unique identifier for the nonroutable endpoint.
name	string	User specified name of the nonroutable endpoint.
subnet	string	IPv4/IPv6 subnet.

Attribute	Type	Description
vrf_id	long	ID of the VRF to which the nonroutable endpoint belongs to.
address_type	string	IPV4/IPV6 based on subnet address type
host_uuid	string	Unique ID of the agent
description.	string	User specified description of the nonroutable endpoint.

GET Non-Routable Endpoints

This endpoint returns a list of nonroutable endpoints in the given tenant.

```
GET /openapi/v1/non_routable_endpoints/{rootScopeName}
```

Parameters: None

Create a Non-Routable Endpoint

This endpoint is used to create a nonroutable endpoint.

```
POST /openapi/v1/non_routable_endpoints/{rootScopeName}
```

Parameters:

Attribute	Type	Description
name	string	User specified name of the nonroutable endpoint.
subnet	string	IPv4 or IPv6 subnet.
address_type(optional)	string	IPv4or IPv6 based on subnet address type
host_uuid(optional)	string	Unique ID of the agent
description(optional)	string	User specified description of the nonroutable endpoint.

*if optional fields are not specified, null values are populated.

Sample python code

```
req_payload = {
  "name": "nre-1",
  "subnet": "1.1.1.1/30",
  "address_type": IPV4,
  "description": "sample parameters test"
}
```

```
  resp = restclient.post('/openapi/v1/non_routable_endpoints/Default',
json_body=json.dumps(req_payload))
```

GET Specific Non-Routable Endpoints with Name

This endpoint returns a nonroutable endpoint for the specified name.

```
GET /openapi/v1/non_routable_endpoints/{rootScopeName}/name/{name}
```

Parameters: None

GET Specific Non-Routable Endpoints with ID

This endpoint returns a nonroutable endpoint for the specified ID.

```
GET /openapi/v1/non_routable_endpoints/{rootScopeName}/id/{id}
```

Parameters: None

Update Specific Non-Routable Endpoint Name

This endpoint is used to update a nonroutable endpoint. It uses either an ID or a name of the existing nonroutable endpoint to update its name.

```
PUT /openapi/v1/non_routable_endpoints/{rootScopeName}
```

Parameters:

Attribute	Type	Description
id	string	Unique identifier for the nonroutable endpoint.
name	string	User specified name of the nonroutable endpoint.
new_name	string	New name to update

Sample python code

```
  req_payload = {
    "name": "nre-1",
    "new_name": "nre-updated",
  }
  resp = restclient.put('/openapi/v1/non_routable_endpoints/Default',
json_body=json.dumps(req_payload))


  req_payload = {
    "id": "5f706964a5b5f16ed4b0aacb",
    "new_name": "nre-updated",
  }
  resp = restclient.put('/openapi/v1/non_routable_endpoints/Default',
json_body=json.dumps(req_payload))
```

Delete Specific Non-Routable Endpoint with Name

This endpoint deletes the specific nonroutable endpoint.

```
DELETE /openapi/v1/non_routable_endpoints/{rootScopeName}/name/{name}
```

Delete Specific Non-Routable Endpoint with ID

This endpoint deletes the specific nonroutable endpoint.

```
DELETE /openapi/v1/non_routable_endpoints/{rootScopeName}/id/{id}
```

Config and Command Schemas for External Appliances and Connectors

Config Groups APIs

The Config Groups APIs provides config schemas for the Appliances and Connectors APIs. These APIs require the `sensor_management` or `external_integration` capability that is associated with the API key.

API to Get the Schema of Config

This endpoint returns a static config schema for selected type/groups of configs.

```
GET /openapi/v1/config_groups/schema/<type>
```

where <type> is the Appliance config type.

Parameters: The request URL contains the following parameters

Name	Type	Description
type	string	Specify the config type from "VM1" "VM3" "NTP" "LOG" "LDAP" "NETFLOW" "IPFIX" "NETSCALER" "F5" "AWS" "ENDPOINT" "SLACK_NOTIFIER" "GCP_CONNECTOR" "PAGERDUTY_NOTIFIER" "SYSLOG_NOTIFIER" "KINESIS_NOTIFIER" "EMAIL_NOTIFIER" "ISE" "MERAKI" "SLACK_NOTIFIER_OVERRIDE" "PAGERDUTY_NOTIFIER_OVERRIDE" "SYSLOG_NOTIFER_OVERRIDE" "KINESIS_NOTIFER_OVERRIDE" "AZURE_CONNECTOR" "EMAIL_NOTIFIER_OVERRIDE" "SYSLOG_SEVERITY_MAPPING" "SERVICENOW" "SYNC_INTERVAL" "ALERT" "VM3_ERSPAN" "AWS_CONNECTOR" "VM0"

Response object: Returns the config schema for selected config type.

Sample response

```
resp = restclient.get('/config_groups/schema/LOG')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "type": "LOG",
    "name": "Log",
    "mode": "TEST",
    "config": {
      "secured": {},
      "unsecured": {
        "log-level": "info",
        "max-log-size": 10,
        "max-log-age": 30,
        "max-log-backups": 20 }
    },
    "fill_ins": [
      {
        "field": "log-level",
        "label": "Logging Level",
        "placeholder": "info",
        "type": "user_fill_in",
        "input_type": "dropdown",
        "possible_values": [
          "trace",
          "debug",
          "info",
          "warn",
          "error"
        ]
    },
      {
        "field": "max-log-size",
        "label": "Max Log File Size (in MB)",
        "placeholder": 10,
        "type": "user_fill_in",
        "input_type": "number",
        "min": 1,
        "max": 10240
      },
      {"field": "max-log-age",
        "label": "Log Rotation (in days)",
        "placeholder": 30,
        "type": "user_fill_in",
        "input_type": "number",
        "min": 1,
        "max": 365
      },
      {
        "field": "max-log-backups",
        "label": "Log Rotation (in instances)",
        "placeholder": 20,
        "type": "user_fill_in",
        "input_type": "number",
        "min": 1,
        "max": 100
}
    ]
  }
```

API to Get the Schema of Troubleshooting Commands

This endpoint returns a static troubleshooting command config schema for selected type of troubleshooting command.

```
GET /openapi/v1/config_groups/command_schema/<type>
```

In request payload, <type> is the troubleshooting command config type.

Parameters:

The request URL contains the following parameters

Name	Type	Description
type	string	Specify the command type from "SHOW LOG" "SHOW_SERVICE_LOG" "SHOW_RUNNING_CONF" "SHOW_SERVICE_RUNNING_CONF" "SHOW_SYS_COMMANDS" "SHOW_DOCKER_COMMANDS" "SHOW_DOCKER_INSTANCE_COMMANDS" "OPER_DOCKER_INSTANCE_COMMANDS" "SHOW_SUPERVISOR_COMMANDS" "SHOW_SUPERVISOR_SERVICE_COMMANDS" "OPER_SUPERVISOR_SERVICE_COMMANDS" "NETWORK_CONNECTIVITY_COMMANDS" "LIST_FILES" "LIST_SERVICE_FILES" "PACKET_CAPTURE" "SHOW_DATA_EXPORT_LGO" "SHOW_DATAEXPORT_RUNNING_CONF" "SHOW_DATA_EXPORT_SYS_COMMANDS" "UPDATE_LISTENING_PORT" "UPDATE_TAN_LOG_CONF" "SNAPSHOT_APPLIANCE" "SNAPSHOT_CONNECTOR" "SHOW_AWS_DOWNLOADER_LOG" "CONTROLLER_PROFILING" "SERVICE_PROFILING" "RESTART_CONNECTOR_CONTAINER" "RESTART_CONNECTOR_SERVICE" "CONNECTOR_ALERT_INTERVAL_APPLIANCE" "CONNECTOR_ALERT_INTERVAL_CONNECTOR" "EXEC_SCRIPT" "SHOW_SEGMENTATION_POLICIES"

Response object: Returns the config schema for selected config type.

Sample response

```
resp = restclient.get('/config_groups/command_schema/SHOW_LOG')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "name": "Show logs",
    "desc": "Show the contents of a log file",
   "long_desc": "Show the contents of a log file and optionally grep the file for a specified
 pattern. The output is tailed for the last 5000 lines.",
    "valid_appliances": [
      "TETRATION_DATA_INGEST",
      "TETRATION_EDGE",
      "TETRATION_EXPORT"
    ],
    "valid_connectors": [
      "netflow",
      "netscaler",
      "f5",
      "aws",
      "anyconnect",
      "slack",
      "kinesis",
      "syslog",
      "email",
      "pagerduty",
      "ise",
      "asa",
      "meraki",
      "servicenow",
      "wad"
    ],
    "arg_fillins": [
      {
        "field": "pattern",
        "label": "Grep Pattern",
        "input_type": "text",
        "optional": true
      }
    ],
    "output_type": "FILE",
    "output_ext": "LOG"
  }
```

External Appliances

External Appliances APIs

The External Appliances APIs are associated with managing SecureWorkload external Appliances. These set of APIs require the `sensor_management` or `external_integration` capability associated with the API key.

