Ultra Cloud Core Subscriber Microservices Infrastructure - Deployment Guide

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About this Guide

Note The documentation set for this product strives to use bias-free language. For purposes of this documentation set, bias-free is defined as language that does not imply discrimination based on age, disability, gender, racial identity, ethnic identity, sexual orientation, socioeconomic status, and intersectionality. While any existing biased terms are being substituted, exceptions may be present in the documentation due to language that is hardcoded in the user interfaces of the product software, language used based on RFP documentation, or language that is used by a referenced third-party product.

This preface describes the Cisco *Subscriber Microservices Infrastructure (SMI)*, how it is organized and its document conventions.

This guide provides the instructions for deploying the Cluster Manager and includes feature descriptions, configuration instructions, and CLI commands for mutiple deployment scenarios.

• Conventions Used, on page vii

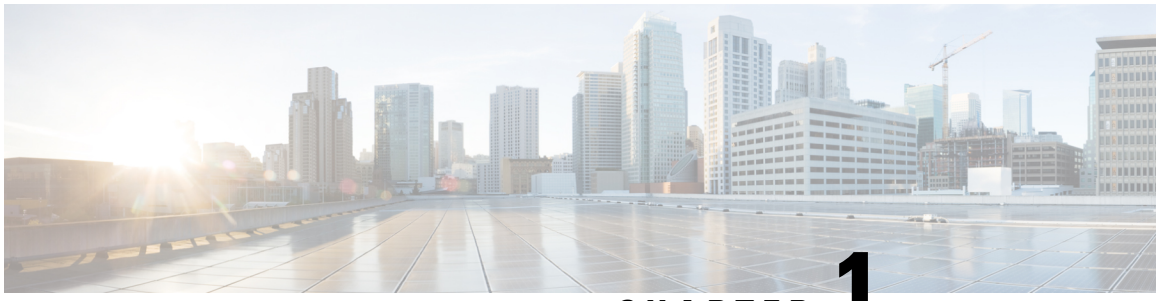
Conventions Used

The following tables describe the conventions used throughout this documentation.

Notice Type	Description
Information Note	Provides information about important features or instructions.
Caution	Alerts you of potential damage to a program, device, or system.
Warning	Alerts you of potential personal injury or fatality. May also alert you of potential electrical hazards.

Typeface Conventions	Description
Text represented as a `screen display`	This typeface represents displays that appear on your terminal screen, for example: `Login:`

Typeface Conventions	Description
Text represented as **commands**	This typeface represents commands that you enter, for example: **show ip access-list** This document always gives the full form of a command in lowercase letters. Commands are not case sensitive.
Text represented as a **command** *variable*	This typeface represents a variable that is part of a command, for example: **show card** *slot_number* *slot_number* is a variable representing the desired chassis slot number.
Text represented as menu or sub-menu names	This typeface represents menus and sub-menus that you access within a software application, for example: Click the **File** menu, then click **New**



CHAPTER 1

Ultra Cloud Core Subscriber Microservices Infrastructure - Overview

Ultra Cloud Core Subscriber Microservices Infrastructure Overview

The Ultra Cloud Core Subscriber Microservices Infrastructure (SMI) provides a run time environment for deploying and managing Cisco's cloud-native network functions (cNFs), also referred to as applications.

It is built around open source projects like Kubernetes (K8s), Docker, Helm, etcd, confd, and gRPC and provides a common set of services used by deployed cNFs including:

- **Protocol Load Balancing**: These microservices provide the external NF interfaces (HTTP, Diameter, GTP, LDAP, etc.) and load balance requests to the application microservices. They normalize internal communications and allow application evolution independent of the interface evolution. Each protocol type is usually implemented as a separate microservice. gRPC is used for internal communication with the application microservices
- **Database Service**: The database service provides a normalized gRPC interface to the application microservices. The database service can interface to different databases allowing the use of different back-end databases depending on the application requirements while maintaining the same interface.
- **Cisco Service Mesh**: This service provides rule-based control over load balancing decisions across different application containers. Through this service, SMI supports and automates operations such as canary upgrades, new service roll-outs, and in-service upgrades.
- **Telemetry Service**: Telemetry functionality is provided through a common set of microservices which collect real-time statistics, alarms, logs from various deployed application components, and translates and streams them to external functions.
- **Dashboard Service**: The dashboard service works with the telemetry service to provide operational overview data for application containers such as state, utilization, and key performance indicators (KPIs).

Cisco's cNFs are implemented as a set of microservices that make use of the common platform services offered by SMI. Refer to the NF's documentation for additional details.

SMI on Bare Metal - Overview

The SMI extends the deployment of Virtual Network Functions (VNF) and Cloud-Native Network Functions (CNFs) to bare metal servers (Cisco UCS-C servers) with the current release. Also, the SMI supports vertically integrated deployment on bare metal servers.

The following are some of the significant features deploying SMI on Bare Metal servers:

- Elimination of VIM-related overhead on Bare Metal servers
- Zero touch deployment for both VNF and CNF based applications
- Automated infrastructure upgrades
- Exposed API for deployment, configuration, and management to enable automation.
- Addresses edge deployment
    - Provides single compute user plane to run at remote sites
- Scales out without any additional overhead
- Ground up API (NETCONF, REST) driven design and architecture
    - All the interfaces are compliant with northbound NFVO (for instance, NSO).
- Simplification and remote management
- Removes shared storage from the architecture
- Single monitoring endpoint for both server and application health

Note The SMI has the ability to run virtual machines for legacy applications. Currently, it supports only User Plane Function (UPF). Future releases will support legacy (Cisco and partner) virtual applications.

Subscriber Microservices Infrastructure Architecture

The Ultra Cloud Core Subscriber Microservices Infrastructure (SMI) is a layered stack of cloud technologies that enable the rapid deployment of, and seamless life cycle operations for microservices-based applications.

The SMI stack consists of the following:

- **SMI Cluster Manager** — Creates the Kubernetes (K8s) cluster, creates the software repository, and provides ongoing Life Cycle Management (LCM) for the cluster including deployment, upgrades, and expansion.

Note The SMI Cluster Manager can install all SMI based applications (including the SMI Cluster Manager) in a Day-0 manner. For Day-1 configurations, you can utilize the deployed application Ops Center.

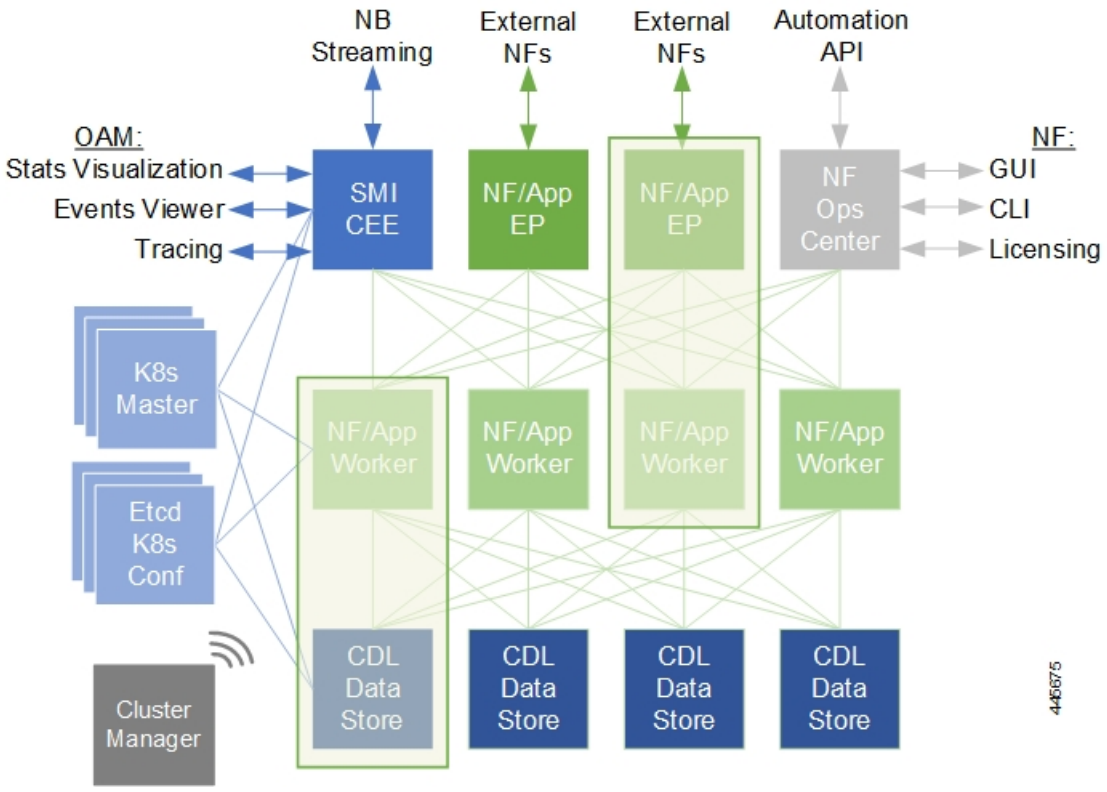
The SMI Cluster Manager supports the following platforms:

- **VMware** — The Cluster Manager deploys the base images using the vSphere APIs.
- **Bare Metal** — The Cluster Manager configures:
  - UCS-C server based hosts using Cisco Integrated Management Controller (CIMC) APIs.
- **Manual** — The Cluster Manager allows other systems (NSO/ESC) to provision the base image and configure the K8s Cluster.

- **Kubernetes Management** — Includes the K8s control plane and etcd functions which provide LCM for the cNF applications deployed in the cluster as well as provides cluster health monitoring and resources scheduling.
- **Common Execution Environment (CEE)** — Provides common utilities and OAM functionalities for Cisco cNFs and applications, including licensing and entitlement functions, configuration management, telemetry and alarm visualization, logging management, and troubleshooting utilities. Additionally, it provides consistent interaction and experience for all customer touch points and integration points in relation to these tools and deployed applications.
- **Common Data Layer (CDL)** — Provides a high performance, low latency, stateful data store, designed specifically for 5G and subscriber applications. This next generation data store offers HA in local or geo-redundant deployments.
- **Service Mesh** — Provides sophisticated message routing between application containers, enabling managed interconnectivity, additional security, and the ability to deploy new code and new configurations in low risk manner.
- **NF/Application Worker nodes** — The containers that comprise an NF application pod.
- **NF/Application Endpoints (EPs)** – The NF's/application's interfaces to other entities on the network.
- **Application Programming Interfaces (APIs)** — SMI provides various APIs for deployment, configuration, and management automation.
- **Ops Center** — The SMI run time environment, as well as each Cisco cloud native application, includes an innovative management interface called Ops Center. This Netconf/Restconf interface, based on Yang schema, enables all configurations for SMI and Cisco cloud native applications, to be automated or managed directly through a CLI.

Figure 1 depicts how these components interconnect to comprise a microservice-based NF/application.

Figure 1: SMI Components



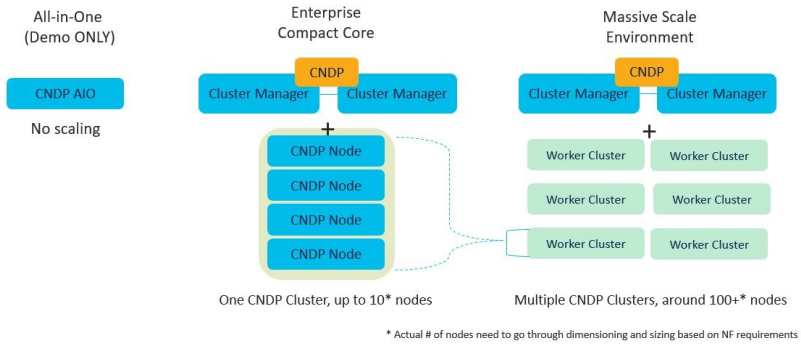
SMI Bare Metal - Architecture

The SMI enables the deployment of Cluster Manager on Bare Metal servers. The following are some of the salient features of SMI Bare Metal architecture:

- Enables all the application containers to run on the bare metal servers with enough resource isolation
- Provides a migration path for SMI on VM to SMI on bare metal
- Automated bring up at the Data Center
- Hardware agnostic architecture

The following figure depicts the high-level SMI Bare Metal Architecture:

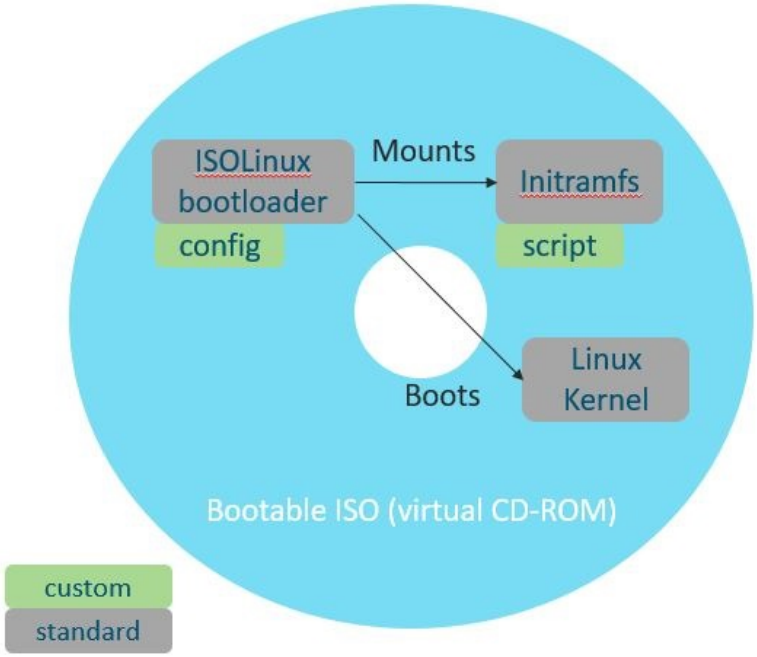
Figure 2: SMI Bare Metal High-level Architecture



With the help of a Bootable ISO, the SMI Cluster Manager boots the Linux Kernel from the base image. This allows compatibility with most of the standard hardware platforms. A customized script downloads and writes the HD image using the Initial RAM File System. Also, the Bootable ISOs smaller size - 23 Mega Bytes (MB) - reduces latency.

The following figure depicts the operations of the Bootable ISO:

Figure 3: Bootable ISO



SMI Bare Metal Deployment Architecture

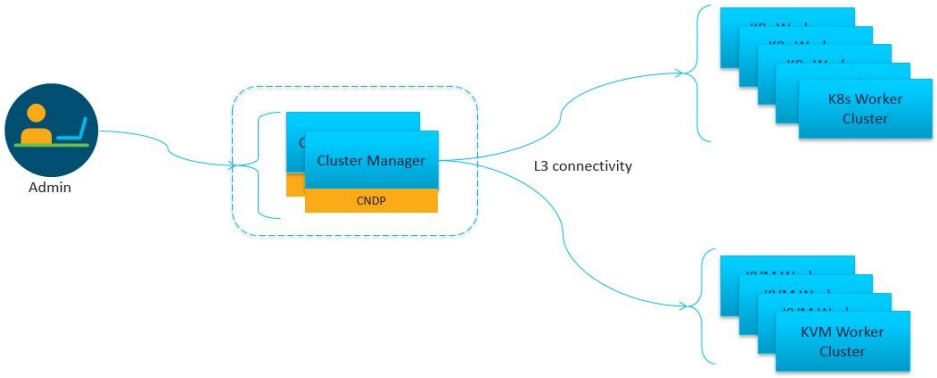
The SMI Bare Metal deployment architecture comprises of a two node Management Cluster. The two node cluster comprises of a SMI CEE (for monitoring) and SMI Cluster Manager running on it. Also, the two node cluster is responsible for:

- Installing and upgrading the BIOS, host OS, Kubernetes, KVM.

- Installing and upgrading Kubernetes based NFs.
- Adding the day-0 configuration to installed NFs.
- Installing StarOS NFs (UPF).
- Monitoring and Alerting.

The SMI Cluster Manager provisions and manages the Life Cycle Management (LCM) of each worker node for both the K8s and Kernel based Virtual Machine (KVM) infrastructure. The following figure depicts the high-level architecture of SMI Bare Metal Deployment architecture:

Figure 4: SMI Bare Metal Deployment Architecture



K8s Cluster Manager

SMI operational components and microservices are deployed on VMs. (Refer to *SMI VM Quantities and Sizing* for details.)

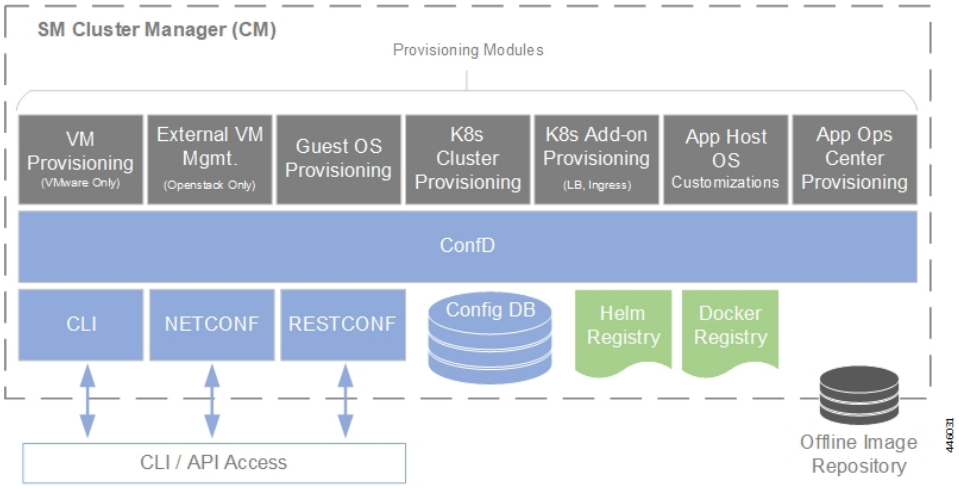
The SMI Cluster Manager (CM) is also deployed as a VM and is used to bootstrap the deployment of other components and applications.

The CM works with the Virtual Infrastructure Manager (VIM) to instantiate the required VMs. In VMware environments, the CM instantiates the virtual machines (VMs) required for the cluster. In OpenStack environments, the CM makes an API call to an orchestrator or Virtual Network Function Manager (VNFM) to instantiate VMs.

The VMs are deployed with a guest OS that is provided with SMI. Once instantiated, the CM provisions the OS, and deploys or provisions the SMI microservices (for example, K8s control plane, K8s etcd, and so on.).

Once all VMs and K8s components are built, the CM can deploy 5G application Ops Centers, which enable NETCONF/RESTCONF interfaces for application configuration and management. All of these actions are API driven and all can be automated and orchestrated.

