IP SLAs Configuration Guide, Cisco IOS XE 17 (Cisco NCS 4200 Series)

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CHAPTER 1

Feature History

The following table lists the new and modified features supported in the IP SLAs Configuration Guide in Cisco IOS XE 17 releases, on Cisco NCS 4201 and Cisco NCS 4202 routers.

Feature	Description
Cisco IOS XE 17.13.1	
Out-of-order Packet Counter on the Cisco RSP3 Module	You can configure Out-of-order packet counter for FPGA-based SAT on the Cisco RSP3 module.
Cisco IOS XE Dublin 17.10.1	
SADT over VC when Access Interface is Down	You can perform Service Activation and Deactivation (SADT) over Virtual Circuit (VC) even when access interface is down.
Cisco IOS XE Bengaluru 17.5.1	
TWAMP Light	This feature enables you to configure a TWAMP Light session using the **`ip sla responder twamp-light test-session`** command on the Cisco RSP2 module.
Cisco IOS XE Bengaluru 17.4.1	
Configurable User-Defined and EMIX Packet Size	This feature allows you to configure user-defined and Enterprise traffic (EMIX) packet sizes. Use the following commands to configure user-defined and EMIX packet sizes: • **packet-size user-defined** *packet size* • **packet-size emix-sequence** *emix-sequence* [**u-value** *u-value value*]
SAT based support for configurable EMIX traffic pattern in FPGA	The support for EMIX packet size is enhanced. For EMIX traffic, packet sizes of 64, 128, 256, 512, 1024, 1280, 1518, Maximum Transmission Unit (MTU) and user-defined patterns are supported. These packet sizes are forwarded in ratio of 1:1:1:1:1.
Cisco IOS XE Amsterdam 17.3.1	

Feature	Description
Configurable Y.1564 Service Activation Frame Sizes and EMIX Support	Enterprise traffic (EMIX) packet size (default abceg pattern) is supported on both, Cisco ASR 900 RSP2 and RSP3 modules. For EMIX traffic, ITU-T Rec. Y.1564 packet sizes of 64, 128, 256, 1024, and 1518 bytes are supported. On the Cisco RSP3 module, it is supported in FPGA-based SADT.

CHAPTER 2

IP SLAs Overview

This module describes IP Service Level Agreements (SLAs). IP SLAs allows Cisco customers to analyze IP service levels for IP applications and services, to increase productivity, to lower operational costs, and to reduce the frequency of network outages. IP SLAs uses active traffic monitoring--the generation of traffic in a continuous, reliable, and predictable manner--for measuring network performance. Using IP SLAs, service provider customers can measure and provide service level agreements, and enterprise customers can verify service levels, verify outsourced service level agreements, and understand network performance. IP SLAs can perform network assessments, verify quality of service (QoS), ease the deployment of new services, and assist administrators with network troubleshooting. IP SLAs can be accessed using the Cisco software commands or Simple Network Management Protocol (SNMP) through the Cisco Round-Trip Time Monitor (RTTMON) and syslog Management Information Bases (MIBs).

Information About IP SLAs

IP SLAs Technology Overview

Cisco IP SLAs uses active traffic monitoring--the generation of traffic in a continuous, reliable, and predictable manner--for measuring network performance. IP SLAs sends data across the network to measure performance between multiple network locations or across multiple network paths. It simulates network data and IP services, and collects network performance information in real time. The information collected includes data about response time, one-way latency, jitter (interpacket delay variance), packet loss, voice quality scoring, network resource availability, application performance, and server response time. IP SLAs performs active monitoring by generating and analyzing traffic to measure performance either between Cisco devices or from a Cisco device to a remote IP device such as a network application server. Measurement statistics provided by the various IP SLAs operations can be used for troubleshooting, for problem analysis, and for designing network topologies.

Using IP SLAs, service provider customers can measure and provide service level agreements, and enterprise customers can verify service levels, verify outsourced service level agreements, and understand network performance for new or existing IP services and applications. IP SLAs uses unique service level assurance metrics and methodology to provide highly accurate, precise service level assurance measurements.