API to Get List of Appliances

This endpoint returns the list of Appliances.

```
GET /openapi/v1/ext_appliances?root_scope_id=<root_scope_id>&type=<type>
```

where <root_scope_id> is the root_scope_id that can be obtained from the Get scopes API, <type> is a string to decide Appliance type.

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Specify the root scope

Name	Type	Description
type	string	Specify the Appliance type, the value can be either “TETRATION_EDGE”, “TETRATION_DATA_INGEST”, “TETRATION_EXPORT”, “TETRATION_ERSPAN” or “TETRATION_INTERNAL”

Response object: Returns the list of Appliance.

Sample response

```
resp =
restclient.get('/ext_appliances?root_scope_id=63bf8d2f497d4f7287dbd335&type=TETRATION_INTERNAL')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "root_scope_id": "63bf8d2f497d4f7287dbd335",
      "type": "tetration_internal",
      "status": {
        "state": "active",
        "controller_state": "up",
        "message": "",
        "display_state": "active"
      },
      "auto_upgrade": true,
      "created_at": 1673498141,
      "updated_at": 1673498141,
      "registered_at": 1673498141,
      "last_checkin_at": 0,
      "last_rpm_sent_at": 0,
      "upgrade_attempts": 0,
      "delete_attempts": 0,
      "last_delete_msg_sent_at": 0,
      "taas": false,
      "deleted": false,
      "deleted_at": 0,
      "connector_limit": 5000,
      "available_slots": 5000,
      "internal": true,
      "id": "63bf8e1d6419d06bef39bc85",
      "ha_peer_appliance_id": "",
      "display_type": "Tetration Internal"
    }
  ]
```

API to Create an Appliance

This endpoint creates an Appliance.

```
POST /openapi/v1/ext_appliances
```

In request payload, to obtain <config> schema, select one of the “valid_config” from API to Get Appliance Schema, on page 916 response, apply the “valid_config” to API to Get the Schema of Config, on page 903.

Parameters: The request URL contains the following parameters

Name	Type	Description
name	string	Specify the name
root_scope_id	string	Specify the root scope
type	string	Specify the Appliance type, the value can be either “TETRATION_EDGE”, “TETRATION_DATA_INGEST”, “TETRATION_EXPORT”, “TETRATION_ERSPAN” or “TETRATION_INTERNAL”
config	set	Provide the filled config schema in JSON format
taas	boolean	Indicate if the Appliance is for TAAS env
version	string	Specify the version

Response object: Returns the created Appliance.

Sample response

```
req_payload = {
    "name":"Data Ingest Appliance",
    "type":"tetration_data_ingest",
    "root_scope_id":"63c41ff2497d4f5f5be73662",
    "config":{
      "VM3":{
        "secured":{},
        "unsecured":{
          "cidr":[
            "172.26.231.141/23",
            "172.26.231.142/23",
            "172.26.231.143/23"
          ],
          "gateway":[
            "172.26.231.140",
            "172.26.231.140",
            "172.26.231.140"
          ],
          "cidr_v6":[],
          "gateway_v6":[],
          "dns":[
            "testserver"
          ],
          "search_domains":[],
          "hostname":"",
          "use_proxy_for_tetration":false,
          "https_proxy":"",
          "no_proxy":[],
          "docker_subnet":""
        }
      }
    }
```

```
  }
  resp = restclient.post('/ext_appliances', json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "root_scope_id":"63c41ff2497d4f5f5be73662",
    "type":"tetration_data_ingest",
    "status":{
      "state":"pending_dio",
      "controller_state":"down",
      "message":"Setting up appliance",
      "display_state":"preparing"
    },
    "auto_upgrade":true,
    "created_at":1674183549,
    "updated_at":1674183549,
    "registered_at":0,
    "last_checkin_at":0,
    "last_rpm_sent_at":0,
    "upgrade_attempts":0,
    "delete_attempts":0,
    "last_delete_msg_sent_at":0,
    "name":"Data Ingest Appliance",
    "taas":false,
    "deleted":false,
    "deleted_at":0,
    "connector_limit":3,
    "available_slots":0,
    "internal":false,
    "id":"63ca037dbca44e263daeb5d0",
    "ha_peer_appliance_id":"",
    "display_type":"Tetration Data Ingest"
  }
```

API to Delete an Appliance

This endpoint deletes the given Appliance.

```
DELETE /openapi/v1/ext_appliances/<id>
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID

Response object: Returns the status of the deleted Appliance.

Sample response

```
resp = restclient.delete('/ext_appliances/63be3b1ade36423c12bff6e1')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "status": 200,
    "code": 1000,
    "message": "deleted"
  }
```

API to Get an Appliance by ID

This endpoint gets the Appliance with given ID.

```
GET /openapi/v1/ext_appliances/<id>
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID

Response object: Returns the Appliance with given ID.

Sample response

```
resp = restclient.get('/ext_appliances/63bf8e1d6419d06bef39bc85')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "root_scope_id": "63bf8d2f497d4f7287dbd335",
    "type": "tetration_internal",
    "status": {
      "state": "active",
      "controller_state": "up",
      "message": "",
      "display_state": "active"
    },
    "auto_upgrade": true,
    "created_at": 1673498141,
    "updated_at": 1673498141,
    "registered_at": 1673498141,
    "last_checkin_at": 0,
    "last_rpm_sent_at": 0,
    "upgrade_attempts": 0,
    "delete_attempts": 0,
    "last_delete_msg_sent_at": 0,
    "taas": false,
    "deleted": false,
    "deleted_at": 0,
    "connector_limit": 5000,
    "available_slots": 5000,
    "internal": true,
    "id": "63bf8e1d6419d06bef39bc85",
    "ha_peer_appliance_id": "",
    "display_type": "Tetration Internal"
  }
```

API to Rename an Appliance

This endpoint renames the Appliance with given ID.

```
PUT /openapi/v1/ext_appliances/<id>
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
name	string	Specify the new name of the Appliance

Response object: Returns the Appliance with given ID and the new name.

Sample response

```
req_payload = {
    "name": "new_name",
  }
  resp = restclient.put('/ext_appliances/63bf8e1d6419d06bef39bc85',
json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "root_scope_id": "63bf8d2f497d4f7287dbd335",
    "type": "tetration_internal",
    "status": {
      "state": "active",
      "controller_state": "up",
      "message": "",
      "display_state": "active"
    },
    "auto_upgrade": true,
    "created_at": 1673498141,
    "updated_at": 1673498141,
    "registered_at": 1673498141,
    "last_checkin_at": 0,
    "last_rpm_sent_at": 0,
    "upgrade_attempts": 0,
     "delete_attempts": 0,
    "last_delete_msg_sent_at": 0,
    "name": "new_name",
    "taas": false,
    "deleted": false,
    "deleted_at": 0,
    "connector_limit": 5000,
    "available_slots": 5000,
    "internal": true,
    "id": "63bf8e1d6419d06bef39bc85",
    "ha_peer_appliance_id": "",
    "display_type": "Tetration Internal"
  }
```

API to Get the Configs on Config Type

This endpoint gets the configs of the Appliance with given ID and config type.

```
GET /openapi/v1/ext_appliances/<id>/config?config_type=<config_type>
```

where <id> is the appliance_id that can be obtained from API to Get List of Appliances, on page 906, <config_type> is the "valid_config" that can be obtained from API to Get Appliance Schema, on page 916.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
config_type	string	Specify the config type. Refer to API to Get the Schema of Config, on page 903 for all possible values listed under Description

Response object: Returns the configs with given Appliance ID and config type

Sample response

```
resp =
restclient.get('/ext_appliances/63c1272039042a1c0ddd3e20/config?config_type=VM3_ERSPAN')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "mode": "TEST_AND_APPLY",
      "name": "VM3_ERSPAN",
      "root_scope_id": "63bf8d2f497d4f7287dbd335",
      "vrf_id": 1,
      "appliance_id": "63c1272039042a1c0ddd3e20",
      "deleted": false,
      "type": "VM3_ERSPAN",
      "state": "COMMIT",
      "attempts": 0,
      "config": {
        "secured": {},
        "unsecured": {
          "cidr": [
            "172.26.231.141/23",
            "172.26.231.142/23",
            "172.26.231.143/23"
          ],
          "gateway": [
            "172.26.231.140",
            "172.26.231.140",
            "172.26.231.140"
          ],
          "cidr_v6": [],
          "gateway_v6": [],
          "dns": [
            "test"
          ],
          "search_domains": [],
          "hostname": "hjtest",
          "https_proxy": "",
          "no_proxy": []
        }
      },
      "push_to_dio_at": 0,
      "created_at": 1673602848,
      "updated_at": 1673602848,
      "discovery_completed_at": 0,
      "committed_at": 0,
      "delete_at": 0,
      "error_at": 0,
      "hidden": false,
      "discovery_phase": 0,
      "internal": false,
      "id": "63c1272039042a1c0ddd3e21"
    }
  ]
```

API to Add a New Config to External Appliance

This endpoint adds a new config to the Appliance with given ID

```
POST /openapi/v1/ext_appliances/<id>/config
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906. In request payload, <type> is the "valid_config" that can be obtained from API to Get Appliance Schema, on page 916. To obtain <config> schema, select one of the "valid_config" from API to Get Appliance Schema, on page 916 response, apply the "valid_config" to API to Get the Schema of Config, on page 903.