Figure 5: SMI Cluster Manager Functionality



Scheduling rules such as affinity and anti-affinity help guide K8s for proper node placement, as well as adding node taint and tolerances. Because K8s uses a declarative method of deployment, operators simply need to update the desired number of services and K8s manages scheduling and maintains the correct number of services, even during failure scenarios.

K8s Resource Management

SMI leverages the native resource reservation controls in K8s.

K8s provides a framework to intelligently place pods on the correct server, VM, and/or node, and assign the appropriate system resources, including:

- Service taints, tolerances, affinity, and anti-affinity rules
  - Provides rules for pod placement across available hardware
  - Prevents resource "hotspots" by separating pods with similar resource profiles
  - Provides high availability (HA) by ensuring secondary instances through pod separation
- CPU reservation
  - Allows applications to specify CPUs/CPU requirements (similar to CPU pinning)
  - Prevents negative impacts from context switching, or noisy/grabby neighbors
- Pod quality of service (QoS) definition (e.g. the quality and range of resources available to the Pods)
  - Guaranteed (resource requests = resource limits)
  - Burstable (resource requests > resource limits)
  - Best effort (no resource requests nor limits)

DSCP is implemented at the network level to manage the quality of service and ensure critical traffic is prioritized.

Common Execution Environment

SMI's Common Execution Environment (CEE) provides OAM capabilities for deployed NFs.

The CEE captures information (key metrics) from the NFs in a centralized way for engineers to debug and troubleshoot the overall solution.

There is only one CEE available per K8s cluster, which provides the common set of tools for all deployed NFs. CEE life cycle is independent of NF and it comes equipped with a dedicated Ops Center, which provides the user interface (CLI) and APIs for managing the monitoring tools.

Monitoring and Debugging

The SMI platform provides multiple layers of health checking:

- **Deployment health checks** — These confirm that the infrastructure meets the application requirements.

  NOTE: Some deployment health checks (input/output operations per second (IOPS) validation and network throughput) may impact performance and should only be executed during the deployment phase.

- **Run time health checks** — These checks are constantly running in the background to verify that logging and tracing are set to the lowest levels, and to check error rates and alarms.

- **Pod health checks** — These confirm that the pod is alive and service availability. If the pod fails the health check, it is killed and re-scheduled onto another available node.

- **Performance checks** — The checks provide such data as transactions per second (TPS), number of records (sessions), CPU and memory utilization, errors, etc.

Statistics are available for viewing through Grafana, as well as for streaming using Prometheus. They are also available in bulkstat format. The granularity of statistics can be as small as 1 second. Statistics are stored for up to 3 days using Thanos to compress and compact the data.

Logging utilizes journald and rsyslog to collect and distribute logs northbound to a fully featured logging platform. SMI also includes logging utilities to collect snapshots for troubleshooting and uploading to Cisco TAC support centers. Logging verbosity and detail levels are set via API, and can be set to Critical, Error, Warning, Informational, or Debug.

Application and platform events can be forwarded northbound using Prometheus plugins such as VES and/or SNMP.

Tracing

Cisco's cloud native based applications are designed to tag messages in a method compatible with OpenTracing project guidelines.

SMI provides tooling and centralized storage for continuous tracings of cNFs even as they may span across multiple nodes.

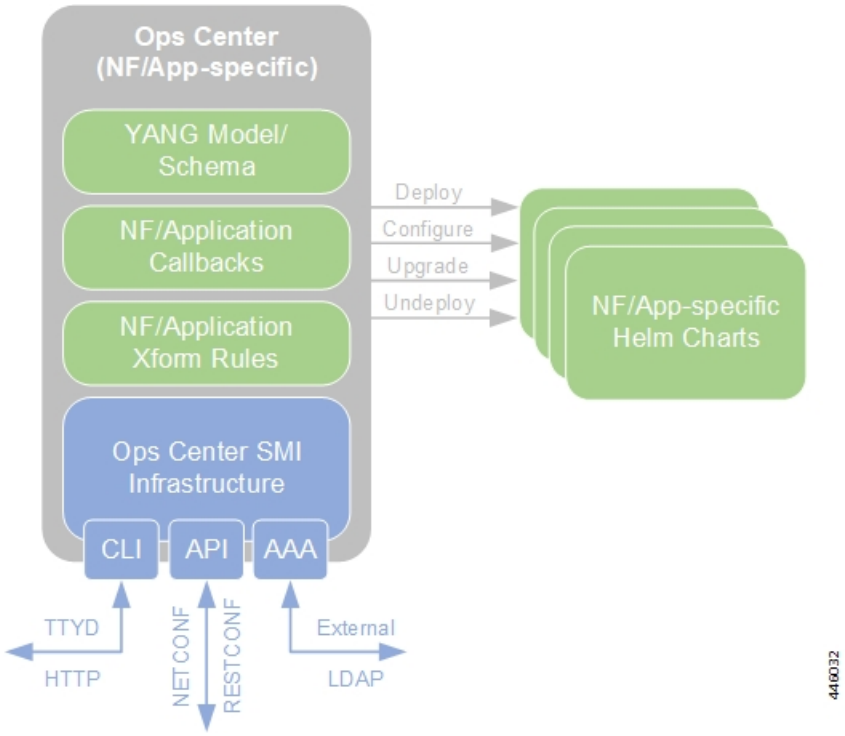
This tracing shows all "message spans" from platform ingress to platform egress as well as how long each unit of work takes.

Ops Center

Cisco's cNFs consist of Helm charts (applications and charts) and Docker files (images).

To simplify and establish consistent operations across the various charts and images that comprise each NF, each NF is designed with an Ops Center. Ops Centers provide a common, stable CLI/API for operators to deploy and manage the NF in a holistic way.

Figure 6: NF/Application Ops Center



SMI provides the following functionality in relation to NF Ops Centers:

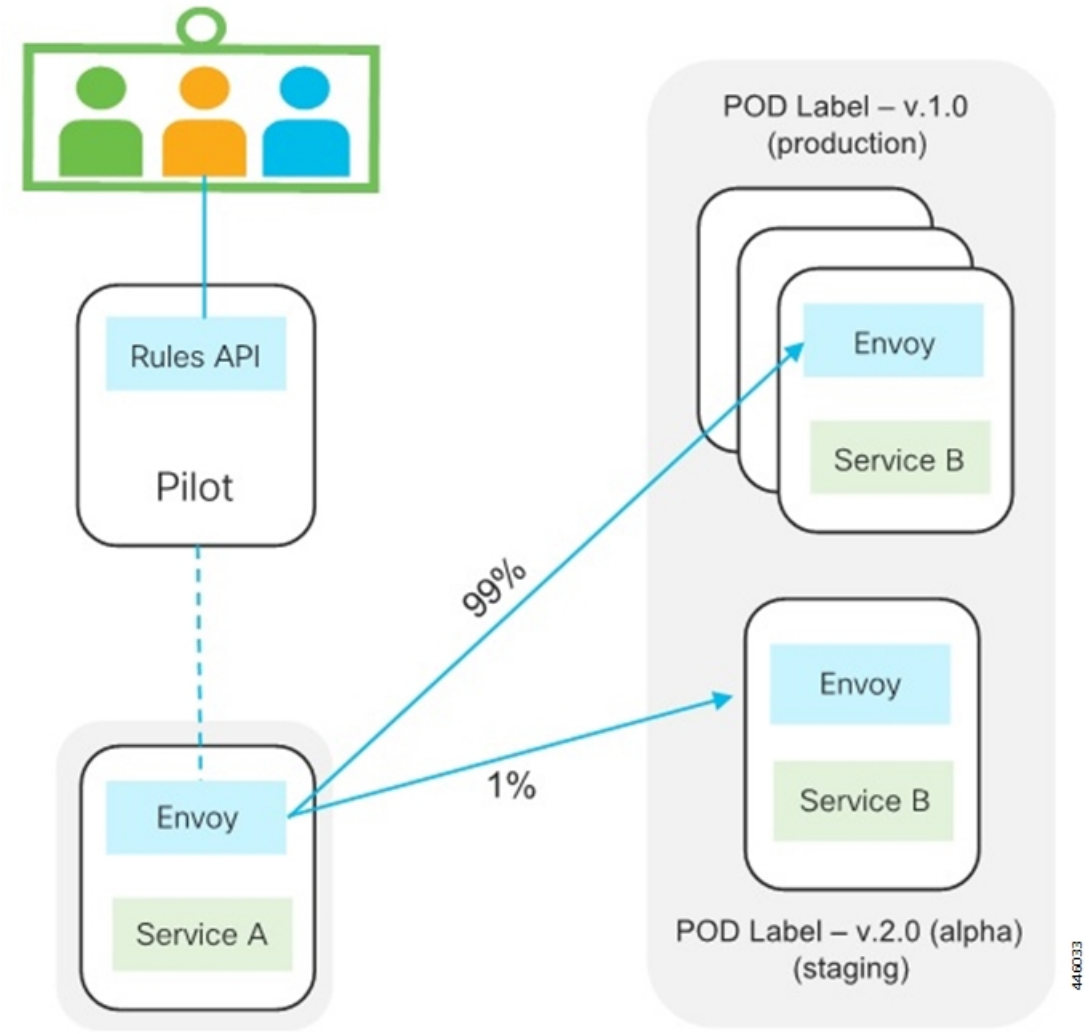
- Common NETCONF, RESTCONF, and CLI interfaces, which allows for integration network orchestrators such as Cisco's Network Services Orchestrator (NSO) without need for a custom network element driver (NED)
- A YANG model for the application
- Audit logging and configuration validation
- Lightweight Directory Access Protocol (LDAP) interface directory information services — for example, Active Directory (AD) — to ensure all applications use a common set of user accounts
- Cisco Smart Licensing integration
- Callbacks into the application to execute operational commands
- NETCONF Access Control (NACM) security model

Service Mesh

The Service Mesh enabled through SMI connects and manages messages between all pods and services in the cluster. Using this service mesh, traffic is steered within the cluster to finely control which NF components are part of the traffic flow.

Granular controls such as traffic percentage, or application-based traffic characteristics — for example, access point name (APN), subscription permanent identifier (SUPI), or other layer 7 attribute value pairs (AVPs) — are used to control traffic within the cluster. This control enables selective and precise upgrades, such as "canary upgrades". This limits risk and impact when deploying changes in-service and in production. It also affords the ability to selectively drain or decommission NFs.

Figure 7: SMI Service Mesh



Besides traffic management applications, the service mesh aids in tracking the flow of traffic between services and nodes, providing security to prevent unauthorized service access and isolating rogue services.

Common Data Layer

The Common Data Layer (CDL) component enabled through SMI provides the clean separation of stateful (also known as backing services) and stateless services (e.g. application services).

CDL provides services for efficiently managing stateful subscriber and identity information across all deployed Cisco NFs. The CDL is an in-memory database designed specifically for high performance carrier grade requirements and subscriber data. Separating stateful services in this way allows for the stateless application services to be autonomous, lightweight, upgradable, recoverable, and rapidly scalable.

Stateful services must address the availability, consistency, and portability of state. These typically require replication across one or more containers while maintaining state consistency.

As such, CDL redundancy is achieved by local and remote replication of session data. In addition, a background process scans the data store for inconsistencies, stale data, and corruption, and corrects them both locally and remotely.

SMI VM Quantities and Sizing

Table 1 and Table 2 provide SMI VM quantity and sizing recommendations.

NOTE: Individual NFs are deployed as K8s workers through SMI. They each have their own VM recommendations. Refer to the NF documentation for details.

Table 1: SMI VM Function and Quantities

VM Purpose	Redundancy	# VMs
SMI Cluster Manager	NA	1
K8s Control Plane	3	3
K8s Etcd	3	3
OAM	3	3

Table 2: SMI VM Sizing Recommendations

VM Function	vCPUs	NUMA per VM (Single/Double)	CPU Pinned	RAM (GB)	Boot Volume Size (GB)	Data Volume Size (GB)
SMI Cluster Manager	2	1	Yes	16	40	100
K8s Control Plane	2	1	Yes	16	100	20
K8s Etcd (CDL)	2	1	Yes	16	100	20
OAM	12	1	Yes	112	100	200

SMI Bare Metal Hardware Requirements

The following table lists the minimum Bare Metal requirements for deploying SMI Cluster Manager.

Table 3: SMI Bare Metal Hardware Requirements (UCS-C Series)

Item	Requirements
Server	Cisco UCS C220 M5/M6/M7

Item	Requirements
Networking	• Cisco Catalyst 3850 Switches • Cisco Nexus 9000 Series Switches
bbg	SSD **Note** For Disk drives, you must use SSDs to improve the read/write access speed.

Note The Bare Metal requirements listed in the table for deploying SMI Cluster Manager are for reference only. For specific requirements, contact your Cisco account representative.

Redundancy

SMI enables redundancy at multiple levels:

- **Network** — This is provided by the infrastructure and hardware with dual networking paths, dual NICs, and interface bonding. It is also provided by the SMI platform through the use of virtual IP addesses (VIPs), load balancers (LBs), and through the use of Cisco's Service Mesh.
- **K8s cluster** — The K8s cluster leverages a multiple control plane design.

  In order to avoid potential conflicts if two components modify the same objects, K8s implements a leader/follower pattern for the controller manager and the scheduler. Each group elects one leader, then the other group members assume follower roles. At any point in time, only the leader is active, and the followers are passive.

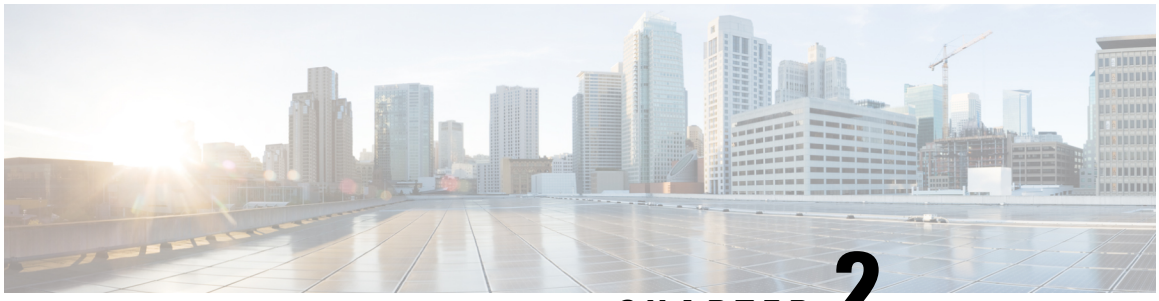
  K8s configuration (etcd) also uses a consensus-based leader/follower election process. Storage includes Storage Area Network/Network Area Storage (SAN/NAS) for persistence during server of VM failure. On leader failure, a new election takes place to determine a new leader. When the old leader recovers, it comes back as follower. Nothing happens on follower failure.
- **OAM services** — OAM services are deployed in large VMs on two or more nodes. Storage includes SAN/NAS for persistence during VM failure. Services are designed to reserve 50%+ capacity per server in order to allow K8s to reschedule services to next available OAM nodes without impact during a failure.
- **NF applications** — Cisco's stateless applications support N+1 redundancy and rely on K8s to monitor and reschedule when necessary. Application components are distributed across servers for HA purposes.

Security

SMI provides several secure methods for accessing, managing, and configuring the system, all based on APIs, including the Ops Center CLI, and NETCONF/RESTCONF interfaces.

Monitoring interfaces such as Grafana also integrate security and authentication using LDAP Systems Security Services Daemon (SSSD) and Secure Architecture for the Networked Enterprise (SANE).

Access and any configuration changes using the provided CLI and/or API are securely logged.



CHAPTER 2

SMI Cluster Manager - Deployment

Deployment Workflow

The SMI Cluster Manager deployment workflow consists of:

- Deploying the Inception Server
- Deploying the Cluster Manager
- Deploying the Kubernetes Cluster
- Deploying Cloud Network Functions (CNFs)
- Deploying VNF VMs (SMI Bare Metal Deployment)

The following figures depict the deployment work flow of the Cluster Manager:

Figure 8: Deployment Workflow - Bare Metal

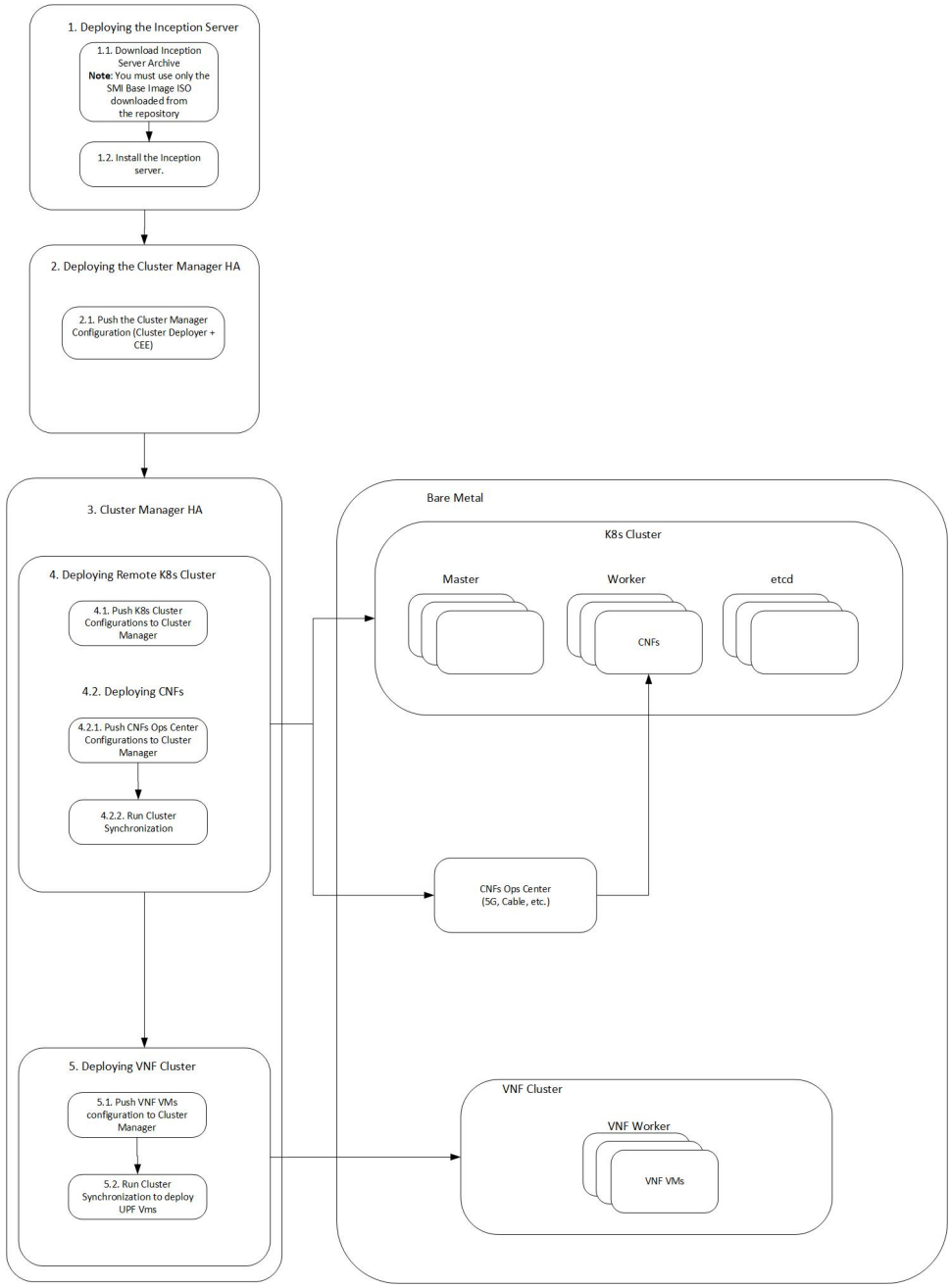


Figure 9: Deployment Workflow - VMware

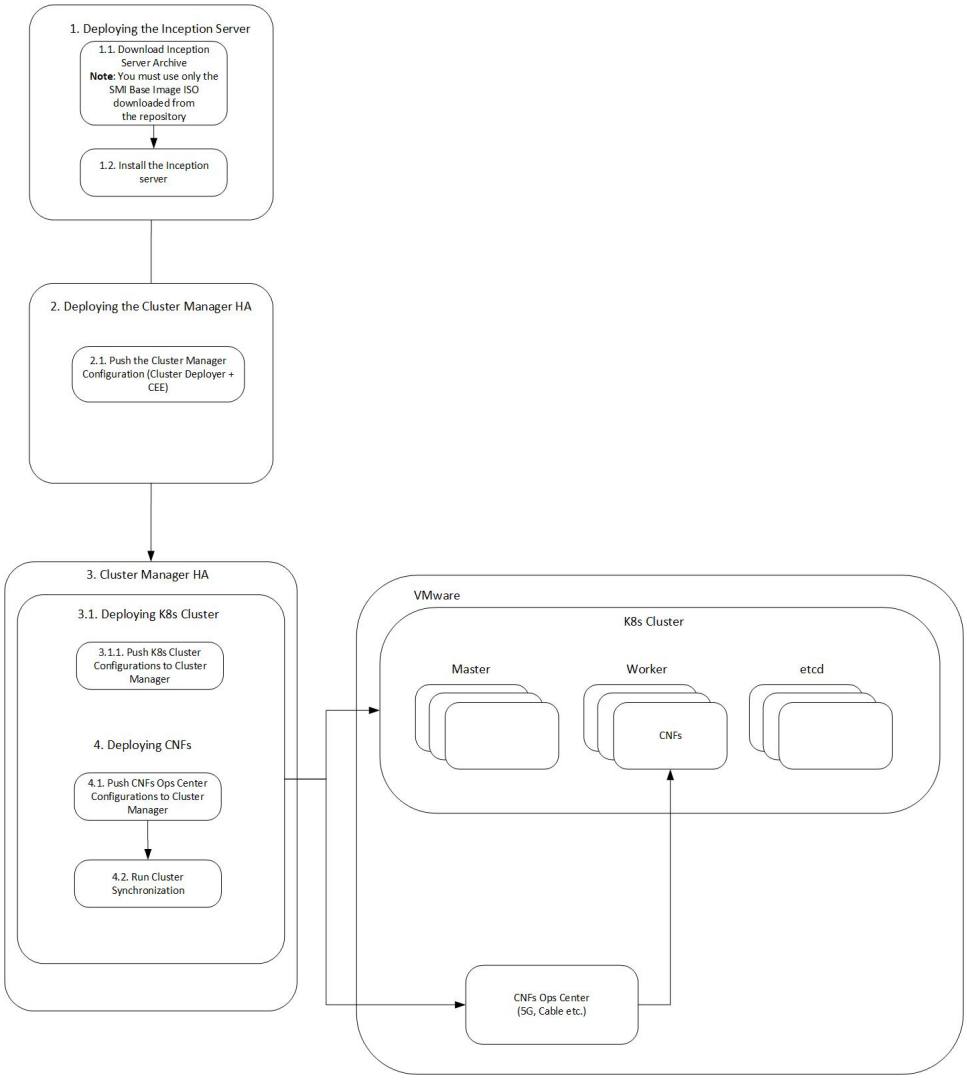
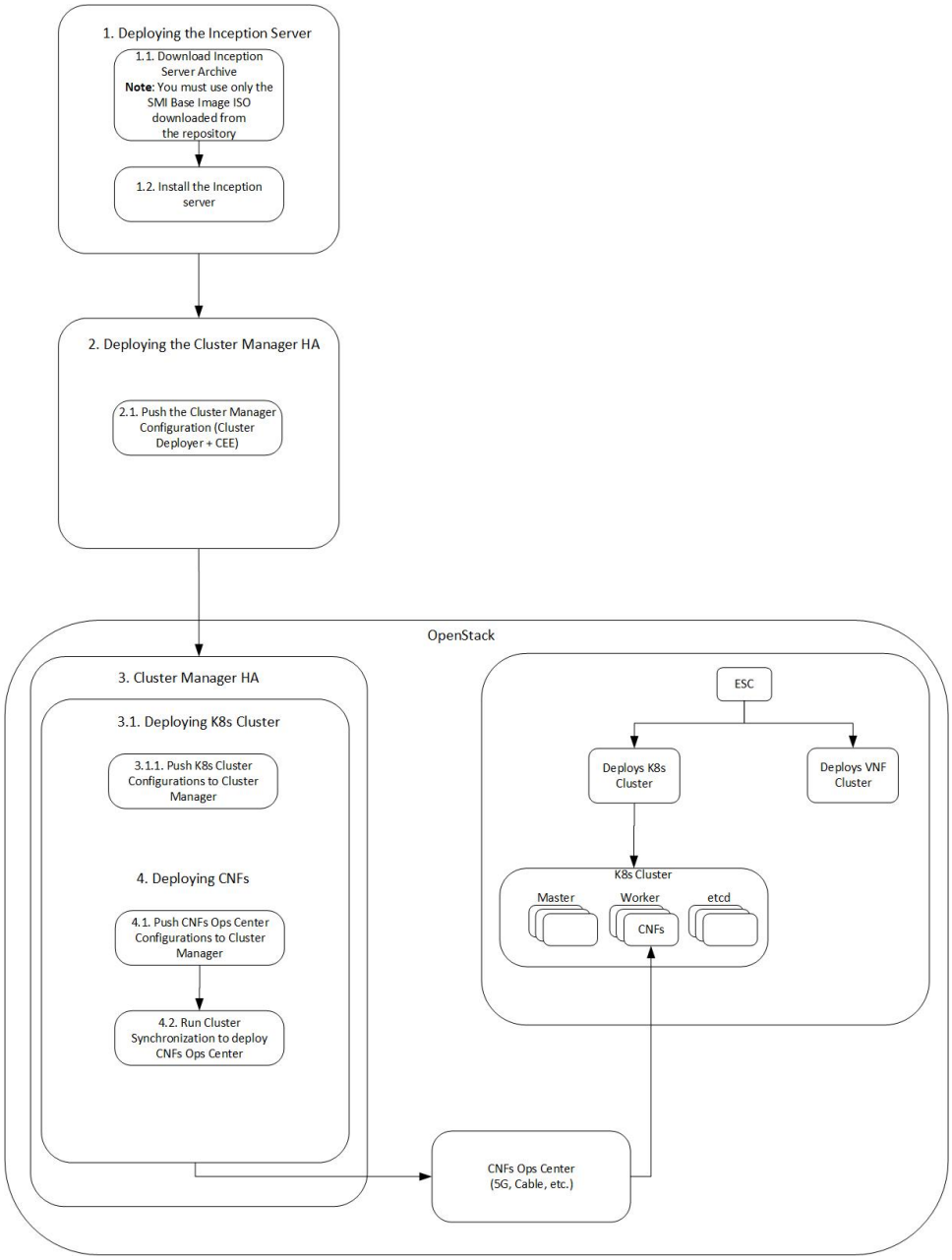


Figure 10: Deployment Workflow - OpenStack



The subsequent sections describe these deployment workflows in detail.

Introduction to Deploying SMI Cluster Manager

This chapter provides information about deploying the SMI Cluster Manager on a High Availability (HA) and All-In-One (AIO) mode using the Inception Server. The Inception Server is a version of Cluster Manager running only on Docker and Docker Compose. A Base OS is required to bring up the Inception Server on a

host machine. The Base OS is provided through an ISO image (Virtual CD-ROM) called the SMI Base Image ISO. You can bring up the Inception Server using the SMI Base Image ISO.

The subsequent sections provide more information about deploying the SMI Base Image ISO on the host machine, deploying the Inception Server and SMI Cluster Manager.

Note The SMI supports only the UTC time zone by default. Use this time zone for all your deployment and installation activities related to the SMI.

Important The */home* directory is reserved for the SMI Cluster Deployer. Do not use this directory for storing data. If you must store data, use the */data* directory instead.

SMI Base Image ISO

The SMI uses a generic installable SMI Base Image ISO (Virtual CD-ROM) for installing the SMI Base image. Currently, the SMI uses a hardened Base OS as the Base image. This ISO image replaces the existing VMDK and QCOW2 artifacts used in the previous SMI releases. The ISO boots and writes the storage device images onto a Virtual Machine (VM) or Bare Metal storage device. Using the SMI Base Image ISO, you can install an OS for the Inception server or install the Base OS for manual deployments (For example, OpenStack).

This ISO image boots the first storage device - with a minimum of 100 GB in size for production - and writes the storage device image to the disk. Additionally, you can use a *cloud-init* ISO along with the SMI Base Image ISO to configure the *cloud-init* data, which is required for building a *cloud-init* ISO. When no *cloud-init* ISO is found, the SMI uses the default configuration.

Note

- For providing ISO compatibility on platforms, which do not allow the mounting of ISO files and also for simplifying the deployment on OpenStack, the SMI Base Image ISO can overwrite its own disk (when the disk is greater than 100 GB in size).
- For accessing and downloading the *cloud-init* ISO from the repository, contact your Cisco Account representative.
- The Linux source operating system is upgraded to Ubuntu 20.04.

Note By default, the user password expiry is set to PASS_MAX_DAYS (/etc/login.defs). Password expiration days must be extended to avoid access lock. For remote hosts, user password days can be configured by using the following CLI configuration:

```
deployment.node-defaults initial-boot default-user-password-expiration-days
[0-9999]
```

Note For base images with restricted umask in CM HA nodes, run the **sudo** command to view the correct DRBD-overview output.

Inception Server Deployment Sequence

The following call flow depicts the installation of the Inception Server using SMI Base Image ISO:

Figure 11: Inception Server Deployment Sequence

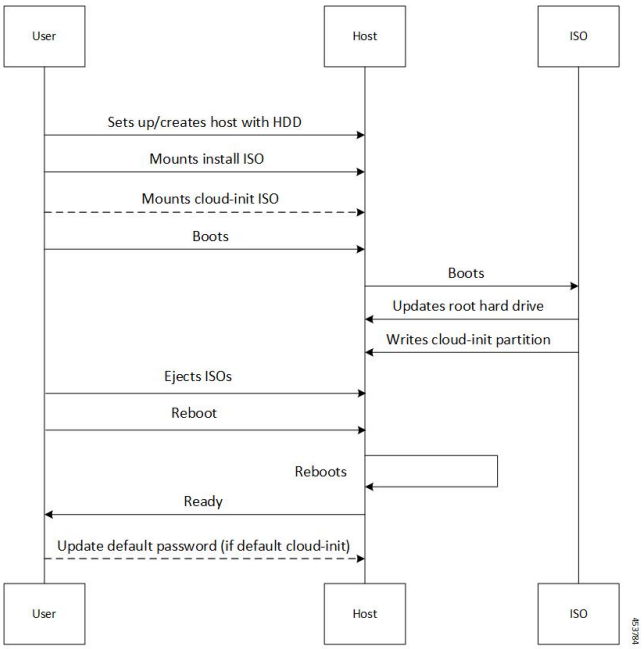


Table 4: Inception Server Deployment Sequence

Steps	Description
1	User creates a new VM or host or uses an existing host.
2	User mounts the ISO. • (Optional) Mount *cloud-init* ISO.
3	After the machine boots, the ISO performs the following: • The first hard drive that meets the minimum requirements is selected and formatted. The base image is written on the formatted hard drive. • If *cloud-init* ISO is found, the *cloud-init* data from the ISO is used. • If there is no *cloud-init* ISO, the default cloud-init data is used.
4	The user ejects the ISO and reboots the host machine.

Installing the Base Image on Bare Metal

The SMI Cluster Manager uses a Base OS as its base image. You can install the base image through an ISO file. Optionally, you can provide the network and user configuration parameters through a *cloud-init* ISO file.

Note For deploying the Inception Server, you must use only the *SMI Base Image ISO* downloaded from the repository. Contact your Cisco Account representative to download the *SMI Base Image ISO* from the repository.

The SMI Cluster Manager installs the Sysstat Package Manager system utility on all hosts during deployment to provide real-time debugging capabilities.

Prerequisites

The following are the prerequisites for installing the SMI base image:

- Download the *SMI base image ISO* file from the repository.
- (Optional) Create a *NoCloud* ISO to provide *cloud-init* data to the machine.
- Configure the following when there is no *cloud-init NoCloud* ISO:
  - DHCP for networking.
  - Default user name. For example, *cloud-user*.
  - Default password. For example, *Cisco_123* (You must change the password immediately after the setup).

SMI Base Image Installation on Bare Metal

To install the SMI base image on Bare Metal:

1. Upload the SMI base image ISO on a *HTTP/HTTPS* or Network File System (NFS) server.
2. Ensure that the *HTTP/HTTPS* server is reachable by the bare metal server manager, for example, Cisco Integrated Management Controller (CIMC) server for the UCS server .

Note The latency between the bare metal server manager and *HTTP/HTTPS* server must be lesser to avoid any delays in processing the request.

3. Log in to the bare metal server manager.
4. Ensure that the **Virtual Drive** is setup as a single disk.
5. Mount the ISO as **Virtual Media** on host.
6. Select **CDROM** in the boot order followed by **HDD**.
   - Ensure that the boot order is not setup through any other boot method.
7. Reboot the host and follow the instructions on the KVM console.

Installing the Base Image on VMware

The SMI Cluster Manager uses a Base OS as its base image. You can install the base image through an ISO file. Optionally, you can provide the network and user configuration parameters through a *cloud-init* ISO file.

Note For deploying the Inception Server, you must use only the *SMI Base Image ISO* downloaded from the repository. Contact your Cisco Account representative to download the *SMI Base Image ISO* from the repository.

Prerequisites

With the current release, the SMI supports VMware vCenter version 7.0.

Note The previous vCenter versions (6.5 and 6.7) are deprecated in the current release. These versions will not be supported in the future SMI releases. For more details about end of life support for these versions, contact your Cisco account representative.

The following are the prerequisites for installing the SMI base image:

- VMware vSphere Hypervisor (ESXi) 6.5 and later versions. The VMware vSphere Hypervisor (ESXi) 6.5 and 6.7 have been fully tested and meets performance benchmarks.
- Download the *SMI base image ISO* file from the repository.
- (Optional) Create a *NoCloud* ISO to provide *cloud-init* data to the machine.
- Configure the following when there is no *cloud-init NoCloud* ISO:
  - DHCP for networking.
  - Default user name. For example, *cloud-user*.
  - Default password. For example, *Cisco_123* (You must change the password immediately after the setup).

Minimum Hardware Requirements - VMware

The following are the minimum hardware requirements for deploying the SMI Base Image ISO on VMware:

- **CPU**: 8 vCPUs
- **Memory**: 24 GB
- **Storage**: 200 GB
- **NIC interfaces**: The number NIC interfaces required is based on the K8s network and VMware host network reachability.

SMI Base Image Installation on VMware

To install the SMI base image on VMware:

1. Upload the *SMI base image ISO* into the datastore manually.

Note Create a new folder to store these images separately.

2. (Optional) Upload the *NoCloud cloud-init* ISO manually, if you have created it.
3. Create a VM with access to the datastore, which has the *SMI base image* and *NoCloud 'cloud-init'* ISOs.
4. Power on the VM
5. Connect to the console

Installing the Base Image on OpenStack

The SMI Cluster Manager uses a Base OS as its base image. You can install the base image through an ISO file. Optionally, you can provide the network and user configuration parameters through a *cloud-init* ISO file.

Note For deploying the Inception Server, you must use only the *SMI Base Image ISO* downloaded from the repository. Contact your Cisco Account representative to download the *SMI Base Image ISO* from the repository.

Prerequisites

The following are the prerequisites for installing the SMI base image (in all the platforms):

- Download the SMI base image ISO file from the repository.
- (Optional) Create a NoCloud ISO to provide cloud-init data to the machine.
- Configure the following when there is no cloud-init NoCloud ISO:
  - DHCP for networking.
  - Default user name. For example, cloud-user.
  - Default password. For example, Cisco_123 (You must change the password immediately after the setup).

SMI Base Image Installation on OpenStack

To install the Base Image on OpenStack:

1. Log in to **Horizon**.
2. Navigate to **Create Image** page and fill in the following image details:
   - **Image Name** - Enter a name for the image.
   - **Image Description** (Optional) - Enter a brief description of the image.
   - **Image Source** - Select **File** as the Image Source.

- **File -** Browse for the ISO image from your system and add it.
- **Format** - Select the Image Format as **Raw**.
- **Minimum Disk (GB)** - Specify the minimum disk size as 100GB.

3. Click **Create Image**.

Note It might take several minutes for the image to save completely.

4. Navigate to the **Launch Instance** page.
5. Click **Details** tab and fill in the following instance details:
   - **Instance Name** - Enter a name for the instance.
   - **Count** - Specify the count as 1.
6. Click **Source** tab and fill in the following details:
   - **Select Boot Source** - Select the Base Image from the drop-down list.
   - **Volume Size (GB)** - Increase the volume size if required.
7. Click **Flavor** tab and select a flavor which meets the minimum requirements for the VM from the grid..

Note You can create a new flavor if required.

8. Click **Networks** tab and select the appropriate networks for the VM based on your environment.
9. Click **Key Pair** tab to create or import key pairs.
   - Click **Create Key Pair** to generate a new key pair.
   - Click **Import Key Pair** to import a key pair.
10. Click **Configuration** tab to add user configuration.
    - To configure the host name and output the *cloud-init* details to a log file, use the following configuration:

```
#cloud-config
output:
   all: '| tee -a /var/log/cloud-init-output.log | tee /dev/ttyS0'
hostname: "test-cluster-control-1"
```

Note If users and private keys are added to *cloud-init*, it overrides the OpenStack Key Pairs.