Parameters: The request URL contains the following parameters

Name	Type	Description
name	string	Specify the config name
type	string	Specify the config type. Refer to API to Get the Schema of Config, on page 903 for all possible values listed under Description
config	set	Provide the filled config schema in JSON format

Response object: Returns the updated config.

Sample response

```
req_payload = {
    "name": "new_config",
    "type": "VM3_ERSPAN",
    "config": {}
  }
  resp = restclient.post('/ext_appliances/63c1272039042a1c0ddd3e20/config',
json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "prev_id": "63c1272039042a1c0ddd3e21",
    "mode": "TEST_AND_APPLY",
    "name": "new_config",
    "root_scope_id": "63bf8d2f497d4f7287dbd335",
    "vrf_id": 1,
    "appliance_id": "63c1272039042a1c0ddd3e20",
    "deleted": false,
    "type": "VM3_ERSPAN",
    "state": "COMMIT",
    "attempts": 0,
    "config": {
      "secured": {},
      "unsecured": null
    },
    "push_to_dio_at": 0,
    "created_at": 1673661042,
    "updated_at": 1673661042,
    "discovery_completed_at": 0,
    "committed_at": 0,
    "delete_at": 0,
    "error_at": 0,
    "hidden": false,
    "discovery_phase": 0,
    "internal": false,
    "id": "63c20a7239042a0991b871b7"
  }
```

API to Delete a Config

This endpoint deletes a config from given Appliance.

```
DELETE /openapi/v1/ext_appliances/<id>/config/<config_id>
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906, <config_id> is the id that can be obtained from API to Get the Configs on Config Type, on page 911.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
config_id	string	Specify the config ID

Response object: Returns the status of the config deleted for given Appliance.

Sample response

```
resp =
restclient.delete('/ext_appliances/63c1272039042a1c0ddd3e20/config/63c1272039042a1c0ddd3e21')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "status": 200,
    "code": 1000,
    "message": "deleted"
  }
```

API to Get the Config

This endpoint gets the config with given ID

```
GET /openapi/v1/ext_appliances/<id>/config/<config_id>
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906, <config_id> is the id that can be obtained from API to Get the Configs on Config Type, on page 911.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
config_id	string	Specify the config ID

Response object: Returns the config with given ID.

Sample response

```
resp =
restclient.get('/ext_appliances/63c1272039042a1c0ddd3e20/config/63c1272039042a1c0ddd3e21')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
b
```

Sample response

```
{
    "mode": "TEST_AND_APPLY",
    "name": "VM3_ERSPAN",
    "root_scope_id": "63bf8d2f497d4f7287dbd335",
    "vrf_id": 1,
    "appliance_id": "63c1272039042a1c0ddd3e20",
    "deleted": false,
    "type": "VM3_ERSPAN",
    "state": "COMMIT",
    "attempts": 0,
    "config": {
      "secured": {},
      "unsecured": {
        "cidr": [
          "172.26.231.141/23",
          "172.26.231.142/23",
          "172.26.231.143/23"
        ],
        "gateway": [
          "172.26.231.140",
          "172.26.231.140",
          "172.26.231.140"
        ],
        "cidr_v6": [],
        "gateway_v6": [],
        "dns": [
          "test"
        ],
        "search_domains": [],
        "hostname": "hjtest",
        "https_proxy": "",
        "no_proxy": []
      }
    },
    "push_to_dio_at": 0,
    "created_at": 1673602848,
    "updated_at": 1673602848,
    "discovery_completed_at": 0,
    "committed_at": 0,
    "delete_at": 0,
    "error_at": 0,
    "hidden": false,
    "discovery_phase": 0,
    "internal": false,
    "id": "63c1272039042a1c0ddd3e21"
  }
```

API to Get Appliance Schema

This endpoint gets the Appliance schema with given type

```
GET /openapi/v1/ext_appliances/schema/<type>
```

where <type> is a string to decide Appliance type.

Parameters: The request URL contains the following parameters

Name	Type	Description
type	string	Specify the Appliance type, the value can be either "TETRATION_EDGE", "TETRATION_DATA_INGEST", "TETRATION_EXPORT", "TETRATION_ERSPAN" or "TETRATION_INTERNAL"

Response object: Returns the config schema.

Sample response

```
resp = restclient.get('/ext_appliances/schema/TETRATION_ERSPAN')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "name": "Data Ingest for ERSPAN",
    "type": "tetration_erspan",
    "desc": "Data Ingest Appliance for ERSPAN",
    "long_desc": "Data Ingest appliance for ERSPAN is a software appliance that can export
 flow data from ERSPAN appliance.",
    "valid_config": [
      "VM3_ERSPAN"
    ],
    "deploy_config": [
      "VM3_ERSPAN"
    ],
    "connectors": [
      "ERSPAN"
    ],
    "limit_connectors_per_appliance": 0,
    "limit_per_rootscope": 8,
    "limit_per_rootscope_taas": 4,
    "limit_per_cluster": 150,
    "cco_url":
"https://software.cisco.com/download/home/286309796/type/286309874/release/3.7.1.26.devel"
  }
```

•

API to List Troubleshooting Commands Available for an Appliance

This endpoint returns the list of troubleshooting commands available for given Appliance.

```
GET /openapi/v1/ext_appliances/<id>/commands/available
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID

Response object: Returns the list of troubleshooting commands available for given Appliance.

Sample response

```
resp = restclient.get('/ext_appliances/63c6ef42bca44e2b5e729191/commands/available')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "type": "UPDATE_LISTENING_PORT",
      "name": "Update the listening port on a connector"
    },
    {
      "type": "SNAPSHOT_APPLIANCE",
      "name": "Collect Snapshot from Appliance"
    },
    {
      "type": "LIST_FILES",
      "name": "List a directory"
    },
    {
      "type": "CONTROLLER_PROFILING",
      "name": "Collect controller profile"
    },
    {
      "type": "SHOW_LOG",
      "name": "Show logs"
    },
    {
      "type": "SHOW_SUPERVISOR_COMMANDS",
      "name": "Execute supervisorctl command"
    },
    {
      "type": "PACKET_CAPTURE",
      "name": "Packet capture"
    },
    {
      "type": "NETWORK_CONNECTIVITY_COMMANDS",
      "name": "Test network connectivity"
    },
    {
      "type": "SHOW_DOCKER_COMMANDS",
      "name": "Execute docker command"
    },
    {
      "type": "CONNECTOR_ALERT_INTERVAL_APPLIANCE",
      "name": "Override connector alert interval for Appliance"
    },
    {
      "type": "SHOW_RUNNING_CONF",
      "name": "Show running configuration"
    },
    {
      "type": "SHOW_SYS_COMMANDS",
      "name": "Execute system command"
    }
  ]
```

API to List Troubleshooting Commands

This endpoint returns the list of troubleshooting commands that are enabled for given Appliance.

```
GET /openapi/v1/ext_appliances/<id>/commands
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID

Response object: Returns the list of troubleshooting commands that are enabled for given Appliance.

Sample response

```
resp = restclient.get('/ext_appliances/63be3b1ade36423c12bff6e1/commands')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "appliance_id": "63be3b1ade36423c12bff6e1",
      "state": "pending",
      "level": "APPLIANCE",
      "command": "SHOW_LOG",
      "arg_string": "",
      "args": {},
      "tailed": false,
      "rc": 0,
      "push_to_dio_at": 0,
      "attempts": 0,
      "deleted": false,
      "deleted_at": 0,
      "created_at": 1673595392,
      "total_chunk": 0,
      "id": "63c10a0039042a6aee1b008c"
    }
  ]
```

API to Create a Troubleshooting Command

This endpoint creates a troubleshooting command available for given Appliance.

```
POST /openapi/v1/ext_appliances/<id>/commands
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906. In request payload, <command> is a troubleshooting command type that can be obtained from API to Get the

Schema of Troubleshooting Commands, on page 905 response "valid_appliances" field. <arguments> is a filled JSON object of the command schema, which can be obtained from API to Get the Schema of Troubleshooting Commands, on page 905.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
command	string	Specify the command type
arguments	set	Provide the filled command schema in JSON format

Response object: Returns the troubleshooting command created for given Appliance.

Sample response

```
req_payload = {
    "command": "SHOW_LOG",
    "arguments": {}
  }
  resp = restclient.post('/ext_appliances/63be3b1ade36423c12bff6e1/commands',
json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "appliance_id": "63be3b1ade36423c12bff6e1",
    "state": "pending",
    "level": "APPLIANCE",
    "command": "SHOW_LOG",
    "args": {},
    "tailed": false,
    "rc": 0,
    "push_to_dio_at": 0,
    "attempts": 0,
    "deleted": false,
    "deleted_at": 0,
    "created_at": 1673595392,
    "total_chunk": 0,
    "id": "63c10a0039042a6aee1b008c"
  }
```

-

API to Delete a Troubleshooting Command

This endpoint deletes a troubleshooting command enabled for given Appliance.