    - By default, log in access to the console is denied. To enable password log in at the console, use the following configuration.

```
#cloud-config
chpasswd:
   list: |
     ubuntu:my_new_password
   expire: false
```

11. Click **Launch Instance**.

Note To monitor the boot progress, navigate to the **Instance Console**. Also, you can interact with the console and view the boot messages through **Console** and **Log** tab respectively.

Host OS User Password Policy

You can configure a password policy for different user accounts on the host OS. Use the following command to set a password policy:

```
$ cat /etc/security/pwquality.conf
```

Based on the policy, a password must meet the following criteria:

- Minimum 14 characters in length.
- Contain at least one lowercase character.
- Contain at least one uppercase character.
- Contain at least one numeric character.
- Contain at least one special character.
- Password must not be too simplistic or based on dictionary word.
- Do not re-use passwords.

  Use the following commands to configure the number of passwords to keep in history:

  ```
  $ cat /etc/pam.d/common-password
  password required  pam_pwhistory.so use_authtok remember=5
  ```

- Minimum number of days that are allowed between password changes is seven.

Introduction to Inception Server

The Inception Server is a replacement to the K3s based VM Cluster Manager. You can use the Inception Server to deploy the SMI Cluster Manager in HA or AIO mode. The Inception Server runs on a Base OS (SMI Base Image) with Docker and Docker Compose.

Installing the Inception Server on smi-install-disk.iso

This section describes the procedures involved in deploying the Inception Server on the host machine, which has the Base OS installed.

Note The procedure to deploy the Inception Server on a host machine with the Base OS installed is the same irrespective of the host machine's environment (Bare Metal, VMware or OpenStack).

Prerequisites

The following are the prerequisites for deploying the Inception Server:

- Download the SMI Cluster Deployer tarball from the repository. The tarball includes the following software packages:
  - Docker
  - Docker-compose
  - Registry

Note For downloading the SMI Cluster Deployer tarball from the repository, contact your Cisco Account representative.

Configuring User and Network Parameters

This section describes the procedures involved in configuring the user and network parameters when *Cloud-init* ISO not available.

To configure SSH access:

1. Access the console.
2. Login with the default *cloud-init* credentials.

Note You must change the password immediately after logging in.

To configure the network and static IP addressing:

1. Login to the console.
2. Update the network configuration in **/etc/netplan/50-cloud-init.yaml** file.

   The following is a sample network configuration:

```
network:
    ethernets:
        ens192:
```

```
            addresses:
            - "ipv4addrees/subnet"
            dhcp4: false
            gateway4: gateway_address
            nameservers:
                addresses:
                - ipvtaddress
                - ipv4address
                - ipv4address
version: 2
```

3. Run the following command to apply the configuration:

   sudo netplan apply

4. Exit the console.
5. Access the machine through SSH.

Deploying the Inception Server

To deploy the Inception Server, use the following configuration:

1. Login to the host, which has the Base OS installed.
2. Create a temporary folder to store the downloaded offline SMI Cluster Manager products tarball.

   mkdir /data/offline-cm

   Example:

   ```
   user1@testaio:~$ mkdir /data/offline-cm
   user1@testaio:~$ cd /data/offline-cm/
   user1@testaio:/data/offline-cm$
   ```

3. Fetch the desired tarball to the newly created temporary folder. You can fetch the tarball either from the artifactory or copy it securely through the *scp* command.

   /data/offline-cm$ wget --user [user] --ask-password [password] <repository_url>

   In the following example, the tarball is fetched from the artifactory using basic authentication:

   Example:

   ```
   user1-cloud@testaio-cmts-control-plane:/data/offline-cm$
     wget --user [user1] --password [user@123]
   <http://<repo_url>/cluster-deployer-2020-04-12.tar>
   ```

4. Untar the offline Cluster Manager tarball.

   /data/offline-cm$ tar xvf <filename>

   Example:

   ```
   user1@testaio-cmts-control-plane:/data/offline-cm$ tar xvf cluster-deployer-2020-04-12.tar
   ```

5. Navigate to the *deployer-inception* folder which has the required charts and docker files.

   /data/offline-cm/data$ cd deployer-inception/

   Example:

```
user1@testaio-cmts-control-plane:/data/offline-cm/data$ cd deployer-inception/
```

6. Run the following command to deploy the Inception Server.

   sudo ./deploy --external-ip *<external_ipaddress>* **--first-boot-password** "*<first_boot_password>*"

Note

- During a fresh installation of the Inception Server, you can load the first boot configuration automatically through the deploy command. The first boot configuration is a YAML file which contains all the original passwords. Loading the first boot configuration is a one-time operation.

  ./deploy --external-ip *<external_ipaddress>* **--first-boot-password** '*<first_boot_password>*' **--first-boot-config** */var/tmp/cluster-config.conf*

  Example:

  ```
  user1@testaio-cmts-control-plane:/data/offline-cm/data/deployer-inception$./deploy
  --external-ip <ipv4address> --first-boot-password '<first_boot_password>'
  --first-boot-config /var/tmp/cluster-config.conf
  ```

- For security reasons, ensure that the first boot configuration YAML file is not stored anywhere in the system after you bring up the Inception server.

Example:

```
user1@testaio-cmts-control-plane:/data/offline-cm/data/deployer-inception$ ./deploy
--external-ip <ipv4address> --first-boot-password '<first_boot_password>'
```

The following examples displays the connection details on the console when the Inception Server setup completes:

```
Connection Information
----------------------
SSH (cli): ssh admin@127.0.0.1 -p 2022
Files: https://files-offline.smi-deployer.10.85.109.252.nip.io
API: https://restconf.smi-deployer.10.85.109.252.nip.io
```

7. Verify the list of the containers after the Inception Server is installed.

   sudo docker ps

   Example:

```
user@u20-inception-252:~/data/deployer-inception$ docker ps
CONTAINER ID  IMAGE                                    COMMAND                  CREATED
 STATUS     PORTS                                      NAMES
de5dac28c575  //cluster_synchronizer:1.2.0-f000c25  "/usr/bin/npm run st…"  4 days ago
 Up 4 days                                          smi-cluster-deployer_cluster_sync_1
f043cd13abaa  //nginx:1.2.0-ff992e0                 "/usr/local/bin/run-…"  4 days ago
 Up 4 days                                            smi-cluster-deployer_ingress_1
0dee8eed93ef  //metrics:1.2.0-9ae401f               "python3 /usr/local/…"  4 days ago
 Up 4 days                                            smi-cluster-deployer_metrics_1
eb1e13cf34e7  //confd_notifications:1.2.0-fe37e9e   "/usr/local/bin/run-…"  4 days ago
 Up 4 days
smi-cluster-deployer_confd_notifications_1
6a2a73827f38  //config_mgmt:1.2.0-61bfe40           "/usr/local/bin/run-…"  4 days ago
 Up 4 days                                           smi-cluster-deployer_config_mgmt_1
079905616eba  //cluster_offline_files:1.2.0-f42a431 "/usr/bin/supervisord"  4 days ago
 Up 4 days
smi-cluster-deployer_cluster-offline-files_1
6453ec01a39f  //confd:1.2.0-cc7013e                 "/usr/local/bin/uid_…"  4 days ago
```

```
 Up 4 days  0.0.0.0:443->443/tcp, :::443->443/tcp     smi-cluster-deployer_confd_1
c3b45608d664  registry:2
           0.0.0.0:5000->5000/tcp, :::5000->5000/tcp
```

Note For upgrading the Inception server, see Upgrading the Inception Server section.

NOTES:

- *external_ipaddress*—Specify the interface IP address that points to your Converged Interconnect Network (CIN) setup. It hosts the ISO and offline tars to be downloaded to the remote hosts.
- *first_boot_password*—Specify the first boot password. The first boot password is a user-defined value.

Installing the Inception Server using Ubuntu 20.04 LTS

Ubuntu 20.04 LTS can be used as a replacement for the smi-install-disk.iso image to simplify the maintenance of the host server running the Inception Deployer.

Users are allowed to install their own Ubuntu servers to manage security updates on their own, and install new releases of the cluster-deployer as required.

Prerequisites

The following are the prerequisites for installing the Ubuntu server:

- ubuntu-20.04.6-live-server-amd64.iso (downloaded from https://releases.ubuntu.com)
- VMware vSphere
- Basic VM sizing recommendations:
  - 8 vCPU
  - 32 GB memory
  - 200 GB disk
- Install RHEL version 8.9 with Python 3 and the latest stable version of containerd, Docker, and Docker Compose
- Ensure Python 3 is running by issuing the following command:

```
cloud-user@rhel89 inception]$ python --version
```

- Separate */tmp* partition in Exec mode
- Executable permission for */tmp* directory in Docker Compose

Installing Ubuntu

To install Ubuntu 20.04, use the following procedure:

1. Create a VM using ubuntu-20.04.6-live-server-amd64.iso.

2. Create an ext4 disk partition named **/tmp** with 20 GB size. The smi-base-iso creates this partition automatically.

   The remaining disk can be partitioned as required.

3. Add the networking and user settings as required.

4. After the installation is completed, perform OS updates (**sudo apt** upgrade).

To deploy the inception server, it is recommended to freshly install the Inception Deployer on a newly installed VM. Refer to the procedure in the Deploying the Inception Server, on page 27 section.

Installing Cluster Deployer on RHEL

You can install the inception deployer on Red Hat Enterprise Linux (RHEL) to enable Linux agnostic deployment. The supported version of RHEL is 8.9.

This feature is an extension of the inception server installation using Ubuntu 20.04 LTS.

Prerequisites

The following are the prerequisites for installing the cluster deployer on RHEL:

- Install RHEL version 8.9 with Python 3, and the latest stable version of containerd, Docker, and Docker Compose
- Ensure Python 3 is running by issuing the following command:

```
cloud-user@rhel89 inception]$ python --version
```

- Separate */tmp* partition in Exec mode
- Executable permission for */tmp* directory in Docker Compose

Installing Inception Server in RHEL

To install the inception server using RHEL, use the following procedure:

1. Bring up the RHEL 8 server.
2. Install Python 3 and Docker in RHEL 8 server.
   - Check the existence of docker-compose and not the version.
   - If Docker is not installed and not initiated, stop the inception server installation.
3. Download the cluster deployer in the RHEL 8 server and install the inception server.

```
[cloud-user@localhost deployer-inception]$ cat /etc/os-release
NAME="Red Hat Enterprise Linux"
VERSION="8.1 (Ootpa)"
ID="rhel"
ID_LIKE="fedora"
VERSION_ID="8.1"
PLATFORM_ID="platform:el8"
PRETTY_NAME="Red Hat Enterprise Linux 8.1 (Ootpa)"
ANSI_COLOR="0;31"
CPE_NAME="cpe:/o:redhat:enterprise_linux:8.1:GA"
HOME_URL="https://www.redhat.com/"
```

```
BUG_REPORT_URL="https://bugzilla.redhat.com/"

REDHAT_BUGZILLA_PRODUCT="Red Hat Enterprise Linux 8"
REDHAT_BUGZILLA_PRODUCT_VERSION=8.1
REDHAT_SUPPORT_PRODUCT="Red Hat Enterprise Linux"
REDHAT_SUPPORT_PRODUCT_VERSION="8.1"

[localhost.localdomain] SMI Cluster Deployer#
[localhost.localdomain] SMI Cluster Deployer# show version
app-version 2024.01.1.i12
chart-version 1.2.0-2024-01-1-2027-240120184610-b3cb38b
[localhost.localdomain] SMI Cluster Deployer# exit
Connection to 10.0.0.1 closed.
```

Upgrading the Inception Server

To upgrade the Inception Server, use the following configuration:

1. Login to the host, which has the Base OS installed.
2. Navigate to the */data/offline-cm* folder.

Note The *offline-cm* folder was created while deploying the Inception Server. For more details, see Deploying the Inception Server section.

3. Remove the *data* folder.

   rm -rf data

4. Fetch the desired tarball to the *offline-cm* folder. You can fetch the tarball either from the artifactory or copy it securely through the *scp* command.

   /data/offline-cm$ wget --user [user] --ask-password [password] <repository_url>

   In the following example, the tarball is fetched from the artifactory using basic authentication:

   Example:

   ```
   user1-cloud@testaio-cmts-control-plane:/data/offline-cm$
     wget --user [test_user1] --password [user@123]
   <http://<repo_url>/cluster-deployer-2020-04-12.tar>
   ```

5. Untar the offline Cluster Manager tarball.

   /data/offline-cm$ tar xvf <filename>

   Example:

   ```
   user1@testaio-cmts-control-plane:/data/offline-cm$ tar xvf cluster-deployer-2020-04-12.tar
   ```

6. Navigate to the *deployer-inception* folder which has the required charts and docker files.

   /data/offline-cm/data$ cd deployer-inception/

   Example:

   ```
   user1@testaio-cmts-control-plane:/data/offline-cm/data$ cd deployer-inception/
   ```

7. Run the following command to deploy the Inception Server.

   ./deploy --external-ip *<external_ipaddress>* **--first-boot-password** "*<first_boot_password>*"

   Example:

   ```
   user1@testaio-cmts-control-plane:/data/offline-cm/data/deployer-inception$ ./deploy
   --external-ip <ipv4address> --first-boot-password "<first_boot_password>"
   ```

   The following connection details is displayed on the console when the Inception Server setup completes:

   ```
   Connection Information
   ----------------------
   SSH (cli): ssh admin@localhost -p <port_number>

   Files: https://files-offline.<ipv4address>.<domain_name>
   UI: https://deployer-ui.<ipv4address>.<domain_name>
   API: https://restconf.<ipv4address>.<domain_name>
   ```

8. Verify the list of the containers after the Inception Server is installed.

   sudo docker ps

   Example:

   ```
   user@u20-inception-252:~/data/deployer-inception$ docker ps
   CONTAINER ID  IMAGE                                    COMMAND                  CREATED
    STATUS     PORTS                                      NAMES
   de5dac28c575  //cluster_synchronizer:1.2.0-f000c25  "/usr/bin/npm run st…"  4 days ago
    Up 4 days                                          smi-cluster-deployer_cluster_sync_1
   f043cd13abaa  //nginx:1.2.0-ff992e0                 "/usr/local/bin/run-…"  4 days ago
    Up 4 days                                            smi-cluster-deployer_ingress_1
   0dee8eed93ef  //metrics:1.2.0-9ae401f               "python3 /usr/local/…"  4 days ago
    Up 4 days                                            smi-cluster-deployer_metrics_1
   eb1e13cf34e7  //confd_notifications:1.2.0-fe37e9e   "/usr/local/bin/run-…"  4 days ago
    Up 4 days
   smi-cluster-deployer_confd_notifications_1
   6a2a73827f38  //config_mgmt:1.2.0-61bfe40           "/usr/local/bin/run-…"  4 days ago
    Up 4 days                                           smi-cluster-deployer_config_mgmt_1
   079905616eba  //cluster_offline_files:1.2.0-f42a431 "/usr/bin/supervisord"  4 days ago
    Up 4 days
   smi-cluster-deployer_cluster-offline-files_1
   6453ec01a39f  //confd:1.2.0-cc7013e                 "/usr/local/bin/uid_…"  4 days ago
    Up 4 days  0.0.0.0:443->443/tcp, :::443->443/tcp     smi-cluster-deployer_confd_1
   c3b45608d664  registry:2
              0.0.0.0:5000->5000/tcp, :::5000->5000/tcp
   ```

9. Stop and start the Inception Server to apply the configuration changes.

   To stop the server:

   cd /data/inception/
   sudo ./stop

   To start the server:

   cd /data/inception/
   sudo ./start

   The following connection details is displayed on the console when Inception Server starts again:

   ```
   Connection Information
   ----------------------
   SSH (cli): ssh admin@localhost -p <port_number>
   ```

```
Files: https://files-offline.<ipv4address>.<domain_name>
UI: https://deployer-ui.<ipv4address>.<domain_name>
API: https://restconf.<ipv4address>.<domain_name>
```

NOTES:

- *external_ipaddress* - Specifies the interface IP address that points to your Converged Interconnect Network (CIN) set up. It hosts the ISO and offline tars to be downloaded to the remote hosts.
- *first_boot_password* - Specifies the first boot password. The first boot password is an user defined value.

Sample First Boot Configuration File

The following is a sample *cluster-config.conf* file used for deploying the Inception server on Bare Metal (UCS) servers.

```
 software cnf <software_version> #For example, cm-2020-02-0-i05
 url <repo_url>
 user <username>
 password <password>
 sha256 <sha256_hash>
exit
environments bare-metal
 ucs-server
exit
clusters <cluster_name> #For example, cndp-testbed-cm
 environment bare-metal
 addons ingress bind-ip-address <IPv4address>
 addons cpu-partitioner enabled
 configuration allow-insecure-registry true
 node-defaults ssh-username <username>
 node-defaults ssh-connection-private-key
  "-----BEGIN OPENSSH PRIVATE KEY-----\n
 <SSH_private_key>
  -----END OPENSSH PRIVATE KEY-----\n"
 node-defaults initial-boot netplan ethernets <interface_name> #For example,
eno1
  dhcp4 false
  dhcp6 false
  gateway4 <IPv4address>
  nameservers search <nameserver>
  nameservers addresses <IPv4addresses>
 exit
 node-defaults initial-boot default-user <username>
 node-defaults initial-boot default-user-ssh-public-key
  "ssh-ed25519 AAAAC3NzaC1lZDI1NTE5AAAAIGwX8KVn8AxreCgAmboVQGMPTehQB61Mqn5xuAx6VpxC
smi@<domain_name>"
 node-defaults initial-boot default-user-password #For example, Csco123#
 node-defaults os proxy https-proxy <proxy_server_url>
 node-defaults os proxy no-proxy <proxy_server_url/IPv4address>
 node-defaults os ntp enabled
 node-defaults os ntp servers <ntp_server>
 exit
```

```
nodes control-plane
 ssh-ip <IPv4address>node-defaults netplan template
 type k8s
 k8s node-type control-plane
 k8s node-labels <node_labels/node_type>
 exit
ucs-server host initial-boot networking static-ip ipv4-address <IPv4address>

 ucs-server host initial-boot networking static-ip netmask <IPv4address>
 ucs-server host initial-boot networking static-ip gateway <IPv4address>
 ucs-server host initial-boot networking static-ip dns <IPv4address>
 ucs-server cimc ip-address <IPv4address>
 ucs-server cimc user <username> #For example, admin
 ucs-server cimc password <password> #For example, C1sc0123#
 ucs-server cimc storage-adaptor create-virtual-drive true
 ucs-server cimc networking ntp enabled
 ucs-server cimc networking ntp servers <ntp_server_url>
 initial-boot netplan ethernets <interface_name> #For example, eno1
  addresses <IPv4address/subnet>
 exit
exit
cluster-manager enabled
cluster-manager repository-local <repo_name> #For example, cm-2020-02-0-i05
cluster-manager netconf-ip <IPv4address>
cluster-manager iso-download-ip <IPv4address>
cluster-manager initial-boot-parameters first-boot-password <password> #For
example, 'Csco123#'
exit
```

Parallel Cluster Sync for Multiple Clusters

SMI supports parallel cluster sync triggered from the same inception deployer or cluster manager.

Note This functionality is currently supported only on Bare Metal and not fully supported on VMware.

The following enhancements optimize time while downloading artifacts:

- Only the individual files will be locked to allow subsequent syncs parallely
- Only the software required to be synced will be downloaded and verified
- Each sync will perform SHA256 or SHA512 validation on each package
- For clusters that require different packages, the downloads will happen concurrently

Note The download process creates file locks that must be persisted for the life of the file. You must not delete or modify the files under any conditions.

Configuring Hostname and URL-based Routing for Ingress

This section describes how to use the Fully Qualified Domain Names (FQDN) and path-based URL routing to connect to an ops-center.

Note The hostname and url path-based routing for the ingress *ip_address* in the *nip.io* format is not supported.

Prerequisites

- The DNS hosts and zones must be configured before configuring the hostname and URL path-based routing.

1. Run the `get ingress -A` command to check for the ingress created after the SMI cluster deployment.

```
kubectl get ingresses -A
NAMESPACE    NAME                                                CLASS    HOSTS
                                                ADDRESS         PORTS     AGE
cee-global   cee-global-product-documentation-ingress            <none>
docs.cee-global-product-documentation.192.22.46.40.nip.io   192.22.46.40   80, 443   28m
cee-global   cli-ingress-cee-global-ops-center                   <none>
cli.cee-global-ops-center.192.22.46.40.nip.io                192.22.46.40   80, 443   32m
cee-global   documentation-ingress                               <none>
documentation.cee-global-ops-center.192.22.46.40.nip.io      192.22.46.40   80, 443   32m
cee-global   grafana-ingress                                     <none>
grafana.192.22.46.40.nip.io                                  192.22.46.40   80, 443   28m
cee-global   restconf-ingress-cee-global-ops-center              <none>
restconf.cee-global-ops-center.192.22.46.40.nip.io           192.22.46.40   80, 443   32m
cee-global   show-tac-manager-ingress                            <none>
show-tac-manager.192.22.46.40.nip.io                         192.22.46.40   80, 443   28m
registry     charts-ingress                                      <none>
charts.192.22.46.40.nip.io                                   192.22.46.40   80, 443   34m
registry     registry-ingress                                    <none>
docker.192.22.46.40.nip.io                                   192.22.46.40   80, 443   34m
smi-cm       cluster-files-offline-smi-cluster-deployer          <none>
files-offline.smi-cluster-deployer.192.22.46.40.nip.io       192.22.46.40   80, 443   32m
smi-cm       ops-center-cli-smi-cluster-deployer                 <none>
cli.smi-cluster-deployer.192.22.46.40.nip.io                 192.22.46.40   80, 443   32m
smi-cm       ops-center-restconf-smi-cluster-deployer            <none>
restconf.smi-cluster-deployer.192.22.46.40.nip.io            192.22.46.40   80, 443   32m
```

2. Assign a hostname to the ingress; Here, the hostname *demo-host-aio.smi-dev.com* is assigned to the ingress in cee global ops-centers. Apply the following changes and run the synchronization.

```
clusters demo-host-aio
 addons distributed-registry ingress-hostname demo-host-aio.smi-dev.com
 cluster-manager ingress-hostname demo-host-aio.smi-dev.com
 ops-centers cee global
  ingress-hostname demo-host-aio.smi-dev.com
 exit
exit
```

The ingress values are updated:

```
kubectl get ingresses -A
NAMESPACE    NAME                                                CLASS    HOSTS
```

```
                                                ADDRESS        PORTS     AGE
cee-global   cee-global-product-documentation-ingress     <none>
docs.cee-global-product-documentation.demo-host-aio.smi-dev.com 192.22.46.40   80, 443
  49m
cee-global   cli-ingress-cee-global-ops-center            <none>
cli.cee-global-ops-center.demo-host-aio.smi-dev.com           192.22.46.40   80, 443
  53m
cee-global   documentation-ingress                        <none>
documentation.cee-global-ops-center.demo-host-aio.smi-dev.com   192.22.46.40   80, 443
  53m
cee-global   grafana-ingress                              <none>
grafana.demo-host-aio.smi-dev.com                             192.22.46.40   80, 443
  49m
cee-global   restconf-ingress-cee-global-ops-center       <none>
restconf.cee-global-ops-center.demo-host-aio.smi-dev.com      192.22.46.40   80, 443
  53m
cee-global   show-tac-manager-ingress                     <none>
show-tac-manager.demo-host-aio.smi-dev.com                    192.22.46.40   80, 443
  49m
registry     charts-ingress                               <none>
charts.demo-host-aio.smi-dev.com                              192.22.46.40   80, 443
  56m
registry     registry-ingress                             <none>
docker.demo-host-aio.smi-dev.com                              192.22.46.40   80, 443
  56m
smi-cm       cluster-files-offline-smi-cluster-deployer   <none>
files-offline.smi-cluster-deployer.demo-host-aio.smi-dev.com    192.22.46.40   80, 443
  53m
smi-cm       ops-center-cli-smi-cluster-deployer          <none>
cli.smi-cluster-deployer.demo-host-aio.smi-dev.com            192.22.46.40   80, 443
  53m
smi-cm       ops-center-restconf-smi-cluster-deployer     <none>
restconf.smi-cluster-deployer.demo-host-aio.smi-dev.com       192.22.46.40   80, 443
  53m
cloud-user@cndp-cm-sa-control-plane:~$
```

3. To configure the URL path, set the *path-based-ingress* parameter to true as shown, and run the synchronization again:

```
clusters demo-host-aio
 addons distributed-registry ingress-hostname demo-host-aio.smi-dev.com
 cluster-manager ingress-hostname demo-host-aio.smi-dev.com
 ops-centers cee global
  ingress-hostname demo-host-aio.smi-dev.com
  initial-boot-parameters path-based-ingress true
 exit
exit
```

After running the synchronization, the ingress hostname and URL path are assigned.

The cee-global ingress shows ***** for the hostname, which means, the ops-center functions are now accessible through the URL path.

```
kubectl get ingresses -A
NAMESPACE    NAME                                          CLASS    HOSTS
                                              ADDRESS        PORTS     AGE
cee-global   cee-global-product-documentation-ingress     <none>   *
                                              192.22.46.40   80, 443   20m
cee-global   cli-ingress-cee-global-ops-center            <none>   *
                                              192.22.46.40   80, 443   24m
cee-global   documentation-ingress                        <none>   *
                                              192.22.46.40   80, 443   24m
cee-global   grafana-ingress                              <none>   *
```

```
                                          192.22.46.40   80, 443   20m
cee-global   restconf-ingress-cee-global-ops-center       <none>   *
                                          192.22.46.40   80, 443   24m
cee-global   show-tac-manager-ingress                     <none>   *
                                          192.22.46.40   80, 443   20m
registry     charts-ingress                               <none>
charts.demo-host-aio.smi-dev.com                               192.22.46.40   80, 443
 27m
registry     registry-ingress                             <none>
docker.demo-host-aio.smi-dev.com                               192.22.46.40   80, 443
 27m
smi-cm       cluster-files-offline-smi-cluster-deployer   <none>
files-offline.smi-cluster-deployer.demo-host-aio.smi-dev.com   192.22.46.40   80, 443
 24m
smi-cm       ops-center-cli-smi-cluster-deployer          <none>
cli.smi-cluster-deployer.demo-host-aio.smi-dev.com             192.22.46.40   80, 443
 24m
smi-cm       ops-center-restconf-smi-cluster-deployer     <none>
restconf.smi-cluster-deployer.demo-host-aio.smi-dev.com        192.22.46.40   80, 443
 24m
```

The following table shows the old path and the new path accessible through the URL.

Table 5: Ops-center accessible through URL Path

Old Path	New Path
https://cli.smi-cluster-deployer.192.22.46.40.nip.io	https://cli.smi-cluster-deployer.demo-host-aio.smi-dev.com
https://cli.cee-global-ops-center.192.22.46.40.nip.io	https://demo-host-aio.smi-dev.com/cee-global/cli/
https://documentation.cee-global-ops-center.192.22.46.40.nip.io	https://demo-host-aio.smi-dev.com/cee-global/docs/
https://grafana.192.22.46.40.nip.io	https://demo-host-aio.smi-dev.com/cee-global/grafana/
https://show-tac-manager.192.22.46.40.nip.io	https://demo-host-aio.smi-dev.com/cee-global/show-tac-manager/

VIP Configuration Enhancements

Multiple virtual IP (VIP) groups can be configured for use by the applications being deployed in the K8s cluster. SMI's cluster deployer logic has been enhanced to check if any IPv4 or IPv6 VIP address has been assigned to more than one VIP group. If the same VIP address has been assigned to multiple VIP groups, the deployment configuration validation will fail.

The following is a sample erroneous VIP groups configuration and a sample of the resulting error message logged through the validation:

Table 6: Erroneous VIP Configurations and Sample Error Messages

Example Erroneous keepalived Configuration	Example Error Message
show running-config clusters tb1-smi-blr-c3 virtual-ips clusters tb1-smi-blr-c3 virtual-ips rep2 vrrp-interface ens224 vrrp-router-id 188 ipv4-addresses 192.168.139.85 mask 24 broadcast 192.168.139.255 device ens224 exit ipv4-addresses 192.168.139.95 mask 24 broadcast 192.168.139.255 device ens256 exit hosts controlplane2 priority 99 exit hosts controlplane3 priority 100 exit exit virtual-ips rep3 vrrp-interface ens224 vrrp-router-id 189 ipv4-addresses 192.168.139.85 mask 24 broadcast 192.168.139.255 device ens224 exit	**Manual validation:** **clusters tb1-smi-blr-c3 actions validate-config run** 2021-04-27 15:21:45.967 ERROR __main__: Duplicate not allowed: ipv4-addresses 192.168.139.85 is assigned across multiple virtual-ips groups 2021-04-27 15:21:45.968 ERROR __main__: virtual-ips groups with same ip-addresses are rep3 and rep2 2021-04-27 15:21:45.968 ERROR __main__: Checks failed in the cluster tb1-smi-blr-c3 are: 2021-04-27 15:21:45.968 ERROR __main__: Check: ntp failed. 2021-04-27 15:21:45.968 ERROR __main__: Check: k8s-node-checks failed. 2021-04-27 15:21:45.968 ERROR __main__: Check: vip-checks failed. **Auto-Validation actions sync run:** **clusters tb1-smi-blr-c3 actions sync run** This will run sync. Are you sure? [no,yes] **yes** message Validation errors occurred: Error: An error occurred validating SSH private key for cluster: tb1-smi-blr-c3 Error: An error occurred validating node proxy for cluster: tb1-smi-blr-c3 Error: An error occurred validating node oam label config for cluster: tb1-smi-blr-c3

The keepalived_config container monitors the configmap vip-config for any changes at regular intervals and if a change is detected the keepalived configuration file is reloaded.

With this enhancement, either all or none of the VIP addresses configured in a VIP group must be present on a node. If only some of the addresses exist on the node, that keepalived process wil be stopped and a new process is automatically started and apply the latest configuration. This ensures that the keepalived processes assign those IP addresses appropriately.

The following is an example of the resulting error message logged through the validation:

kubectl logs keepalived-zqlzp -n smi-vips -c keepalived-config --tail 50 --follow

```
container
INFO:root:group name :rep2
INFO:root:Ip address: 192.168.139.85 on interface ens224 found on this device: True
INFO:root:Ip address: 192.168.139.95 on interface ens256 found on this device: False
INFO:root:Error Occurred: All VIPs in /config/keepalived.yaml must be either present or
absent in this device
INFO:root:VIP Split brain Scenario: Restarting the keepalived process.
```

Monitoring Virtual IPs for Multiple Ports

SMI Cluster Deployer supports monitoring the Virtual IP for a single port using the **check-port** command.

```
virtual-ips rep2
 check-port 25
 vrrp-interface ens224
 vrrp-router-id 188
 check-interface ens256
exit
```

Now, the cluster deployer is enhanced to monitor the VIP for multiple ports.

For multiple ports, use **check-ports** command:

```
virtual-ips rep2
 check-ports [ 25 80 43 65]
 vrrp-interface ens224
 vrrp-router-id 188
 check-interface ens256
exit
```

Note Use either **check-port** or **check-ports** during configuration, but not both.

Splitting Master and Additional Master VIPs into Separate VRRPs

Feature Description

The CNDP allows you to configure an internal and external VIP as part of the cluster deployment. K8s uses the internal VIP while the ingress uses the external VIP to allow access to management interfaces such as Grafana, Ops-center, and Prometheus.

By default, both VIPs are part of one VRRP and failovers together. The VRRP verifies only the internal network for connectivity issues to prioritize the stability of the Kubernetes cluster. This can cause loss of connectivity to management interfaces if there's a network failure on the external network only.

This feature adds support for splitting the VIPs into different VRRP instances to allow them to failover independently.

Feature Configuration

To enable this feature, use the following configuration:

```
configuration separate-master-vip-vrrps true
```

You must configure **k8s additional-master-ip** for control plane nodes with the local external IP of the node that VRRP unicast uses.

Limitations

- This feature applies only to CNDP-managed master VIPs. It is not applicable for the additional VIPs.
- You must enable this feature in a separate activity after upgrading the CM nodes and the cluster with the new software. You must not combine with a base-image or major upgrade events.
- CM HA clusters cannot enable the feature.
- It is recommended to use the separate VIP configuration for the snmp-trapper in CEE.

Example Configuration

```
addons ingress bind-ip-address 10.1.15.66
addons ingress bind-ip-address-internal 10.192.2.1
configuration master-virtual-ip 10.192.2.1
configuration master-virtual-ip-cidr 24
configuration master-virtual-ip-interface vlan107
configuration keepalived-auth "<auth-key>"
configuration additional-master-virtual-ip 10.1.15.66
configuration additional-master-virtual-ip-cidr 24
configuration additional-master-virtual-ip-interface vlan101

# Enable separate vrrps
configuration separate-master-vip-vrrps true
...
nodes controlplane-1
 maintenance false
 k8s node-type control-plane
 k8s ssh-ip 10.192.2.2

#Provide the local host IP on the additional master VIP interface(existing node IP on the
same vlan/network)
k8s additional-master-ip 10.1.15.67
initial-boot netplan ethernets vlan107
 addresses [ 10.192.2.2/24 ]
exit
initial-boot netplan ethernets vlan101
 addresses [ 10.1.15.67/24 ]
exit
...
nodes controlplane-2
 maintenance false
 k8s node-type control-plane
 k8s ssh-ip 10.192.2.3
 k8s additional-master-ip 10.1.15.68
 initial-boot netplan ethernets vlan107
  addresses [ 10.192.2.3/24 ]
 exit
 initial-boot netplan ethernets vlan101
  addresses [ 10.1.15.68/24 ]
 exit
...
nodes controlplane-3
 maintenance false
 k8s node-type control-plane
 k8s ssh-ip 10.192.2.4
 k8s additional-master-ip 10.1.15.69
 initial-boot netplan ethernets vlan107
  addresses [ 10.192.2.4/24 ]
```

```
 exit
 initial-boot netplan ethernets vlan101
  addresses [ 10.1.15.69/24 ]
 exit
...
```

SMI Cluster Manager in High Availability

The SMI Cluster Manager supports an active and standby High Availability (HA) model, which consists of two Bare Metal nodes. One node runs as Active and the other one runs as Standby node.

The SMI Cluster Manager uses the Distributed Replicated Block Device (DRDB) to replicate data between these two nodes. The DRDB acts a networked RAID 1 and mirrors the data in real-time with continuous replication. The DRDB is placed in between the I/O stack (lower end) and file system (upper end) to provide transparency for the applications on the host.

The SMI Cluster Manager uses the Virtual Router Redundancy Protocol (VRRP) for providing high availability to the networks. The Keepalived configuration implements VRRP and uses it to deliver high availability among servers. In the event of an issue with the Active node, the SMI Cluster Manager HA uses Keepalived to provide fail-over redundancy.

Note The SMI Cluster Manager HA solution is a simple configuration, which requires minimal configuration changes. However, the fail-over time is longer because of mounting only one DRDB at once.

Failover and Split Brain Policies

The SMI Cluster Manager implements the following policies during failover and split brain scenarios.

Failover Policy

During a failover, the active node shuts down all K8s and Docker services. When all the services stop, the DRDB disk is unmounted and demoted.

The standby node promotes and mounts the DRDB disk, and starts the Docker and K8s services.

Split Brain Policy

The following policies are defined for automatic split brain recovery:

1. **discard-least-changes**—This policy is used when there is no primary node. It discards and rolls back all modifications on the host where fewer changes have occurred.
2. **discard-secondary**—This policy is used when there is a primary node. It makes the secondary node as the split brain victim.

Note Split brain occurs when both HA nodes switch into the primary role in disconnected state. This happens when networking partition is present between primary and standby nodes, and must be managed to avoid DRBD brain split. DRBD brain split can be recovered by discarding data on the selected victim node.

Cluster Manager Internal Network for HA Communications

Earlier, SMI releases used the externally routable ssh-ip address to configure keepalived and DRBD communications between the active and standby CM HA nodes. This model left potential for a split-brain situation should the externally routable network become unstable or unavailable.