```
DELETE /openapi/v1/ext_appliances/<id>/commands/<command_id>
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906, <command_id> is the id that can be obtained from API to List Troubleshooting Commands, on page 918.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
command_id	string	Specify the command ID

Response object: Returns the status of the troubleshooting command deleted for given Appliance.

Sample response

```
resp =
restclient.delete('/ext_appliances/63be3b1ade36423c12bff6e1/commands/63c10a0039042a6aee1b008c')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "status": 200,
    "code": 1000,
    "message": "deleted"
  }
```

API to Return a Troubleshooting Command

This endpoint returns the selected troubleshooting command for a given Appliance.

```
GET /openapi/v1/ext_appliances/<id>/commands/<command_id>
```

where <id> is the appliance_id that is obtained from the API to Get List of Appliances, on page 906, <command_id> is the id that is obtained from API to List Troubleshooting Commands, on page 918.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
command_id	string	Specify the command ID

Response object: Returns the selected troubleshooting command for a given Appliance.

Sample response

```
resp =
restclient.get('/ext_appliances/63be3b1ade36423c12bff6e1/commands/63c10fd139042a1c0ddd3e1f')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "appliance_id": "63be3b1ade36423c12bff6e1",
    "state": "pending",
    "level": "APPLIANCE",
    "command": "SHOW_LOG",
    "arg_string": "",
    "args": {},
    "tailed": false,
    "rc": 0,
    "push_to_dio_at": 0,
    "attempts": 0,
    "deleted": false,
    "deleted_at": 0,
    "created_at": 1673596881,
    "total_chunk": 0,
    "id": "63c10fd139042a1c0ddd3e1f"
  }
```

API to Download the Output of the Appliance Command as a File

This endpoint downloads the output of the command as a file.

```
GET /openapi/v1/appliances/<id>/commands/{command_id}/download
```

where <id> is the appliance_id that can be obtained from the API to Get List of Appliances, on page 906, <command_id> is the id that can be obtained from API to List Troubleshooting Commands, on page 918. Not all commands have downloadable output, check the command schema provided by API to Get the Schema of Troubleshooting Commands, on page 905, where "output_type": "FILE" indicates it has downloadable content and "output_ext" tells the file type.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
command_id	string	Specify the command ID

Response object: Download the command output as a file.

Sample response

```
resp = restclient.download('downloadFile',
'/appliances/63c6ef42bca44e2b5e729191/commands/63cace941a49bd4c0e0cf45a/download')
```

Connectors

Connectors APIs

The Connectors APIs are associated with managing Secure Workload Connectors. These set of APIs require the `sensor_management` or `external_integration` capability associated with the API key.

API to Get All Types of Connectors

This endpoint gets all types of Connectors for given root scope.

```
GET /openapi/v1/connectors/cards?root_scope_id=<root_scope_id>
```

where <root_scope_id> is the root_scope_id that can be obtained from the Get scopes, on page 791 API.

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Specify the root scope

Response object: Returns all types of Connector with given root scope ID.

Sample response

```
resp = restclient.get('/connectors/cards?root_scope_id=63bf8d2f497d4f7287dbd335')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[{
    "type": "NETFLOW",
    "name": "NetFlow",
    "desc": "Collect telemetry from network devices",
    "long_desc": "Collect NetFlow V9 and/or IPFIX telemetry from network devices such as
routers and switches.",
    "group": "Flow Ingest",
    "index": 0,
    "appliance_type": "tetration_data_ingest",
    "state": "disabled",
    "limit_per_appliance": 3,
    "limit_per_rootscope": 10,
    "limit_per_cluster": 100,
    "config": [
      "LOG",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Flow Visibility"
    ],
    "connector_count": 0,
    "group_order": 0
  },
  {
    "type": "NETSCALER",
    "name": "NetScaler",
    "desc": "Collect telemetry from Citrix ADC",
    "long_desc": "Collect telemetry from Citrix ADC, stitch client and server side flows.",

    "group": "Flow Ingest",
    "index": 2,
    "appliance_type": "tetration_data_ingest",
    "state": "disabled",
    "limit_per_appliance": 3,
    "limit_per_rootscope": 10,
    "limit_per_cluster": 100,
    "config": [
      "LOG",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Flow Visibility",
      "Flow Stitching",
      "ADM"
    ],
    "connector_count": 0,
    "group_order": 0
  },
  {
    "type": "F5",
    "name": "F5",
    "desc": "Collect telemetry from F5 BIG-IP",
    "long_desc": "Collect telemetry from F5 BIG-IP, stitch client and server side flows,
enrich client inventory with user attributes.",
    "group": "Flow Ingest",
    "index": 1,
    "appliance_type": "tetration_data_ingest",
    "state": "disabled",
    "limit_per_appliance": 3,
    "limit_per_rootscope": 10,
    "limit_per_cluster": 100,
    "config": [
      "LDAP",
      "LOG",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Flow Visibility",
      "User Insights",
      "Flow Stitching",
      "ADM"
    ],
    "connector_count": 0,
    "group_order": 0
  },
  {
    "type": "ANYCONNECT",
    "name": "AnyConnect",
    "desc": "Collect telemetry from AnyConnect NVM",
    "long_desc": "Collect telemetry data from Cisco AnyConnect Network Visibility Module
(NVM) and enrich endpoint inventories with user attributes",
    "group": "Endpoints",
    "index": 0,
    "appliance_type": "tetration_data_ingest",
    "state": "disabled",
    "limit_per_appliance": 1,
    "limit_per_rootscope": 50,
    "limit_per_cluster": 500,
    "config": [
      "ENDPOINT",
      "LDAP",
      "LOG",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Flow Visibility",
      "Process Annotation",
      "User Insights",
      "Endpoint Insights",
      "Inventory Enrichment"
    ],
    "connector_count": 0,
    "group_order": 1
  },
  {
    "type": "ASA",
    "name": "Cisco Secure Firewall",
    "desc": "Collect telemetry from Cisco Secure Firewall",
    "long_desc": "Collect telemetry from Cisco Secure Firewall, stitch client and server
side flows. Recommended usage with ISE connector for flow visibility.",
    "group": "Flow Ingest",
    "index": 3,
    "appliance_type": "tetration_data_ingest",
    "state": "disabled",
    "limit_per_appliance": 1,
    "limit_per_rootscope": 10,
    "limit_per_cluster": 100,
    "config": [
      "LOG",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Flow Visibility",
      "Flow Stitching",
      "ADM"
    ],
    "connector_count": 0,
    "group_order": 0
  },
  {
    "type": "SLACK",
    "name": "Slack",
    "desc": "Send alerts to Slack",
    "long_desc": "Send Tetration Alerts to Slack.",
    "group": "Alerts",
    "index": 2,
    "appliance_type": "tetration_edge",
    "state": "disabled",
    "limit_per_appliance": 1,
    "limit_per_rootscope": 1,
    "limit_per_cluster": 150,
    "config": [
      "SLACK_NOTIFIER",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Alert Destination"
    ],
    "connector_count": 0,
    "group_order": 3
  },
  {
    "type": "KINESIS",
    "name": "Kinesis",
    "desc": "Send alerts to Kinesis",
    "long_desc": "Send Tetration Alerts to Kinesis.",
    "group": "Alerts",
    "index": 4,
    "appliance_type": "tetration_edge",
    "state": "disabled",
    "limit_per_appliance": 1,
    "limit_per_rootscope": 1,
    "limit_per_cluster": 150,
    "config": [
      "KINESIS_NOTIFIER",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Alert Destination"
    ],
    "connector_count": 0,
    "group_order": 3
  },
  {
    "type": "SYSLOG",
    "name": "Syslog",
    "desc": "Send alerts to Syslog server",
    "long_desc": "Send Tetration Alerts to Syslog server.",
    "group": "Alerts",
    "index": 0,
    "appliance_type": "tetration_edge",
    "state": "disabled",
    "limit_per_appliance": 1,
    "limit_per_rootscope": 1,
    "limit_per_cluster": 150,
    "config": [
      "SYSLOG_NOTIFIER",
      "SYSLOG_SEVERITY_MAPPING",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Alert Destination"
    ],
    "connector_count": 0,
    "group_order": 3
  },
  {
    "type": "EMAIL",
    "name": "Email",
    "desc": "Send alerts to Email",
    "long_desc": "Send Tetration Alerts to Email.",
    "group": "Alerts",
    "index": 1,
    "appliance_type": "tetration_edge",
    "state": "disabled",
    "limit_per_appliance": 1,
    "limit_per_rootscope": 1,
    "limit_per_cluster": 150,
    "config": [
      "EMAIL_NOTIFIER",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Alert Destination"
    ],
    "connector_count": 0,
    "group_order": 3
  },
  {
    "type": "PAGERDUTY",
    "name": "Pager Duty",
        "desc": "Send alerts to Pager Duty",
        "long_desc": "Send Tetration Alerts to Pager Duty",
        "group": "Alerts",
        "index": 3,
        "appliance_type": "tetration_edge",
        "state": "disabled",
        "limit_per_appliance": 1,
        "limit_per_rootscope": 1,
        "limit_per_cluster": 150,
        "config": [
          "PAGERDUTY_NOTIFIER",
          "ALERT"
        ],
        "max_instances": 0,
        "noteworthy": false,
        "hidden": false,
        "capabilities": [
          "Alert Destination"
        ],
        "connector_count": 0,
        "group_order": 3
      },
      {
        "type": "ISE",
        "name": "ISE",
        "desc": "Collect endpoints and inventories from Cisco ISE",
        "long_desc": "Collect information about endpoints and inventories managed by Cisco ISE
     appliances and enrich endpoint inventories with user attributes and secure group tags
    (SGT). Recommended usage with Cisco Secure Firewall connector for flow visibility.",
        "group": "Endpoints",
        "index": 1,
        "appliance_type": "tetration_edge",
        "state": "disabled",
        "limit_per_appliance": 1,
        "limit_per_rootscope": 1,
        "limit_per_cluster": 150,
        "config": [
          "LDAP",
          "LOG",
          "ALERT"
        ],
        "instance_spec": "ISE",
        "max_instances": 20,
        "noteworthy": false,
        "hidden": false,
        "capabilities": [
          "User Insights",
          "Inventory Enrichment",
          "Endpoint Insights",
          "Software Compliance Posture",
          "MDM Insights"
        ],
        "connector_count": 0,
        "group_order": 1
      },
      {
        "type": "MERAKI",
        "name": "Meraki",
        "desc": "Collect telemetry from Meraki firewalls",
        "long_desc": "Collect telemetry data from Meraki firewalls.",
        "group": "Flow Ingest",
        "index": 5,
        "appliance_type": "tetration_data_ingest",
        "state": "disabled",
     "limit_per_appliance": 1,
     "limit_per_rootscope": 10,
     "limit_per_cluster": 100,
     "config": [
       "LOG",
       "ALERT"
     ],
     "max_instances": 0,
     "noteworthy": false,
     "hidden": false,
     "capabilities": [
       "Flow Visibility"
     ],
     "connector_count": 0,
     "group_order": 0
   },
   {
     "type": "SERVICENOW",
     "name": "ServiceNow",
     "desc": "Collect ServiceNow CMDB records for inventories",
     "long_desc": "Collect CMDB information and service records from ServiceNow instance and
  enriches endpoint inventories with cmdb attributes.",
     "group": "Inventory Enrichment",
     "index": 1,
     "appliance_type": "tetration_edge",
     "state": "disabled",
     "limit_per_appliance": 1,
     "limit_per_rootscope": 1,
     "limit_per_cluster": 150,
     "config": [
       "SERVICENOW",
       "SYNC_INTERVAL",
       "LOG",
       "ALERT"
     ],
     "instance_spec": "SERVICENOW",
     "max_instances": 10,
     "noteworthy": false,
     "hidden": false,
     "capabilities": [
       "User Insights",
       "Inventory Enrichment",
       "Endpoint Insights",
       "Software Compliance Posture"
     ],
     "connector_count": 0,
     "group_order": 2
   },
   {
     "type": "ERSPAN",
     "name": "ERSPAN",
     "desc": "Collect ERSPAN traffic",
     "long_desc": "",
     "group": "Flow Ingest",
     "index": 7,
     "appliance_type": "tetration_erspan",
     "state": "enabled",
     "limit_per_appliance": 3,
     "limit_per_rootscope": 24,
     "limit_per_cluster": 450,
     "config": [],
     "max_instances": 0,
     "noteworthy": false,
     "hidden": false,
    "capabilities": [],
    "connector_count": 3,
    "group_order": 0
  },
  {
    "type": "AWS_CONNECTOR",
    "name": "AWS",
    "desc": "AWS Connector",
    "long_desc": "",
    "group": "Cloud",
    "index": 0,
    "appliance_type": "tetration_internal",
    "state": "disabled",
    "limit_per_appliance": 5000,
    "limit_per_rootscope": 5000,
    "limit_per_cluster": 100000,
    "config": [
      "AWS_CONNECTOR"
    ],
    "max_instances": 0,
    "noteworthy": true,
    "pre_release_tag": "BETA",
    "hidden": false,
    "capabilities": [
      "Flow Visibility",
      "Segmentation",
      "Managed K8s",
      "Inventory Enrichment"
    ],
    "connector_count": 0,
    "group_order": 5
  },
  {
    "type": "AZURE_CONNECTOR",
    "name": "Azure",
    "desc": "Azure Connector",
    "long_desc": "",
    "group": "Cloud",
    "index": 1,
    "appliance_type": "tetration_internal",
    "state": "disabled",
    "limit_per_appliance": 5000,
    "limit_per_rootscope": 5000,
    "limit_per_cluster": 100000,
    "config": [
      "AZURE_CONNECTOR"
    ],
    "max_instances": 0,
    "noteworthy": true,
    "pre_release_tag": "BETA",
    "hidden": false,
    "capabilities": [
      "Flow Visibility",
      "Segmentation",
      "Managed K8s",
      "Inventory Enrichment"
    ],
    "connector_count": 0,
    "group_order": 5
  },
  {
    "type": "GCP_CONNECTOR",
    "name": "GCP",
    "desc": "GCP Connector",
    "long_desc": "",
    "group": "Cloud",
    "index": 2,
    "appliance_type": "tetration_internal",
    "state": "disabled",
    "limit_per_appliance": 5000,
    "limit_per_rootscope": 5000,
    "limit_per_cluster": 100000,
    "config": [
      "GCP_CONNECTOR"
    ],
    "max_instances": 0,
    "noteworthy": true,
    "pre_release_tag": "BETA",
    "hidden": false,
    "capabilities": [
      "Managed K8s"
    ],
    "connector_count": 0,
    "group_order": 5
  }]
```

API to Delete a Connector

This endpoint deletes the given Connector.

```
DELETE /openapi/v1/connectors/<id>
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID

Response object: Returns the status of the deleted Connector.

Sample response

```
resp = restclient.delete('/connectors/63c12e316419d0131767e21c')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "status": 200,
    "code": 1000,
    "message": "deleted"
  }
```

API to Get a Connector by ID

This endpoint gets the Connector with given ID.

```
GET /openapi/v1/connectors/<id>
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID

Response object: Returns the Connector with given ID.

Sample response

```
 resp = restclient.get('/connectors/63c12e316419d0131767e21b')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 {
    "name": "ERSPAN",
    "updated_at": 0,
    "created_at": 1673604657,
    "appliance_id": "63c1272039042a1c0ddd3e20",
    "root_scope_id": "63bf8d2f497d4f7287dbd335",
    "vrf_id": 1,
    "type": "ERSPAN",
    "ip_bindings": [],
    "internal": false,
    "id": "63c12e316419d0131767e21b"
  }
```

API to Rename a Connector

This endpoint renames the Connector with given ID.

```
PUT /openapi/v1/connectors/<id>
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID
name	string	Specify the new name of the Connector

Response object: Returns the Connector with given ID and the new name.

Sample response

```
req_payload = {
    "name": "ERSPAN2",
  }
  resp = restclient.put('/ext_appliances/63c12e316419d0131767e21b',
json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "name": "ERSPAN2",
    "updated_at": 0,
    "created_at": 1673604657,
    "appliance_id": "63c1272039042a1c0ddd3e20",
    "root_scope_id": "63bf8d2f497d4f7287dbd335",
    "vrf_id": 1,
    "type": "ERSPAN",
    "ip_bindings": [],
    "internal": false,
    "id": "63c12e316419d0131767e21b"
  }
```

API to Get the Connector Info with Details

This endpoint gets the Connector info with details.