To reduce this potential, the CM HA nodes can be configured to use the internal network for keepalived and DRBD communication. This is done using the following commands in the CM configuration file:

nodes *<node_name>*
cm ha-ip *<internal_address>*

The following configuration is an example identifying the parameters to configure internal and external addresses:

```
# The master-virtual-ip parameter contains the *internal* VIP address.
configuration master-virtual-ip 192.0.1.101
configuration master-virtual-ip-cidr 24
configuration master-virtual-ip-interface vlan1001
#
# The additional-master-virtual-ip parameter contains the details of the *externally*
available VIP address.
configuration additional-master-virtual-ip 203.0.113.214
configuration additional-master-virtual-ip-cidr 26
configuration additional-master-virtual-ip-interface vlan3540
#
#The additional cm ha-ip parameter needs to be added with the *internal* IP of the node.
# note: node-ip in a CM HA config points to the internal master-virtual-ip
nodes cm1
ssh-ip 203.0.113.212
type k8s
k8s node-type control-plane
k8s node-ip 192.0.1.101
cm ha-ip 192.0.1.59
...
initial-boot netplan vlans vlan3540
addresses [ 203.0.113.212/26 ]
exit
os netplan-additions ethernets eno1
addresses [ 192.200.0.29/8 ]
exit
os netplan-additions vlans vlan1001
addresses [ 192.0.1.59/24 ]
exit
exit
nodes cm2
ssh-ip 203.0.113.213
type k8s
k8s node-type backup
k8s node-ip 192.0.1.101
cm ha-ip 192.0.1.60
...
initial-boot netplan vlans vlan3540
addresses [ 203.0.113.213/26 ]
```

```
exit
os netplan-additions ethernets eno1
addresses [ 192.200.0.29/8 ]
exit
os netplan-additions vlans vlan1001
addresses [ 192.0.1.60/24 ]
exit
exit
```

Modifications in the Data Model

You must specify the Active and Standby node during the configuration explicitly because of the asymmetric HA configuration:

1. **Active Node** - You must use the *control plane* node as the Active node. Using the *k8s hostname-override* parameter, you can specify the K8s host name (instead of using the default name).

   Example:

   ```
   nodes active
     k8s node-type control-plane
     k8s hostname-override ha-active
     ...
    exit
   ```

2. **Standby Node** - A new K8s node type called *backup* is introduced for the Standby node.

   Example:

   ```
   nodes standby
     k8s node-type backup
     ...
    exit
   ```

Deploying the SMI Cluster Manager in High Availability

You can deploy the SMI Cluster Manager on a active and standby High Availability (HA) model. For more information on SMI Cluster Manager HA model, see SMI Cluster Manager in High Availability section.

Prerequisites

The following are the prerequisites for deploying the SMI Cluster Manager:

- An Inception Deployer that has deployed the Cluster Manager.
- The SMI Cluster Manager that has deployed the CEE cluster.

Minimum Hardware Requirements - Bare Metal

The minimum hardware requirements for deploying the SMI Cluster Manager on Bare Metal are:

Table 7: Minimum Hardware Requirements (UCS-C Series)

Deployment Model	Nodes	Server Type	Networking	NIC	Cores Per Socket		
					Linux	K8s	CEE
HA (> 3 Node Model)	First 3 Nodes	Cisco UCS C220 M5/M6/M7	Cisco Catalyst 3850 and Cisco Nexus 9000 Series Switches	Cisco UCS C220 M5/M6: • Intel® Ethernet Network Adapter E810-CQDA2 • Intel® Network Adapter XL710 • Intel® Network Adapter X710 • Intel® Ethernet Controller XXV710 • NVIDIA ConnectX-5| • Intel® X520 • Intel® Ethernet Controller 82599ES • Intel® Ethernet Network Adapter E810	2 cores	2 cores	4 cores
	Additional Nodes	Cisco UCS C220 M5/M6/M7			2 cores	2 cores	

Note You must install a RAID Controller such as Cisco 12 Gbps modular RAID controller with 2 GB cache module on the UCS server for the cluster sync operation to function properly. For RAID 1, you must install a minimum of 2 SSDs to improve the read and write access speed.

Supported Configurations - VMware

The SMI Cluster Manager supports the following VM configurations:

Note Individual NFs are deployed as K8s workers through SMI. They each have their own VM recommendations. Refer to the NF documentation for details.

Table 8: Supported Configurations - VMware

Nodes	CPU	Cores Per Socket	RAM	Boot Disk	Data Disk
Control Plane	2 CPU	2	16 GB	200 GB	
ETCD	2 CPU	2	16 GB	200 GB	
Worker	36 CPU	36	164 GB	200 GB	1000 GB

Deploying the Cluster Manager in HA

To deploy the SMI Cluster Manager in HA mode, use the following configuration:

1. Login to the Inception Server CLI and enter the configuration mode
   - Add the SMI Cluster Manager HA configuration to deploy the SMI Cluster Manager in HA mode.

Note
- For deploying the SMI Cluster Manager on Bare Metal, add the SMI Cluster Manager HA Configuration defined for Bare Metal environments. A sample SMI Cluster Manager HA Configuration for Bare Metal is provided Sample Cluster Manager HA Configuration - Bare Metal.
- For deploying the SMI Cluster Manager on VMware, add the SMI Cluster Manager HA Configuration defined for VMware environments. A sample SMI Cluster Manager HA Configuration for Bare Metal is provided Sample Cluster Manager HA Configuration - VMware.
- For deploying the SMI Cluster Manager on OpenStack, add the SMI Cluster Manager HA Configuration defined for OpenStack environments. A sample SMI Cluster Manager HA Configuration for Bare Metal is provided Sample Cluster Manager HA Configuration - OpenStack.

2. Commit and exit the cluster configuration.
3. Run the cluster synchronization

   clusters *cluster_name* **actions sync run debug true**

4. Monitor the progress of the synchronization

   monitor sync-logs *cluster_name*

5. Connect to the SMI Cluster Manager CLI after the synchronization completes

```
ssh admin@cli.smi-cluster-deployer.<ipv4address>.<domain_name> -p
<port_number>
```

NOTES:

- **clusters** *cluster_name* – Specifies the information about the nodes to be deployed. *cluster_name* is the name of the cluster.
- *actions* – Specifies the actions performed on the cluster.
- **sync run** – Triggers the cluster synchronization.
- **monitor sync-logs** *cluster_name* - Monitors the cluster synchronization.

Upgrading SMI Cluster Manager in HA

The SMI Cluster Manager HA upgrade involves the following process: adding a new software definition, updating the repository and synchronizing the cluster to apply the changes.

However, you can upgrade the SMI Cluster Manger HA only when the following conditions are met:

1. The active node must be active and running.
2. The standby node must be in standby mode and running.

Important

- You cannot perform an upgrade when one of the SMI Cluster manger node (Active or Standby) is down. The SMI Cluster Manager does not support partition upgrade.
- The SMI Cluster Manager does not allow any cluster synchronization while performing an upgrade. Also, while upgrading the SMI Cluster manager, the control flip-flops from Active to Standby node and from Standby to Active node. This may result in minor service interruptions.

To upgrade an SMI Cluster Manager in HA, use the following configuration:

1. Login to the Inception Cluster Manager CLI and enter the Global Configuration mode.
2. To upgrade, add a new software definition for the software.

```
configure
  software cnf <cnf_software_version>
  url <repo_url>
  user <user_name>
  password <password>
  sha256 <SHA256_hash_key>
  exit
```

Example:

```
Cluster Manager# config
Cluster Manager(config)# software cnf cm-2020-02-0-i06
Cluster Manager(config)# url <repo_url>
Cluster Manager(config)#user <username>
Cluster Manager(config)#password "<password>"
Cluster Manager(config)#sha256 <sha256_key>
```

```
Cluster Manager(config)#exit
Cluster Manager(config)#
```

3. Update the repository to reference the new software.

   clusters *<cluster_name>*
   cluster-manager repository-local *<cnf_software_version>*
   exit

   Example:

   ```
   Cluster Manager# config
   Cluster Manager(config)# clusters cndp-testbed-cm
   Cluster Manager(config)#cluster-manager repository-local cm-2020-02-0-i06
   Cluster Manager(config)#exit
   ```

4. Commit the changes.

5. Trigger the Cluster synchronization.

   configure
   clusters *<cluster_name>* **actions sync run debug true**

   Example:

   ```
   Cluster Manager# config
   Cluster Manager(config)# clusters cndp-testbed-cm actions sync run debug true
   ```

6. Monitor the upgrade progress

   monitor syc-logs *<cluster_name>*

   Example:

   ```
   Cluster Manager# monitor syc-logs cndp-testbed-cm
   ```

7. Login to the SMI Cluster Manager after the Cluster synchronization completes.

   ssh admin@cli.smi-cluster-deployer.<ipv4_address>.<domain_name> -p <port_number>

8. Verify the software version using the following command.

   show version

   Example:

   ```
   SMI Cluster Manager# show version
   ```

NOTES:

- **software cnf** <*cnf_software_version*> - Specifies the Cloud Native Function software package.
- **url** <*repo_url*> - Specifies the *HTTP/HTTP/file* URL of the software.
- **user** <*user_name*> - Specifies the username for *HTTP/HTTPS* authentication.
- **password** <*password*> - Specifies the password used for downloading the software package.
- **sha256** <*SHA256_hash_key*> - Specifies the SHA256 hash of the downloaded software.

Sample High Availability Configurations

This section provides a sample SMI Cluster Manager HA configuration with an Active and Standby nodes. The following parameters are used in this HA configuration:

- Active Node Host Name: *ha-active*
- Standby Node Host Name: *ha-standby*
- Primary IP address for Active Node: <*Primary_active_node_IPv4address*>
- Primary IP address for Standby Node: <*Primary_standby_node_IPv4address*>
- Virtual IP address: <*Virtual_IPv4address*>

Defining a High Availability Configuration

The following examples defines the virtual IP address for the cluster named *ha*.

```
clusters ha
 configuration master-virtual-ip <Virtual_IPv4address>
 ...
```

The following examples defines the two HA nodes.

```
nodes active
  ssh-ip <Primary_active_node_IPv4address>
 type k8s
  k8s node-type control-plane
  k8s hostname-override ha-active
  k8s ssh-ip       <Primary_active_node_IPv4address>
 k8s node-ip       <Virtual_IPv4address>
 ...
exit
nodes standby
 ssh-ip <Primary_standby_node_IPv4address>
 type k8s
  k8s node-type backup
  k8s ssh-ip <Primary_standby_node_IPv4address>
 k8s node-ip <Virtual_IPv4address>
 ...
exit
```

Sample Cluster Manager HA Configuration - Bare Metal

This section shows sample configurations to set up a HA Cluster Manager, which defines two HA nodes (Active and Standby) on bare metal servers.

Cisco UCS Server

```
software cnf <software_version> #For example, cm-2020-02-0-i05
url <repo_url>
user <username>
password <password>
sha256 <sha256_hash>
```

```
exit
environments bare-metal
 ucs-server
exit
clusters <cluster_name> #For example, cndp-testbed-cm
 environment bare-metal
 addons ingress bind-ip-address <IPv4address>
 addons cpu-partitioner enabled
 configuration allow-insecure-registry true
 node-defaults ssh-username <username>
 node-defaults ssh-connection-private-key
  "-----BEGIN OPENSSH PRIVATE KEY-----\n
 <SSH_private_key>
  -----END OPENSSH PRIVATE KEY-----\n"
 node-defaults initial-boot netplan ethernets <interface_name> #For example,
eno1
  dhcp4 false
  dhcp6 false
  gateway4 <IPv4address>
  nameservers search <nameserver>
  nameservers addresses <IPv4addresses>
 exit
 node-defaults initial-boot default-user <username>
 node-defaults initial-boot default-user-ssh-public-key
  "<SSH_Public_Key>"
 node-defaults initial-boot default-user-password #For example, Csco123#
 node-defaults os proxy https-proxy <proxy_server_url>
 node-defaults os proxy no-proxy <proxy_server_url/IPv4address>
 node-defaults os ntp enabled
 node-defaults os ntp servers <ntp_server>
 exit
 nodes control-plane
  ssh-ip <IPv4address>node-defaults netplan template
  type k8s
  k8s node-type control-plane
  k8s node-labels <node_labels/node_type>
  exit
 ucs-server host initial-boot networking static-ip ipv4-address <IPv4address>

  ucs-server host initial-boot networking static-ip netmask <IPv4address>
  ucs-server host initial-boot networking static-ip gateway <IPv4address>
  ucs-server host initial-boot networking static-ip dns <IPv4address>
  ucs-server cimc ip-address <IPv4address>
  ucs-server cimc user <username> #For example, admin
  ucs-server cimc password <password> #For example, C1sc0123#
  ucs-server cimc storage-adaptor create-virtual-drive true
  ucs-server cimc networking ntp enabled
  ucs-server cimc networking ntp servers <ntp_server_url>
  initial-boot netplan ethernets <interface_name> #For example, eno1
   addresses <IPv4address/subnet>
  exit
 exit
 cluster-manager enabled
```

```
 cluster-manager repository-local <repo_name> #For example, cm-2020-02-0-i05
 cluster-manager netconf-ip <IPv4address>
 cluster-manager iso-download-ip <IPv4address>
 cluster-manager initial-boot-parameters first-boot-password <password> #For
 example, 'Csco123#'
exit
```

Sample Cluster Manager HA Configuration - VMware

The following is a sample HA configuration, which defines two HA nodes (Active and Standby) for VMware environments:

```
clusters <cluster_name>

        # associating an existing vcenter environment
        environment <vcenter_environment> #Example:laas

        # General cluster configuration
        configuration master-virtual-ip <keepalived_ipv4_address>
        configuration master-virtual-ip-cidr
<netmask_of_additional_master_virtual_ip> #Default is 32
        configuration master-virtual-ip-interface <interface_name>
        configuration additional-master-virtual-ip <ipv4_address>
        configuration additional-master-virtual-ip-cidr
<netmask_of_additional_master_virtual_ip> #Default is 32
       configuration additional-master-virtual-ip-interface <interface_name>

        configuration virtual-ip-vrrp-router-id <virtual_router_id> #To support
 multiple instances of VRRP in the same subnet
      configuration pod-subnet <pod_subnet> #To avoid conflict with already existing
 subnets
        configuration size <functional_test_ha/functional_test_aio/production>
      configuration allow-insecure-registry <true> #To allow insecure registries


       # istio and nginx ingress addons
        addons ingress bind-ip-address <keepalived_ipv4_address>
        addons istio enabled

        # vsphere volume provider configuration
        addons vsphere-volume-provider server <vcenter_server_ipv4_address>
        addons vsphere-volume-provider server-port <vcenter_port>
        addons vsphere-volume-provider allow-insecure <true> #To allow self
signed certs
        addons vsphere-volume-provider user <vcenter_username>
        addons vsphere-volume-provider password <vcenter_password>
        addons vsphere-volume-provider datacenter <vcenter_datacenter>
        addons vsphere-volume-provider datastore <vcenter_nfs_storage>
#Corresponding vcenter nfs storage
        addons vsphere-volume-provider network <network_id>
       addons vsphere-volume-provider folder <cluster_folder_containing_the_VMs>


        # Openstack volume provider configuration
        addons openstack-volume-provider username <username>
        addons openstack-volume-provider password <password>
```

```
        addons openstack-volume-provider auth-url <auth_url>
        addons openstack-volume-provider tenant-id <tenant_id>
        addons openstack-volume-provider domain-id <domain_id>

        # initial-boot section of node-defaults for vmware
        node-defaults initial-boot default-user <default_username>
       node-defaults initial-boot default-user-ssh-public-key <public_ssh_key>

        node-defaults initial-boot netplan template


        # initial-boot section of node-defaults for VMs managed in Openstack
        node-defaults initial-boot default-user <default_user>
        node-defaults netplan template
          #jinja2:variable_start_string:'__DO_NOT_ESCAPE__' ,
variable_end_string:'__DO_NOT_ESCAPE__'
          #

        #k8s related config of node-defaults
        node-defaults k8s ssh-username <default_k8s_ssh_username>
        node-defaults k8s ssh-connection-private-key
               -----BEGIN RSA PRIVATE KEY-----
               <SSH_Private_Key>
               -----END RSA PRIVATE KEY-----

          # os related config of node-defaults
          node-defaults os proxy https-proxy <https_proxy>
          node-defaults os proxy no-proxy <no_proxy_info>
          node-defaults os ntp servers <local_ntp_server>
          exit

          # node configuration of multinode cluster. vmware related info overrides the
defaults provided in the environment 'laas' associated with the cluster

     nodes node_name #For example, etcd1
       k8s node-type etcd
       k8s ssh-ip ipv4address
       k8s node-ip ipv4address
       vmware datastore datastore_name
       vmware host host_name
       vmware performance latency-sensitivity normal
       vmware performance memory-reservation false
       vmware performance cpu-reservation false
       vmware sizing ram-mb ram_size_in_mb
       vmware sizing cpus cpu_size
       vmware sizing disk-root-gb disk_root_size_in_gb
       vmware nics network_ID
     exit
  exit
  nodes node_name #For example, etcd2
     k8s node-type etcd
     k8s ssh-ip ipv4address
     k8s node-ip ipv4address
     vmware datastore datastore_name
     vmware host host_name
```

```
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
  exit
exit
nodes node_name #For example, etcd3
    k8s node-type etcd
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
  exit
exit
nodes node_name #For example, controlplane1
    k8s node-type control-plane
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
   exit
exit
nodes node_name #For example, controlplane2
   k8s node-type control-plane
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   vmware datastore datastore_name
   vmware host host_name
   vmware performance latency-sensitivity normal
   vmware performance memory-reservation false
   vmware performance cpu-reservation false
   vmware sizing ram-mb ram_size_in_mb
   vmware sizing cpus cpu_size
   vmware sizing disk-root-gb disk_root_size_in_gb
```

```
    vmware nics network_ID
    exit
  exit
nodes node_name #For example, controlplane3
    k8s node-type control-plane
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
    exit
exit
nodes node_name #For example, oam1
    k8s node-type worker
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    k8s node-labels node_labels
    exit
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
    exit
exit
nodes node_name #For example, oam2
    k8s node-type worker
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    k8s node-labels node_labels
    exit
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
    exit
```

```
exit
nodes node_name #For example, oam3
  k8s node-type worker
  k8s ssh-ip ipv4address
  k8s node-ip ipv4address
  k8s node-labels node_labels
  exit
  vmware datastore datastore_name
  vmware host host_name
  vmware performance latency-sensitivity normal
  vmware performance memory-reservation false
  vmware performance cpu-reservation false
  vmware sizing ram-mb ram_size_in_mb
  vmware sizing cpus cpu_size
  vmware sizing disk-root-gb disk_root_size_in_gb
  vmware nics network_ID
  exit
exit
nodes node_name #For example, session-data1
  k8s node-type worker
  k8s ssh-ip ipv4address
  k8s node-ip ipv4address
  k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-1 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-2 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-1 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-2 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-3 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-4 true
  exit
  k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
  exit
  k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
  exit
  vmware datastore datastore_name
  vmware host host_name
  vmware performance latency-sensitivity normal
  vmware performance memory-reservation false
  vmware performance cpu-reservation false
  vmware sizing ram-mb ram_size_in_mb
  vmware sizing cpus cpu_size
  vmware sizing disk-root-gb disk_root_size_in_gb
  vmware nics network_ID
  exit
 exit
```

```
 nodes node_name #For example, session-data2
   k8s node-type worker
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-1 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-2 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-1 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-2 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-3 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-4 true
   exit
   k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
   exit
   k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
   exit
   vmware datastore datastore_name
   vmware host host_name
   vmware performance latency-sensitivity normal
   vmware performance memory-reservation false
   vmware performance cpu-reservation false
   vmware sizing ram-mb ram_size_in_mb
   vmware sizing cpus cpu_size
   vmware sizing disk-root-gb disk_root_size_in_gb
   vmware nics network_ID
   exit
exit
nodes node_name #For example, session-data3
   k8s node-type worker
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-3 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-4 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-5 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-6 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-7 true
   exit
   k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-8 true
   exit
```

```
      k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
      exit
      k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
      exit
      vmware datastore datastore_name
      vmware host host_name
      vmware performance latency-sensitivity normal
      vmware performance memory-reservation false
      vmware performance cpu-reservation false
      vmware sizing ram-mb ram_size_in_mb
      vmware sizing cpus cpu_size
      vmware sizing disk-root-gb disk_root_size_in_gb
      vmware nics network_ID
      exit
    exit
    nodes node_name #For example, session-data4
      k8s node-type worker
      k8s ssh-ip ipv4address
      k8s node-ip ipv4address
      k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
      exit
      k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-3 true
      exit
      k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-4 true
      exit
      k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-5 true
      exit
      k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-6 true
      exit
      k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-7 true
      exit
      k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-8 true
      exit
      k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
      exit
      k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
      exit
      vmware datastore datastore_name
      vmware host host_name
      vmware performance latency-sensitivity normal
      vmware performance memory-reservation false
      vmware performance cpu-reservation false
      vmware sizing ram-mb ram_size_in_mb
      vmware sizing cpus cpu_size
      vmware sizing disk-root-gb disk_root_size_in_gb
      vmware nics network_ID
      exit
  exit
exit
         # Virtual IPs
        virtual-ips <name> #Example: rxdiam
```

```
    vrrp-interface <interface_name>
    vrrp-router-id <router_id>

    ipv4-addresses <ipv4_address>
      mask <netmassk>
      broadcast <broadcast_ipv4_address>
      device <interface_name>
    exit
    # nodes associated with the virtual-ip
    hosts <node_name> #Example: smi-cluster-core-protocol1
      priority <priority_value>
    exit
    hosts <node_name> #Example: smi-cluster-core-protocol2
      priority <priority_value>
    exit
  exit
   # Secrets for product registry
  secrets docker-registry <secret_name>
    docker-server <server_name or docker_registry>
    docker-username <username>
    docker-password <password>
    docker-email <email>
    namespace <k8s_namespace> #Example: cee-voice
  exit
  ops-centers <app_name> <instance_name> #Example: cee data
    repository <artifactory_url>



    username <username>
    password <password>

    initial-boot-parameters use-volume-claims <true/false> #True to use
persistent volumes and vice versa
    initial-boot-parameters first-boot-password <password> #First boot
password for product opscenter
   initial-boot-parameters auto-deploy <true/false> #Auto deploys all the
 services of the product else deploys the opscenter only
   initial-boot-parameters single-node <true/false> #True for single node
 and false for multi node deployments
    initial-boot-parameters image-pull-secrets
<docker_registry_secrets_name>
    exit
  exit
```