```
GET /openapi/v1/connectors/cards/<type>?root_scope_id=<root_scope_id>
```

where <root_scope_id> is the root_scope_id that can be obtained from the Get scopes, on page 791 API. In request payload, <type> is a string to decide Connector type.

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Specify the root scope
type	string	Specify the Connector type, the value can be either "NETFLOW", "NETSCALER" "F5" "AWS" "ANYCONNECT" "ASA" "SLACK" "KINESIS" "SYSLOG" "EMAIL" "MERAKI" "PAGERDUTY" "ISE" "SERVICENOW" "ERSPAN" "AWS_CONNECTOR" "AZURE_CONNECTOR" "GCP_CONNECTOR"

Response object: Returns the Connectors under given scope.

Sample response

```
resp = restclient.get('/connectors/cards/NETFLOW?root_scope_id=63bf8d2f497d4f7287dbd335')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "type": "NETFLOW",
    "name": "NetFlow",
    "desc": "Collect telemetry from network devices",
    "long_desc": "Collect NetFlow V9 and/or IPFIX telemetry from network devices such as
routers and switches.",
    "group": "Flow Ingest",
    "index": 0,
    "appliance_type": "tetration_data_ingest",
    "state": "disabled",
    "limit_per_appliance": 3,
    "limit_per_rootscope": 10,
    "limit_per_cluster": 100,
    "config": [
      "LOG",
      "ALERT"
    ],
    "max_instances": 0,
    "noteworthy": false,
    "hidden": false,
    "capabilities": [
      "Flow Visibility"
    ],
    "connector_count": 0,
    "info": {
      "help": "NetFlow connector collects telemetry data from various network devices (such
 as routers, switches).<br> It supports ingest of telemetry data in IPFIX and NetFlow V9
protocols. This connector can be used to discover inventory as it provides a network context.
 The connector helps convert data from flow exports and send them securely as Tetration
Flow records into an instance of Tetration. <br><br><b> Connector Alerts: </b><br> When
Connector Alerts are enabled, you may receive the following alerts: <br> &nbsp; 1. NetFlow
 Connector is down (due to missing heartbeats). <br> &nbsp; 2. Informational alert on high
 CPU/Memory usage."
    },
    "group_order": 0
  }
```

API to Get Connectors

This endpoint returns all Connectors for a given Appliance.

```
GET
/openapi/v1/connectors?root_scope_id=<root_scope_id>&appliance_id=<appliance_id>&type=<type>&state=<state>
```

where <root_scope_id> is the root_scope_id that can be obtained from the Get scopes, on page 791 API, <appliance_id> is the appliance_id that can be obtained from API to Get List of Appliances, on page 906, <type> is a string to decide Connector type that can be obtained from API to Get Appliance Schema, on page 916 "connectors" field, <state> is a filter for connectors state.

Parameters: The request URL contains the following parameters

Name	Type	Description
root_scope_id	string	Specify the root scope
appliance_id	string	Specify the Appliance ID
type	string	Specify the Connector type, the value can be either “NETFLOW”, “NETSCALER” “F5” “AWS” “ANYCONNECT” “ASA” “SLACK” “KINESIS” “SYSLOG” “EMAIL” “MERAKI” “PAGERDUTY” “ISE” “SERVICENOW” “ERSPAN” “AWS_CONNECTOR” “AZURE_CONNECTOR” “GCP_CONNECTOR”

Name	Type	Description
state	string	Filter the Connectors state, the value can be either “ENABLED” “DISABLED” or “UNAVAILABLE”

Response object: Returns all Connectors for given Appliance.

Sample response

```
resp =
restclient.get('root_scope_id=63bf8d2f497d4f7287dbd335&appliance_id=63c1272039042a1c0ddd3e20&type=ERSPAN&state=ENABLED')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "name": "ERSPAN",
      "updated_at": 0,
      "created_at": 1673604657,
      "appliance_id": "63c1272039042a1c0ddd3e20",
      "root_scope_id": "63bf8d2f497d4f7287dbd335",
      "vrf_id": 1,
      "type": "ERSPAN",
      "ip_bindings": [],
      "state": "enabled",
      "internal": false,
      "id": "63c12e316419d0131767e21b"
    },
    {
      "name": "ERSPAN",
      "updated_at": 0,
      "created_at": 1673604657,
      "appliance_id": "63c1272039042a1c0ddd3e20",
      "root_scope_id": "63bf8d2f497d4f7287dbd335",
      "vrf_id": 1,
      "type": "ERSPAN",
      "ip_bindings": [],
      "state": "enabled",
      "internal": false,
      "id": "63c12e316419d0131767e21c"
    },
    {
      "name": "ERSPAN",
      "updated_at": 0,
      "created_at": 1673604657,
      "appliance_id": "63c1272039042a1c0ddd3e20",
      "root_scope_id": "63bf8d2f497d4f7287dbd335",
      "vrf_id": 1,
      "type": "ERSPAN",
      "ip_bindings": [],
      "state": "enabled",
      "internal": false,
      "id": "63c12e316419d0131767e21d"
    }
  ]
```

API to Create a Connector

This endpoint creates a Connector for given Appliance.

```
POST /openapi/v1/connectors
```

In request payload, <root_scope_id> is the root_scope_id that can be obtained from the Get scopes, on page 791 API, <appliance_id> is the appliance_id that can be obtained from API to Get List of Appliances, on page 906, <type> is a string to decide Connector type that can be obtained from API to Get Appliance Schema, on page 916 "connectors" field.

Parameters: The request URL contains the following parameters

Name	Type	Description
name	string	Specify the name
root_scope_id	string	Specify the root scope
appliance_id	string	Specify the Appliance ID
type	string	Specify the Connector type, the value can be either “NETFLOW”, “NETSCALER” “F5” “AWS” “ANYCONNECT” “ASA” “SLACK” “KINESIS” “SYSLOG” “EMAIL” “MERAKI” “PAGERDUTY” “ISE” “SERVICENOW” “ERSPAN” “AWS_CONNECTOR” “AZURE_CONNECTOR” “GCP_CONNECTOR”
version	string	Specify the version

Response object: Returns the created connector.

Sample response

```
req_payload = {
    "root_scope_id": "63c41ff2497d4f5f5be73662",
    "appliance_id": "63c6ef42bca44e2b5e729191",
    "type": "NETFLOW",
    "name": "netflowtest",
    "version": "1.1.1"
  }
  resp = restclient.post('/connectors', json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "name": "netflowtest",
    "updated_at": 0,
    "created_at": 1674187875,
    "appliance_id": "63c6ef42bca44e2b5e729191",
    "root_scope_id": "63c41ff2497d4f5f5be73662",
    "vrf_id": 1,
    "type": "NETFLOW",
    "ip_bindings": [],
    "sources": [],
    "internal": false,
    "id": "63ca14631a49bd4c0e0cefa2"
  }
```

API to Get the Configs on Connector Config Type

This endpoint gets the configs of the Connector with given ID.

```
GET /openapi/v1/connectors/<id>/config?config_type=<config_type>
```

where <id> is the id that can be obtained from the API to Get List of Appliances, on page 906. <config_type> is the "valid_config" that can be obtained from API to Get Appliance Schema, on page 916.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID
config_type	string	Specify the config type. Refer to API to Get the Schema of Config, on page 903 for all possible values listed under Description

Response object: Returns the configs with given Connector ID and config type.

Sample response

```
resp = restclient.get('/connectors/63db5418e6ee1167a4c0986c/config?config_type=LOG')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
 [{
    "mode": "TEST_AND_APPLY",
    "name": "Log instance 2/1/23 22:29",
    "root_scope_id": "63d98f45497d4f53005b24fa",
    "vrf_id": 1,
    "appliance_id": "63dad690e6ee1131f255e985",
    "connector_id": "63db5418e6ee1167a4c0986c",
    "service_id": "63db5418e6ee1167a4c0986d",
    "deleted": false,
    "type": "LOG",
    "state": "COMMIT",
    "error_code": "NO_ERROR",
    "error_text": "",
    "attempts": 1,
    "config": {
      "secured": {},
      "unsecured": {
        "log-level": "info",
        "max-log-size": 10,
        "max-log-age": 30,
        "max-log-backups": 20
      }
    },
    "push_to_dio_at": 1675319360,
    "created_at": 1675319360,
    "updated_at": 1675319364,
    "discovery_completed_at": 0,
    "committed_at": 1675319364,
    "delete_at": 0,
    "error_at": 0,
    "hidden": false,
    "discovery_phase": 0,
    "internal": false,
    "id": "63db5840f029813659f9fcf5"
  }]
```

API to Add a New Config to Connector

This endpoint adds a new config to the Connector with given ID

```
POST /openapi/v1/connectors/<id>/config
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932. <config_type> is the "valid_config" that can be obtained from API to Get Appliance Schema, on page 916. To obtain <config> schema, select one of the "config" from API to Get All Types of Connectors, on page 921 response, apply the "config" to API to Get the Schema of Config, on page 903.

Parameters: The request URL contains the following parameters

Name	Type	Description
name	string	Specify the config name
type	string	Specify the config type. Refer to API to Get the Schema of Config, on page 903 for all possible values listed under Description
config	set	Provide the filled config schema in JSON format

Response object: Returns the updated config.

Sample response

```
req_payload = {
    "name": "Log instance 2/1/23 22:29",
    "type": "LOG",
    "config": {
      "secured": {},
      "unsecured": {
        "log-level": "info",
        "max-log-size": 10,
        "max-log-age": 30,
        "max-log-backups": 20
      }
    }
  }
  resp = restclient.post('/connectors/63db5418e6ee1167a4c0986c/config',
json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "mode": "TEST_AND_APPLY",
    "name": "Log instance 2/1/23 11:29",
    "root_scope_id": "63d98f45497d4f53005b24fa",
    "vrf_id": 1,
    "appliance_id": "63dad690e6ee1131f255e985",
    "connector_id": "63db5418e6ee1167a4c0986c",
    "deleted": false,
    "type": "LOG",
    "state": "PENDING",
    "attempts": 0,
    "config": {
      "secured": {},
      "unsecured": {
        "log-level": "info",
        "max-log-size": 10,
        "max-log-age": 30,
        "max-log-backups": 20
      }
    },
    "push_to_dio_at": 0,
    "created_at": 1675322272,
    "updated_at": 1675322272,
    "discovery_completed_at": 0,
    "committed_at": 0,
    "delete_at": 0,
    "error_at": 0,
    "hidden": false,
    "discovery_phase": 0,
    "internal": false,
    "id": "63db63a0f029813659f9fcf7"
  }
```

API to Delete a Config

This endpoint deletes a config from given Connector.

```
DELETE /openapi/v1/connectors/<id>/config/<config_id>
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932, <config_id> is the id that can be obtained from API to Get the Configs on Connector Config Type, on page 935.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID
config_id	string	Specify the config ID

Response object: Returns the status of the config deleted for given Connector.

Sample response

```
resp =
restclient.delete('/connectors/63c1272039042a1c0ddd3e20/config/63c1272039042a1c0ddd3e21')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "status": 200,
    "code": 1000,
    "message": "deleted"
  }
```

-

API to Get the Config

This endpoint gets the config with given ID

```
GET /openapi/v1/connectors/<id>/config/<config_id>
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932, <config_id> is the id that can be obtained from API to Get the Configs on Connector Config Type, on page 935.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Appliance ID
config_id	string	Specify the config ID

Response object: Returns the config with given ID.

Sample response

```
resp = restclient.get('/connectors/63db5418e6ee1167a4c0986c/config/63db5840f029813659f9fcf5')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "mode": "TEST_AND_APPLY",
    "name": "Log instance 2/1/23 22:29",
    "root_scope_id": "63d98f45497d4f53005b24fa",
    "vrf_id": 1,
    "appliance_id": "63dad690e6ee1131f255e985",
    "connector_id": "63db5418e6ee1167a4c0986c",
    "service_id": "63db5418e6ee1167a4c0986d",
    "deleted": false,
    "type": "LOG",
    "state": "COMMIT",
    "error_code": "NO_ERROR",
    "error_text": "",
    "attempts": 1,
    "config": {
      "secured": {},
      "unsecured": {
        "log-level": "info",
        "max-log-size": 10,
        "max-log-age": 30,
        "max-log-backups": 20
      }
    },
    "push_to_dio_at": 1675319360,
    "created_at": 1675319360,
    "updated_at": 1675319364,
    "discovery_completed_at": 0,
    "committed_at": 1675319364,
    "delete_at": 0,
    "error_at": 0,
    "hidden": false,
    "discovery_phase": 0,
    "internal": false,
    "id": "63db5840f029813659f9fcf5"
  }
```

API to List Troubleshooting Commands Available for Connector

This endpoint returns the list of troubleshooting commands available for given Connector.

```
GET /openapi/v1/connectors/<id>/commands/available
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID

Response object: Returns the list of troubleshooting commands available for given Connector.

Sample response

```
resp = restclient.get('/connectors/63c6f2701a49bd2bb0696cab/commands/available')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "type": "LIST_SERVICE_FILES",
      "name": "List a directory in a service"
    },
    {
      "type": "CONTROLLER_PROFILING",
      "name": "Collect controller profile"
    },
    {
      "type": "SHOW_LOG",
      "name": "Show logs"
    },
    {
      "type": "SHOW_SERVICE_LOG",
      "name": "Show service logs"
    },
    {
      "type": "RESTART_CONNECTOR_CONTAINER",
      "name": "Restart the connector docker container"
    },
    {
      "type": "SHOW_SUPERVISOR_COMMANDS",
      "name": "Execute supervisorctl command"
    },
    {
      "type": "CONNECTOR_ALERT_INTERVAL_CONNECTOR",
      "name": "Override connector alert interval for Connector"
    },
    {
      "type": "SERVICE_PROFILING",
      "name": "Collect connector profile"
    },
    {
      "type": "SNAPSHOT_CONNECTOR",
      "name": "Collect Snapshot from a connector"
    },
    {
      "type": "PACKET_CAPTURE",
      "name": "Packet capture"
    },
    {
      "type": "NETWORK_CONNECTIVITY_COMMANDS",
      "name": "Test network connectivity"
    },
    {
      "type": "SHOW_SERVICE_RUNNING_CONF",
      "name": "Show running configuration of a service"
    },
    {
      "type": "RESTART_CONNECTOR_SERVICE",
      "name": "Restart the connector service"
    },
    {
      "type": "SHOW_SYS_COMMANDS",
      "name": "Execute system command"
    }
  ]
```

API to List Troubleshooting Commands

This endpoint returns the list of troubleshooting commands that are enabled for given Connector.

```
GET /openapi/v1/connectors/<id>/commands
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID

Response object: Returns the list of troubleshooting commands that are enabled for given Connector.

Sample response

```
resp = restclient.get('/connectors/63db5418e6ee1167a4c0986c/commands')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
[
    {
      "appliance_id": "63dad690e6ee1131f255e985",
      "connector_id": "63db5418e6ee1167a4c0986c",
      "service_id": "63db5418e6ee1167a4c0986d",
      "state": "success",
      "level": "SERVICE",
      "command": "SHOW_LOG",
      "arg_string": "",
      "args": {
        "pattern": "info"
      },
      "tailed": false,
      "rc": 0,
      "push_to_dio_at": 1675319615,
      "attempts": 1,
      "error_code": "NO_ERROR",
      "error_text": "",
      "deleted": false,
      "deleted_at": 0,
      "created_at": 1675319613,
      "total_chunk": 0,
      "id": "63db593df029813659f9fcf6"
    }
  ]
```

API to Create a Troubleshooting Command

This endpoint creates a troubleshooting command available for given Connector.

```
POST /openapi/v1/connectors/<id>/commands
```

here <id> is the id that can be obtained from the API to Get Connectors, on page 932. In request payload, <command> is a troubleshooting command type that can be obtained from API to List Troubleshooting Commands Available for Connector, on page 939. <arguments> is a filled JSON object of the command schema, which can be obtained from API to Get the Schema of Troubleshooting Commands, on page 905.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID
command	string	Specify the command type
arguments	set	Provide the filled command schema in JSON format

Response object: Returns the troubleshooting command created for given Appliance.

Sample response

```
req_payload = {
    "command": "SHOW_LOG",
    "arguments": {
      "pattern": "info"
    }
  }
  resp = restclient.post('/connectors/63db5418e6ee1167a4c0986c/commands',
json_body=json.dumps(req_payload))
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "appliance_id": "63dad690e6ee1131f255e985",
    "connector_id": "63db5418e6ee1167a4c0986c",
    "service_id": "63db5418e6ee1167a4c0986d",
    "state": "pending",
    "level": "SERVICE",
    "command": "SHOW_LOG",
    "args": {
      "pattern": "info"
    },
    "tailed": false,
    "rc": 0,
    "push_to_dio_at": 0,
    "attempts": 0,
    "deleted": false,
    "deleted_at": 0,
    "created_at": 1675319613,
    "total_chunk": 0,
    "id": "63db593df029813659f9fcf6"
  }
```

API to Delete a Troubleshooting Command

This endpoint deletes a troubleshooting command available for given Connector.

```
DELETE /openapi/v1/connectors/<id>/commands/<command_id>
```

where <id> is id that can be obtained from the API to Get Connectors, on page 932, <command_id> is the id that can be obtained from API to List Troubleshooting Commands, on page 918.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID
command_id	string	Specify the command ID

Response object: Returns the status of the troubleshooting command deleted for given Connector.

Sample response

```
resp =
restclient.delete('/connectors/63c12e316419d0131767e21c/commands/63c10a0039042a6aee1b008c')

  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "status": 200,
    "code": 1000,
    "message": "deleted"
  }
```

API to Return a Troubleshooting Command

This endpoint returns the selected troubleshooting command for a given connector.

```
GET /openapi/v1/connectors/<id>/commands/<command_id>
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932, <command_id> is the id that can be obtained from API to List Troubleshooting Commands, on page 918.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID

Name	Type	Description
command_id	string	Specify the command ID

Response object: Returns the selected troubleshooting command for a given connector.

Sample response

```
resp =
restclient.get('/connectors/63db5418e6ee1167a4c0986c/commands/63db593df029813659f9fcf6')
  if resp.status_code == 200:
    parsed_resp = json.loads(resp.content)
    print json.dumps(parsed_resp)
```

Sample response

```
{
    "appliance_id": "63dad690e6ee1131f255e985",
    "connector_id": "63db5418e6ee1167a4c0986c",
    "service_id": "63db5418e6ee1167a4c0986d",
    "state": "success",
    "level": "SERVICE",
    "command": "SHOW_LOG",
    "arg_string": "",
    "args": {
      "pattern": "info"
    },
    "tailed": false,
    "rc": 0,
    "push_to_dio_at": 1675319615,
    "attempts": 1,
    "error_code": "NO_ERROR",
    "error_text": "",
    "deleted": false,
    "deleted_at": 0,
    "created_at": 1675319613,
    "total_chunk": 0,
    "id": "63db593df029813659f9fcf6"
  }
```

API to Download the Output of the Connector Command as a File

This endpoint downloads the output of the command as a file.