Sample Cluster Manager HA Configuration - OpenStack

The following is a sample HA configuration, which defines two HA nodes (Active and Standby) for OpenStack environments:

```
software cnf <software_version> #For example, cm-2020-02-0-i05
url <repo_url>
user <username>
password <password>
```

```
 sha256 <sha256_hash>
exit
environments manual
 manual
exit
clusters <cluster_name> #For example, cndp-testbed-cm
 environment manual
 addons ingress bind-ip-address <IPv4address>
 addons cpu-partitioner enabled
 configuration allow-insecure-registry true
 node-defaults ssh-username <username>
 node-defaults ssh-connection-private-key
  "-----BEGIN OPENSSH PRIVATE KEY-----\n
 <SSH_private_key>
  -----END OPENSSH PRIVATE KEY-----\n"
 node-defaults initial-boot netplan ethernets <interface_name> #For example,
eno1
  dhcp4 false
  dhcp6 false
  gateway4 <IPv4address>
  nameservers search <nameserver>
  nameservers addresses <IPv4addresses>
 exit
 node-defaults initial-boot default-user <username>
 node-defaults initial-boot default-user-ssh-public-key
  "<SSH_Public_Key>"
 node-defaults initial-boot default-user-password #For example, Csco123#
 node-defaults os proxy https-proxy <proxy_server_url>
 node-defaults os proxy no-proxy <proxy_server_url/IPv4address>
 node-defaults os ntp enabled
 node-defaults os ntp servers <ntp_server>
 exit
 nodes control-plane
  ssh-ip <IPv4address>node-defaults netplan template
  type k8s
  k8s node-type control-plane
  k8s node-labels <node_labels/node_type>
  exit
 cluster-manager enabled
 cluster-manager repository-local <repo_name> #For example, cm-2020-02-0-i05
 cluster-manager netconf-ip <IPv4address>
 cluster-manager iso-download-ip <IPv4address>
 cluster-manager initial-boot-parameters first-boot-password <password> #For
 example, 'Csco123#'
exit
```

Dual Stack Support

Dual stack enables networking devices to be configured with both IPv4 and IPv6 addresses. SMI supports certain subnets to be configured with dual stack within the remote Kubernetes cluster and the CM HA.

Dual Stack Support for Remote Kubernetes and CM HA

The host and the remote Kubernetes can be configured with the IPv6 address, by setting the *ipv6-mode* to **dual-stack** in the configuration file.

This section provides sample configurations for the SMI Management Cluster with Cluster Manager HA and CEE, and the remote Kubernetes with the pod subnet, service subnet and the docker subnet configured with IPv6 address.

The following are the default IPv6 addresses for the subnets:

- The default IPv6 subnet for pod subnet is fd20::0/112
- The default IPv6 subnet for service subnet is fd20::0/112
- The default IPv6 CIDR for docker subnet is fd00::/80

Note

- You must reset the cluster after upgrading an IPv4 cluster with dual stack.
- The network interfaces that are configured using the **clusters nodes k8s node-ip** CLI command must have an IPv6 address.

For deployment information, see the SMI Cluster Manager in High Availability section.

Dual Stack Configuration for Remote Kubernetes

Prerequisites

The following are the prerequisites for deploying the remote Kubernetes cluster for dual stack configuration:

- SMI Cluster Manager and CEE are deployed.
- All the pods are running.
- The network is configured to interact with the remote cluster CIN on both IPv4 and IPv6.

The following is the sample configuration for remote Kubernetes:

```
software cnf cee
 url                            <repo_url>
 user                           <user>
 password                       <password>
 accept-self-signed-certificate false
 sha256                         <sha256_hash>
exit
software cnf cm
 url                            <url>
 user                           <username>
 password                       <password>
 accept-self-signed-certificate false
 sha256                         <sha256_hash>
exit
environments ucs
 ucs-server
exit
feature-gates alpha true
```

```
clusters tb16-2
 environment ucs
 vm-defaults upf software 74879
 vm-defaults upf networking management netmask 255.255.255.192
 vm-defaults upf networking management gateway 10.84.114.193
 vm-defaults upf networking management interface-type bridge
 vm-defaults upf networking management bridge name ex4000
 vm-defaults upf day0 username starent
 vm-defaults upf day0 password <password>
 vm-defaults upf day0 syslog-ip 10.192.1.101
 node-defaults ssh-username cloud-user
 node-defaults kvm fluent-forwarding host 10.192.1.59
 node-defaults kvm fluent-forwarding port 24224
 node-defaults kvm fluent-forwarding disable-tls true
 node-defaults initial-boot default-user cloud-user
 node-defaults initial-boot default-user-ssh-public-key <ssh_public_key>
 node-defaults initial-boot default-user-password <password>
 node-defaults initial-boot netplan ethernets eno5
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets eno6
  dhcp4 false
Aborted: by user
[upf-cm-tb16-2-cm1] SMI Cluster Deployer# show running-config clusters tb16-ipv6
clusters tb16-ipv6
 environment ucs
 addons ingress bind-ip-address 10.84.114.206
 addons ingress bind-ip-address-internal 10.192.1.61
 addons cpu-partitioner enabled
 configuration master-virtual-ip        10.84.114.206
 configuration master-virtual-ip-interface vlan3540
 configuration additional-master-virtual-ip 10.192.1.61
 configuration additional-master-virtual-ip-interface vlan1001
 configuration ipv6-mode                dual-stack
 configuration pod-subnet               12.0.0.0/16
 configuration allow-insecure-registry  true
 configuration docker-address-pools pool1
  base 192.51.0.0/16
  size 24
 exit
 node-defaults ssh-username cloud-user
 node-defaults initial-boot default-user cloud-user
 node-defaults initial-boot default-user-ssh-public-key <ssh_public_key>
 node-defaults initial-boot default-user-password <password>
 node-defaults initial-boot netplan ethernets eno5
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets eno6
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan bonds bd0
  dhcp4      false
  dhcp6      false
  optional   true
  interfaces [ eno5 eno6 ]
  parameters mode      active-backup
  parameters mii-monitor-interval 100
  parameters fail-over-mac-policy active
 exit
 node-defaults initial-boot netplan vlans vlan1001
  dhcp4 false
```

```
 dhcp6 false
 id    1001
 link  bd0
exit
node-defaults k8s ssh-connection-private-key <ssh_connection_key>
node-defaults ucs-server cimc user admin
node-defaults ucs-server cimc password <password>
node-defaults ucs-server cimc networking ntp enabled
node-defaults ucs-server cimc networking ntp servers 192.200.0.29
exit
node-defaults os netplan-additions vlans vlan3540
 dhcp4    false
 dhcp6    false
 gateway4 10.84.114.193
 gateway6 2001:420:2c7f:f690::1
 nameservers search [ cisco.com ]
 nameservers addresses [ 10.84.96.130 64.102.6.247 161.44.124.122 ]
 id       3540
 link     bd0
exit
node-defaults os ntp enabled
node-defaults os ntp servers ntp.esl.cisco.com
exit
nodes controlplane1
 ssh-ip 10.192.1.62
 type   k8s
 k8s node-type control-plane
 k8s ssh-ip   10.192.1.62
 k8s node-ip  10.192.1.62
 k8s ssh-username cloud-user
 k8s node-labels smi.cisco.com/node-type oam
 exit
 ucs-server cimc ip-address 192.100.0.6
 initial-boot netplan vlans vlan1001
  addresses [ 10.192.1.62/24 fd32:e985:ce1:fff2::106/64 ]
  routes 10.192.1.0/24 10.192.1.1
  exit
 exit
 os netplan-additions vlans vlan3540
  addresses [ 10.84.114.246/26 2001:420:2c7f:f690::f106/64 ]
 exit
exit
nodes controlplane2
 ssh-ip 10.192.1.63
 type   k8s
 k8s node-type control-plane
 k8s ssh-ip   10.192.1.63
 k8s node-ip  10.192.1.63
 k8s ssh-username cloud-user
 k8s node-labels smi.cisco.com/node-type oam
 exit
 ucs-server cimc ip-address 192.100.0.5
 initial-boot netplan vlans vlan1001
  addresses [ 10.192.1.63/24 fd32:e985:ce1:fff2::105/64 ]
  routes 10.192.1.0/24 10.192.1.1
  exit
 exit
 os netplan-additions vlans vlan3540
  addresses [ 10.84.114.248/26 2001:420:2c7f:f690::f105/64 ]
 exit
exit
nodes controlplane3
 ssh-ip 10.192.1.64
 type   k8s
```

```
  k8s node-type control-plane
  k8s ssh-ip   10.192.1.64
  k8s node-ip  10.192.1.64
  k8s ssh-username cloud-user
  k8s node-labels smi.cisco.com/node-type oam
  exit
  ucs-server cimc ip-address 192.100.0.4
  initial-boot netplan vlans vlan1001
   addresses [ 10.192.1.64/24 fd32:e985:ce1:fff2::104/64 ]
   routes 10.192.1.0/24 10.192.1.1
   exit
  exit
  os netplan-additions vlans vlan3540
   addresses [ 10.84.114.250/26 2001:420:2c7f:f690::f104/64 ]
  exit
 exit
 ops-centers cee voice
  repository-local cee
  initial-boot-parameters use-volume-claims true
  initial-boot-parameters first-boot-password <password>
  initial-boot-parameters auto-deploy true
  initial-boot-parameters single-node false
 exit
exit
```

Dual Stack Configuration for SMI Management Cluster with CM HA and CEE

Prerequisites

- The management cluster is deployed comprising of the CM HA active and standby nodes and CEE.
- Inception cluster manager is deployed
- All the containers are running.
- The network is configured to interact with the remote cluster CIN on both IPv4 and IPv6.

The following is the configuration for management cluster:

```
software cnf cee
 url                            <repo_url>
 user                           <username>
 password                       <password>
 accept-self-signed-certificate false
 sha256                         <sha256_hash
exit
software cnf cm
 url                            <repo_url>
 user                           <username>
 password                       <password>
 accept-self-signed-certificate false
 sha256                         <sha256_hash>
exit
environments ucs
 ucs-server
exit
feature-gates alpha true
clusters tb16-ipv6-ha
 environment ucs
 addons ingress bind-ip-address 10.84.114.206
 addons ingress bind-ip-address-internal 10.192.1.61
 addons cpu-partitioner enabled
 configuration master-virtual-ip        10.84.114.206
```

```
configuration master-virtual-ip-interface vlan3540
configuration additional-master-virtual-ip 10.192.1.61
configuration additional-master-virtual-ip-interface vlan1001
configuration ipv6-mode                dual-stack
configuration pod-subnet               12.0.0.0/16
configuration allow-insecure-registry  true
configuration docker-address-pools pool1
 base 192.51.0.0/16
 size 24
exit
node-defaults ssh-username cloud-user
node-defaults initial-boot default-user cloud-user
node-defaults initial-boot default-user-ssh-public-key "<SSH_Public_Key>"
node-defaults initial-boot default-user-password <user_password>
node-defaults initial-boot netplan ethernets eno5
 dhcp4 false
 dhcp6 false
exit
node-defaults initial-boot netplan ethernets eno6
 dhcp4 false
 dhcp6 false
exit
node-defaults initial-boot netplan bonds bd0
 dhcp4      false
 dhcp6      false
 optional   true
 interfaces [ eno5 eno6 ]
 parameters mode      active-backup
 parameters mii-monitor-interval 100
 parameters fail-over-mac-policy active
exit
node-defaults initial-boot netplan vlans vlan1001
 dhcp4 false
 dhcp6 false
 id    1001
 link  bd0
exit
node-defaults k8s ssh-connection-private-key <ssh_connection_key>
node-defaults ucs-server cimc user admin
node-defaults ucs-server cimc password <password>
node-defaults ucs-server cimc networking ntp enabled
node-defaults ucs-server cimc networking ntp servers 192.200.0.29
exit
node-defaults os netplan-additions vlans vlan3540
 dhcp4    false
 dhcp6    false
 gateway4 10.84.114.193
 gateway6 2001:420:2c7f:f690::1
 nameservers search [ cisco.com ]
 nameservers addresses [ 10.84.96.130 64.102.6.247 161.44.124.122 ]
 id       3540
 link     bd0
exit
node-defaults os ntp enabled
node-defaults os ntp servers ntp.esl.cisco.com
exit
nodes controlplane1
 ssh-ip 10.192.1.62
 type   k8s
 k8s node-type control-plane
 k8s node-ip  10.192.1.61
 k8s ssh-username cloud-user
 k8s node-labels smi.cisco.com/node-type oam
 exit
```

```
  ucs-server cimc ip-address 192.100.0.6
  initial-boot netplan vlans vlan1001
   addresses [ 10.192.1.62/24 fd32:e985:ce1:fff2::106/64 ]
   routes 10.192.1.0/24 10.192.1.1
   exit
  exit
  os netplan-additions vlans vlan3540
   addresses [ 10.84.114.246/26 2001:420:2c7f:f690::f106/64 ]
  exit
 exit
 nodes controlplane2
  ssh-ip 10.192.1.63
  type   k8s
  k8s node-type backup
  k8s node-ip  10.192.1.61
  k8s ssh-username cloud-user
  k8s node-labels smi.cisco.com/node-type oam
  exit
  ucs-server cimc ip-address 192.100.0.5
  initial-boot netplan vlans vlan1001
   addresses [ 10.192.1.63/24 fd32:e985:ce1:fff2::105/64 ]
   routes 10.192.1.0/24 10.192.1.1
   exit
  exit
  os netplan-additions vlans vlan3540
   addresses [ 10.84.114.248/26 2001:420:2c7f:f690::f105/64 ]
  exit
 exit
 cluster-manager enabled
 cluster-manager repository-local cm
 cluster-manager netconf-port 831
 cluster-manager ssh-port 2023
 cluster-manager initial-boot-parameters first-boot-password <password>
 ops-centers cee voice
  repository-local cee
  initial-boot-parameters use-volume-claims true
  initial-boot-parameters first-boot-password <password>
  initial-boot-parameters auto-deploy true
  initial-boot-parameters single-node false
 exit
exit
```

Note To improve scalability, if you must switch to PCIe from an mLOM card, where the K8s internal network is on VLAN 107, change the network bond value from bd0 to bd1.

Considering that the CEE and SMF are shut down, you must only move the VIP from bd0 to bd1 without changing the IP subnet.

SMI Cluster Manager in All-In-One Mode

This section provides information about deploying the SMI Cluster Manager in All-In-One (AIO).

Prerequisites

The following are the prerequisites for deploying the SMI Cluster Manager:

- An Inception Deployer that has deployed the Cluster Manager.
- The SMI Cluster Manager that has deployed the CEE cluster.

Minimum Hardware Requirements - Bare Metal

The minimum hardware requirements for deploying the SMI Cluster Manager on Bare Metal are:

Table 9: Minimum Hardware Requirements - Bare Metal

Deployment Model	Nodes	Server Type	Networking	NIC	Cores Per Socket		
					Linux	K8s	CEE
All-in-One (AIO)	All Nodes	Cisco UCS C220 M5/M6/M7	Cisco Catalyst 3850 and Cisco Nexus 9000 Series Switches	Cisco UCS C220 M5/M6/M7: • Intel® Ethernet Network Adapter E810-CQDA2 • Intel® Network Adapter XL710 • Intel® Network Adapter X710 • Intel® Ethernet Controller XXV710 • NVIDIA ConnectX-5| • Intel® X520 • Intel® Ethernet Controller 82599ES • Intel® Ethernet Network Adapter E810	2 cores	2 cores	4 cores

Note You must install a RAID Controller such as Cisco 12 Gbps modular RAID controller with 2 GB cache module on the UCS server for the cluster sync operation to function properly. For RAID 1, you must install a minimum of 2 SSDs to improve the read and write access speed.