```
GET /openapi/v1/connectors/<id>/commands/{command_id}/download
```

where <id> is the id that can be obtained from the API to Get Connectors, on page 932, <command_id> is the id that can be obtained from API to List Troubleshooting Commands, on page 918. Not all commands have downloadable output, check the command schema that is provided by API to Get the Schema of Troubleshooting Commands, on page 905, where "output_type": "FILE" indicates it has downloadable content and "output_ext" tells the file type.

Parameters: The request URL contains the following parameters

Name	Type	Description
id	string	Specify the Connector ID
command_id	string	Specify the command ID

Response object: Returns the selected troubleshooting command for a given connector.

Sample response

```
resp = restclient.download('downloadFile',
'/connectors/63c6ef42bca44e2b5e729191/commands/63cace941a49bd4c0e0cf45a/download')
```

CHAPTER 17

Limits

Flows and Endpoints

Metric	Limit	8RU/39RU/SaaS/-
Number of concurrent servers (virtual machine or bare metal) from which telemetry data can be analyzed by Secure Workload	• Up to 10,000 with detailed flow telemetry Up to 20,000 with conversation-only flow telemetry	8RU
	• Up to 37,500 with detailed flow telemetry Up to 75,000 with conversation-only flow telemetry	39RU
Number of flow events that can be processed by Secure Workload per second	up to 500,000 per second	8RU
	up to 2 million per second	39RU

Tenants, Child Scopes, Inventory Filters, and Roles

Metric	Limit	8RU/39RU
Number of workloads in full fidelity mode	10000	8RU
	37500	39RU
Number of tenants	7	8RU
	35	39RU
Number of child scopes per tenant	1000 *	8RU
	5000	39RU
Number of child scopes across tenants	7000	8RU
	35000	39RU
Number of workspaces per tenant	1000 *	8RU
	3500 *	39RU
Number of workspaces across tenants	5000	8RU
	20000	39RU
Number of inventory filters per tenant	1000 *	8RU
	5000 *	39RU
Number of inventory filters across tenants	7000 *	8RU
	35000 *	39RU
Number of Roles per child scope	6	8RU
	6	39RU

Note * If conversation mode is enabled on all agents, Secure Workload supports up to two times the mentioned limits for limits marked with an asterisk (*). For details, see Conversation Mode.

Cloud Connectors

Cloud Connectors	Metric	Limit	Scale	Virtual Networks	Kubernetes Clusters
AWS Connector	Total number of flows exported by AWS connector	15000 flows per second	5 accounts per connector	5 per account	5 per account
Azure Connector	Total number of flows exported by Azure connector	15000 flows per second	5 subscriptions per connector	5 per subscription	5 per subscription
Google Cloud Platform	Total number of flows exported by GCP connector	15000 flows per second	5 projects per connector	5 per project	5 per project

Note

- A maximum of 50 connectors, including cloud connectors, can be configured in a cluster across all tenants.
- The workloads managed by cloud connectors in Secure Workload require workload licenses, therefore, ensure that your total workloads are licensed and within the cluster limits.

Connectors

Note

- A maximum of 50 connectors, including cloud connectors, can be configured in a cluster across all tenants.
- For limits applicable to individual connectors, see What are Connectors.

Connector	Metric	Limit
AnyConnect Connector	Total number of AnyConnect endpoints supported by one AnyConnect connector	5000 endpoints **Note** The number of AnyConnect endpoints across all AnyConnect Proxy sensors is limited by the number of sensors supported by the Secure Workload appliance.
AnyConnect Connector	Number of LDAP attributes that could be labelled on inventories of AnyConnect endpoints	6 attributes
AWS Connector	Total number of flows exported by AWS connector	15000 flows per second
F5 Connector	Total number of flows exported by F5 connector	15000 flows per second
NetFlow Connector	Total number of flows exported by one NetFlow connector	15000 flows per second
NetScaler Connector	Total number of flows exported by NetScaler connector	15000 flows per second
ERSPAN Connector	Total number of flows exported by ERSPAN connector	15000 flows per second

Secure Workload Virtual Appliances for Connectors

Appliance	Metric	Limit
Secure Workload Ingest Appliance	Number of connectors on one appliance	3
	Number of appliances per root scope	100
	Number of appliances per cluster	500
Secure Workload Edge Appliance	Number of connectors on one appliance	6
	Number of appliances per root scope	1
	Number of appliances per cluster	Number of root scopes

Label Limits

Feature	Metric	Limit	8RU/39RU/SaaS/-
Label limits	Maximum number of IP Addresses that can be labeled across all root scopes	1,500,000 *	39RU
		500,000 *	8RU
	Maximum number of subnets that can be labeled across all root scopes	200,000	39RU
		50,000	8RU
	Maximum number of IP Addresses that can be labeled per tenant (CMDB only)	6,000 / 100 licenses (SaaS only)	
	Maximum number of subnets that can be labeled per tenant (CMDB only)	120 / 100 licenses (SaaS only)	

Note * If conversation mode is enabled on all agents, Secure Workload supports up to two times the mentioned limits for limits marked with an asterisk (*). For details, see Conversation Mode.

Limits Related to Policies

Feature	Metric	Limit	8RU/39RU/SaaS/-
Automatic policy discovery (formerly ADM)	Maximum number of member workloads (endpoints) allowed for automatic policy discovery runon a single scope	10,000	-
	Maximum number of conversations allowed for automatic policy discovery run on a single scope	10,000,000	-
	Maximum number of member workloads (endpoints) allowed for automatic policy discovery on a branch of the scope tree	37,500	-
	Maximum number of conversations allowed for automatic policy discovery on a branch of the scope tree	20,000,000	-
	Maximum number of total unique workloads (endpoints) allowed for automatic policy discovery run	15,000,000	-
	Maximum number of exclusion filters in Default Policy Discovery config	100	-
	Maximum number of exclusion filters allowed per workspace	100	-

Feature	Metric	Limit	8RU/39RU/SaaS/-
Concrete policies	Aggregate size of policies on agents installed on non-Kubernetes workloads	2.5 MB (About 2000 policies, depending on complexity)	-
	Aggregate size of policies on agents installed on Kubernetes nodes	7.5 MB (About 6000 policies, depending on complexity)	-

Other Features

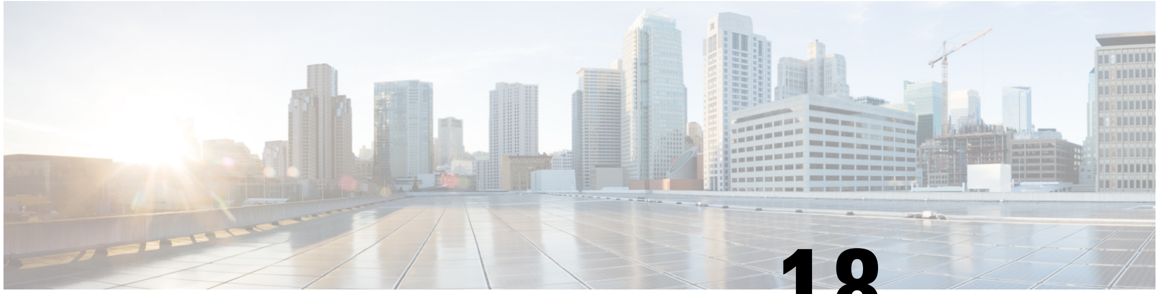
Feature	Metric	Limit	8RU/39RU/SaaS/-
Alerts	Number of instances supported within a root scope	256	-
	Number of instances supported across root scopes	1024	-
	Number of latest alerts that are displayed on UI per root scope	5000	-
	Maximum alert rate to preview in UI	60 per minute. **Note** If more than 60 alerts are sent per minute then UI will show a summary message indicating that alerts were sent to the DataTap but are suppressed in UI. Note that the 60 alerts per minute apply to the rate at which alerts are sent to datataps, and does not apply to the alert time nor event time and is unrelated to any specific batch of data.	-

Feature	Metric	Limit	8RU/39RU/SaaS/-
	Number of alerts configured per root scope (via modal)	1000	-
	Maximum number of alerts processed by Alerts App per minute batch	20000	-
Compliance App	Number of workspaces supported	128	-

Feature	Metric	Limit	8RU/39RU/-
Number of tracked inventory items	Maximum number of IP Addresses that can be tracked across all root scopes	1,500,000 *	39RU
		500,000 *	8RU
	Maximum number of subnets that can be tracked across all root scopes	200,000	39RU
		50,000	8RU

Data-In or Data-Out

Feature	Metric	Limit	8RU/39RU/SaaS/-
Data Taps	Number of data taps supported per appliance	10	-



CHAPTER 18

End User License Agreement

End User License Agreement

To view the End User License Agreement and Supplemental End User License Agreement for your product, go to https://www.cisco.com/c/en/us/about/legal/cloud-and-software/software-terms.html. Click the **Supplemental End User License Agreements** tab and search for your product.