Supported Configurations - VMware

The SMI Cluster Manager supports the following VM configurations:

Note Individual NFs are deployed as K8s workers through SMI. They each have their own VM recommendations. Refer to the NF documentation for details.

Table 10: Supported Configurations - VMware

Nodes	CPU	Cores Per Socket	RAM	Data Disk
Control Plane	2 CPU	2	16 GB	200 GB
ETCD	2 CPU	2	16 GB	200 GB
Worker	36 CPU	36	164 GB	2000 GB

Deploying the SMI Cluster Manager in All-In-One Mode

You can deploy the SMI Cluster Manager using the Inception Server on AIO mode. To deploy the SMI Cluster Manager:

1. Login to the Inception Server and enter the configuration mode.
   - Add the configuration SMI Cluster Manager AIO configuration.

Note

- For deploying a single node SMI Cluster Manager on Bare Metal, add the SMI Cluster Manager AIO configuration defined for Bare Metal environments. A sample SMI Cluster Manager AIO configuration for Bare Metal environments is provided Sample Cluster Manager AIO Configuration - Bare Metal.
- For deploying a single node SMI Cluster Manager on VMware, add the SMI Cluster Manager AIO configuration defined for VMware environments. A sample SMI Cluster Manager AIO configuration for VMware environments is provided Sample Cluster Manager AIO Configuration - VMware.
- For deploying a single node SMI Cluster Manager on VMware, add the SMI Cluster Manager AIO configuration defined for OpenStack environments. A sample SMI Cluster Manager AIO configuration for OpenStack environments is provided Sample Cluster Manager AIO Configuration - OpenStack.

- Commit and exit the configuration

2. Run the cluster synchronization

   clusters *cluster_name* **actions sync run debug true**

   - Monitor the progress of the synchronization

     monitor sync-logs *cluster_name*

Note The synchronization completes after 30 minutes approximately. The time taken for synchronization is based on network factors such as network speed, and VM power.

3. Connect to the SMI Cluster Manager CLI after the synchronization completes

   ssh admin@cli.smi-cluster-deployer.<ipv4address>.<domain_name> -p <port_number>

NOTES:

- **clusters** *cluster_name* – Specifies the information about the nodes to be deployed. *cluster_name* is the name of the cluster.
- *actions* – Specifies the actions performed on the cluster.
- **sync run** – Triggers the cluster synchronization.
- **monitor sync-logs** *cluster_name* - Monitors the cluster synchronization.

Sample Cluster Manager AIO Configuration - Bare Metal

This section shows sample configurations to set up a single node Cluster Manager on bare metal servers.

Cisco UCS Server

```
 software cnf <software_version> #For example, cm-2020-02-0-i05
 url <repo_url>
 user <username>
 password <password>
 sha256 <sha256_hash>
exit
environments bare-metal
 ucs-server
exit
clusters <cluster_name> #For example, cndp-testbed-cm
 environment bare-metal
 addons ingress bind-ip-address <IPv4address>
 addons cpu-partitioner enabled
 configuration allow-insecure-registry true
 node-defaults ssh-username <username>
 node-defaults ssh-connection-private-key
  "-----BEGIN OPENSSH PRIVATE KEY-----\n
 <SSH_private_key>
  -----END OPENSSH PRIVATE KEY-----\n"
 node-defaults initial-boot netplan ethernets <interface_name> #For example,
eno1
  dhcp4 false
  dhcp6 false
  gateway4 <IPv4address>
  nameservers search <nameserver>
  nameservers addresses <IPv4addresses>
 exit
 node-defaults initial-boot default-user <username>
 node-defaults initial-boot default-user-ssh-public-key
  "<SSH_Public_Key>"
 node-defaults initial-boot default-user-password #For example, Csco123#
 node-defaults os proxy https-proxy <proxy_server_url>
 node-defaults os proxy no-proxy <proxy_server_url/IPv4address>
 node-defaults os ntp enabled
 node-defaults os ntp servers <ntp_server>
 exit
 nodes control-plane
  ssh-ip <IPv4address>node-defaults netplan template
  type k8s
  k8s node-type control-plane
  k8s node-labels <node_labels/node_type>
  exit
 ucs-server host initial-boot networking static-ip ipv4-address <IPv4address>

  ucs-server host initial-boot networking static-ip netmask <IPv4address>
  ucs-server host initial-boot networking static-ip gateway <IPv4address>
  ucs-server host initial-boot networking static-ip dns <IPv4address>
```

```
 ucs-server cimc ip-address <IPv4address>
 ucs-server cimc user <username> #For example, admin
 ucs-server cimc password <password> #For example, C1sc0123#
 ucs-server cimc storage-adaptor create-virtual-drive true
 ucs-server cimc networking ntp enabled
 ucs-server cimc networking ntp servers <ntp_server_url>
 initial-boot netplan ethernets <interface_name> #For example, eno1
  addresses <IPv4address/subnet>
 exit
exit
cluster-manager enabled
cluster-manager repository-local <repo_name> #For example, cm-2020-02-0-i05
cluster-manager netconf-ip <IPv4address>
cluster-manager iso-download-ip <IPv4address>
cluster-manager initial-boot-parameters first-boot-password <password> #For
example, 'Csco123#'
exit
```

Sample Cluster Manager AIO Configuration - VMware

The following is a sample configuration for a single node Cluster Manager on VMware vCenter:

```
clusters <cluster_name>

        # associating an existing vcenter environment
        environment <vcenter_environment> #Example:laas

        # General cluster configuration
        configuration master-virtual-ip <keepalived_ipv4_address>
        configuration master-virtual-ip-cidr
<netmask_of_additional_master_virtual_ip> #Default is 32
        configuration master-virtual-ip-interface <interface_name>
        configuration additional-master-virtual-ip <ipv4_address>
        configuration additional-master-virtual-ip-cidr
<netmask_of_additional_master_virtual_ip> #Default is 32
       configuration additional-master-virtual-ip-interface <interface_name>

        configuration virtual-ip-vrrp-router-id <virtual_router_id> #To support
 multiple instances of VRRP in the same subnet
      configuration pod-subnet <pod_subnet> #To avoid conflict with already existing
 subnets
        configuration size <functional_test_ha/functional_test_aio/production>
      configuration allow-insecure-registry <true> #To allow insecure registries


       # istio and nginx ingress addons
        addons ingress bind-ip-address <keepalived_ipv4_address>
        addons istio enabled

        # vsphere volume provider configuration
        addons vsphere-volume-provider server <vcenter_server_ipv4_address>
        addons vsphere-volume-provider server-port <vcenter_port>
        addons vsphere-volume-provider allow-insecure <true> #To allow self
signed certs
```

```
        addons vsphere-volume-provider user <vcenter_username>
        addons vsphere-volume-provider password <vcenter_password>
        addons vsphere-volume-provider datacenter <vcenter_datacenter>
        addons vsphere-volume-provider datastore <vcenter_nfs_storage>
#Corresponding vcenter nfs storage
        addons vsphere-volume-provider network <network_id>
       addons vsphere-volume-provider folder <cluster_folder_containing_the_VMs>


        # Openstack volume provider configuration
        addons openstack-volume-provider username <username>
        addons openstack-volume-provider password <password>
        addons openstack-volume-provider auth-url <auth_url>
        addons openstack-volume-provider tenant-id <tenant_id>
        addons openstack-volume-provider domain-id <domain_id>

        # initial-boot section of node-defaults for vmware
        node-defaults initial-boot default-user <default_username>
      node-defaults initial-boot default-user-ssh-public-key <public_ssh_key>

        node-defaults initial-boot netplan template


        # initial-boot section of node-defaults for VMs managed in Openstack
        node-defaults initial-boot default-user <default_user>
        node-defaults netplan template
          #jinja2:variable_start_string:'__DO_NOT_ESCAPE__' ,
variable_end_string:'__DO_NOT_ESCAPE__'
          #

        #k8s related config of node-defaults
        node-defaults k8s ssh-username <default_k8s_ssh_username>
        node-defaults k8s ssh-connection-private-key
               -----BEGIN RSA PRIVATE KEY-----
               <SSH_Private_Key>
               -----END RSA PRIVATE KEY-----

          # os related config of node-defaults
          node-defaults os proxy https-proxy <https_proxy>
          node-defaults os proxy no-proxy <no_proxy_info>
          node-defaults os ntp servers <local_ntp_server>
          exit

          # node configuration of multinode cluster. vmware related info overrides the
defaults provided in the environment 'laas' associated with the cluster

     nodes node_name #For example, etcd1
        k8s node-type etcd
        k8s ssh-ip ipv4address
        k8s node-ip ipv4address
        vmware datastore datastore_name
        vmware host host_name
        vmware performance latency-sensitivity normal
        vmware performance memory-reservation false
        vmware performance cpu-reservation false
        vmware sizing ram-mb ram_size_in_mb
```

```
      vmware sizing cpus cpu_size
      vmware sizing disk-root-gb disk_root_size_in_gb
      vmware nics network_ID
   exit
exit
nodes node_name #For example, etcd2
    k8s node-type etcd
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
  exit
exit
nodes node_name #For example, etcd3
    k8s node-type etcd
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
  exit
exit
nodes node_name #For example, controlplane1
    k8s node-type control-plane
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
   exit
exit
nodes node_name #For example, controlplane2
```

```
   k8s node-type control-plane
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   vmware datastore datastore_name
   vmware host host_name
   vmware performance latency-sensitivity normal
   vmware performance memory-reservation false
   vmware performance cpu-reservation false
   vmware sizing ram-mb ram_size_in_mb
   vmware sizing cpus cpu_size
   vmware sizing disk-root-gb disk_root_size_in_gb
   vmware nics network_ID
   exit
 exit
nodes node_name #For example, controlplane3
   k8s node-type control-plane
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   vmware datastore datastore_name
   vmware host host_name
   vmware performance latency-sensitivity normal
   vmware performance memory-reservation false
   vmware performance cpu-reservation false
   vmware sizing ram-mb ram_size_in_mb
   vmware sizing cpus cpu_size
   vmware sizing disk-root-gb disk_root_size_in_gb
   vmware nics network_ID
   exit
exit
nodes node_name #For example, oam1
   k8s node-type worker
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   k8s node-labels node_labels
   exit
   vmware datastore datastore_name
   vmware host host_name
   vmware performance latency-sensitivity normal
   vmware performance memory-reservation false
   vmware performance cpu-reservation false
   vmware sizing ram-mb ram_size_in_mb
   vmware sizing cpus cpu_size
   vmware sizing disk-root-gb disk_root_size_in_gb
   vmware nics network_ID
   exit
exit
nodes node_name #For example, oam2
   k8s node-type worker
   k8s ssh-ip ipv4address
   k8s node-ip ipv4address
   k8s node-labels node_labels
```

```
    exit
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
    exit
exit
nodes node_name #For example, oam3
    k8s node-type worker
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    k8s node-labels node_labels
    exit
    vmware datastore datastore_name
    vmware host host_name
    vmware performance latency-sensitivity normal
    vmware performance memory-reservation false
    vmware performance cpu-reservation false
    vmware sizing ram-mb ram_size_in_mb
    vmware sizing cpus cpu_size
    vmware sizing disk-root-gb disk_root_size_in_gb
    vmware nics network_ID
    exit
exit
nodes node_name #For example, session-data1
    k8s node-type worker
    k8s ssh-ip ipv4address
    k8s node-ip ipv4address
    k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
    exit
    k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-1 true
    exit
    k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-2 true
    exit
    k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-1 true
    exit
    k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-2 true
    exit
    k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-3 true
    exit
    k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-4 true
    exit
    k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
    exit
    k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
    exit
```

```
  vmware datastore datastore_name
  vmware host host_name
  vmware performance latency-sensitivity normal
  vmware performance memory-reservation false
  vmware performance cpu-reservation false
  vmware sizing ram-mb ram_size_in_mb
  vmware sizing cpus cpu_size
  vmware sizing disk-root-gb disk_root_size_in_gb
  vmware nics network_ID
  exit
 exit
 nodes node_name #For example, session-data2
  k8s node-type worker
  k8s ssh-ip ipv4address
  k8s node-ip ipv4address
  k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-1 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-2 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-1 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-2 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-3 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-4 true
  exit
  k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
  exit
  k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
  exit
  vmware datastore datastore_name
  vmware host host_name
  vmware performance latency-sensitivity normal
  vmware performance memory-reservation false
  vmware performance cpu-reservation false
  vmware sizing ram-mb ram_size_in_mb
  vmware sizing cpus cpu_size
  vmware sizing disk-root-gb disk_root_size_in_gb
  vmware nics network_ID
  exit
exit
nodes node_name #For example, session-data3
  k8s node-type worker
  k8s ssh-ip ipv4address
  k8s node-ip ipv4address
  k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-3 true
```

```
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-4 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-5 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-6 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-7 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-8 true
  exit
  k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
  exit
  k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
  exit
  vmware datastore datastore_name
  vmware host host_name
  vmware performance latency-sensitivity normal
  vmware performance memory-reservation false
  vmware performance cpu-reservation false
  vmware sizing ram-mb ram_size_in_mb
  vmware sizing cpus cpu_size
  vmware sizing disk-root-gb disk_root_size_in_gb
  vmware nics network_ID
  exit
exit
nodes node_name #For example, session-data4
  k8s node-type worker
  k8s ssh-ip ipv4address
  k8s node-ip ipv4address
  k8s node-labels node_labels #For example, smi.cisco.com/cdl-ep true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-3 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-index-4 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-5 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-6 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-7 true
  exit
  k8s node-labelsnode_labels #For example, smi.cisco.com/cdl-slot-8 true
  exit
  k8s node-labelsnode_labels/node_type #For example, smi.cisco.com/node-type db
  exit
  k8s node-labelsnode_labels/vm_type #For example, smi.cisco.com/vm-type session
  exit
  vmware datastore datastore_name
  vmware host host_name
  vmware performance latency-sensitivity normal
```

```
      vmware performance memory-reservation false
      vmware performance cpu-reservation false
      vmware sizing ram-mb ram_size_in_mb
      vmware sizing cpus cpu_size
      vmware sizing disk-root-gb disk_root_size_in_gb
      vmware nics network_ID
      exit
   exit
exit
          # Virtual IPs
         virtual-ips <name> #Example: rxdiam

           vrrp-interface <interface_name>
           vrrp-router-id <router_id>

           ipv4-addresses <ipv4_address>
             mask <netmassk>
             broadcast <broadcast_ipv4_address>
             device <interface_name>
           exit
           # nodes associated with the virtual-ip
           hosts <node_name> #Example: smi-cluster-core-protocol1
             priority <priority_value>
           exit
           hosts <node_name> #Example: smi-cluster-core-protocol2
             priority <priority_value>
           exit
         exit
          # Secrets for product registry
         secrets docker-registry <secret_name>
           docker-server <server_name or docker_registry>
           docker-username <username>
           docker-password <password>
           docker-email <email>
           namespace <k8s_namespace> #Example: cee-voice
         exit
         ops-centers <app_name> <instance_name> #Example: cee data
           repository <artifactory_url>




           username <username>
           password <password>

           initial-boot-parameters use-volume-claims <true/false> #True to use
persistent volumes and vice versa
           initial-boot-parameters first-boot-password <password> #First boot
password for product opscenter
          initial-boot-parameters auto-deploy <true/false> #Auto deploys all the
 services of the product else deploys the opscenter only
           initial-boot-parameters single-node <true/false> #True for single node
 and false for multi node deployments
           initial-boot-parameters image-pull-secrets
```

```
<docker_registry_secrets_name>
          exit
        exit
```

Sample Cluster Manager AIO Configuration - OpenStack

The following is a sample configuration for a single node Cluster Manager on OpenStack environment:

```
 software cnf <software_version> #For example, cm-2020-02-0-i05
 url <repo_url>
 user <username>
 password <password>
 sha256 <sha256_hash>
exit
environments manual
 manual
exit
clusters <cluster_name> #For example, cndp-testbed-cm
 environment manual
 addons ingress bind-ip-address <IPv4address>
 addons cpu-partitioner enabled
 configuration allow-insecure-registry true
 node-defaults ssh-username <username>
 node-defaults ssh-connection-private-key
  "-----BEGIN OPENSSH PRIVATE KEY-----\n
 <SSH_private_key>
  -----END OPENSSH PRIVATE KEY-----\n"
 node-defaults initial-boot netplan ethernets <interface_name> #For example,
eno1
  dhcp4 false
  dhcp6 false
  gateway4 <IPv4address>
  nameservers search <nameserver>
  nameservers addresses <IPv4addresses>
 exit
 node-defaults initial-boot default-user <username>
 node-defaults initial-boot default-user-ssh-public-key
  "<SSH_Public_Key>"
 node-defaults initial-boot default-user-password #For example, Csco123#
 node-defaults os proxy https-proxy <proxy_server_url>
 node-defaults os proxy no-proxy <proxy_server_url/IPv4address>
 node-defaults os ntp enabled
 node-defaults os ntp servers <ntp_server>
 exit
 nodes control-plane
  ssh-ip <IPv4address>node-defaults netplan template
  type k8s
  k8s node-type control-plane
  k8s node-labels <node_labels/node_type>
  exit
 cluster-manager enabled
 cluster-manager repository-local <repo_name> #For example, cm-2020-02-0-i05
```

```
 cluster-manager netconf-ip <IPv4address>
 cluster-manager iso-download-ip <IPv4address>
 cluster-manager initial-boot-parameters first-boot-password <password> #For
 example, 'Csco123#'
exit
```

Cluster Manager Pods

A pod is a process that runs on your Kubernetes cluster. Pod encapsulates a granular unit that is known as a container. A pod contains one or multiple containers.

Kubernetes deploys one or multiple pods on a single node which can be a physical or virtual machine. Each pod has a discrete identity with an internal IP address and Port space. However, the containers within a pod can share the storage and network resources.

The following table lists the Cluster Manager (CM) pod names and their descriptions.

Table 11: CM Pods

Pod Name	Description
cluster-files-offline-smi-cluster-deployer	Hosts all the necessary software that is locally required for successfully provisioning the remote Kubernetes clusters or UPF clusters. This pod in part enables a complete offline orchestration of the remote clusters.
ops-center-smi-cluster-deployer	Deployer operations center that can take in the required config for baremetal and/or VM Kubernetes clusters and provision it. It also accepts software inputs to spawn the required network functions on the appropriate clusters with day 0 configuration.
squid-proxy	Squid is a caching and forwarding HTTP web proxy. It has wide variety of uses, including speeding up a web server by caching repeated requests, caching web, DNS and other lookups, and aiding security by filtering traffic.