Depending on the specific IP SLAs operation, statistics of delay, packet loss, jitter, packet sequence, connectivity, path, server response time, and download time can be monitored within the Cisco device and stored in both CLI and SNMP MIBs. The packets have configurable IP and application layer options such as a source and destination IP address, User Datagram Protocol (UDP)/TCP port numbers, a type of service (ToS) byte (including Differentiated Services Code Point [DSCP] and IP Prefix bits), a Virtual Private Network (VPN) routing/forwarding instance (VRF), and a URL web address.

Being Layer-2 transport independent, IP SLAs can be configured end-to-end over disparate networks to best reflect the metrics that an end-user is likely to experience. Performance metrics collected by IP SLAs operations include the following:

- Delay (both round-trip and one-way)
- Jitter (directional)
- Packet loss (directional)
- Packet sequencing (packet ordering)
- Path (per hop)
- Connectivity (directional)
- Server or website download time
- Voice quality scores

Because IP SLAs is accessible using SNMP, it also can be used by performance monitoring applications like CiscoWorks Internetwork Performance Monitor (IPM) and other third-party Cisco partner performance management products. For details about network management products that use IP SLAs, see http://www.cisco.com/go/ipsla .

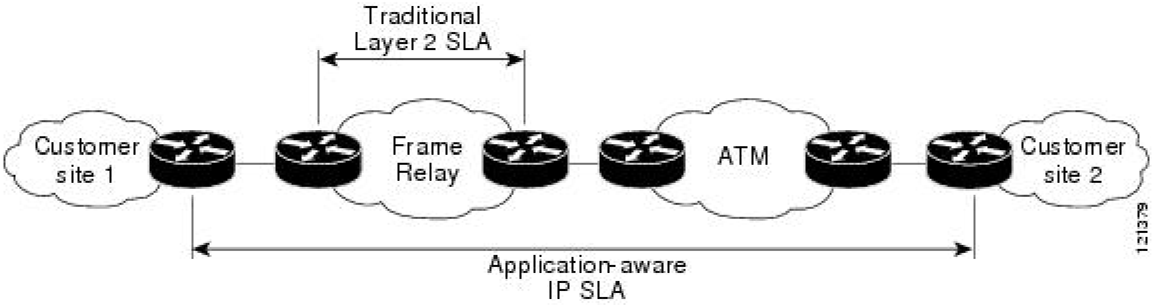
SNMP notifications based on the data gathered by an IP SLAs operation allow the router to receive alerts when performance drops below a specified level and when problems are corrected. IP SLAs uses the Cisco RTTMON MIB for interaction between external Network Management System (NMS) applications and the IP SLAs operations running on the Cisco devices. For a complete description of the object variables referenced by the IP SLAs feature, refer to the text of the CISCO-RTTMON-MIB.my file, available from the Cisco MIB website .

Service Level Agreements

Internet commerce has grown significantly in the past few years as the technology has advanced to provide faster, more reliable access to the Internet. Many companies now need online access and conduct most of their business online and any loss of service can affect the profitability of the company. Internet service providers (ISPs) and even internal IT departments now offer a defined level of service--a service level agreement--to provide their customers with a degree of predictability.

The latest performance requirements for business-critical applications, voice over IP (VoIP) networks, audio and visual conferencing, and VPNs are creating internal pressures on converged IP networks to become optimized for performance levels. Network administrators are increasingly required to support service level agreements that support application solutions. The figure below shows how IP SLAs has taken the traditional concept of Layer 2 service level agreements and applied a broader scope to support end-to-end performance measurement, including support of applications.

Figure 1: Scope of Traditional Service Level Agreement Versus IP SLAs



IP SLAs provides the following improvements over a traditional service level agreement:

- End-to-end measurements--The ability to measure performance from one end of the network to the other allows a broader reach and more accurate representation of the end-user experience.
- Sophistication--Statistics such as delay, jitter, packet sequence, Layer 3 connectivity, and path and download time that are broken down into bidirectional and round-trip numbers provide more data than just the bandwidth of a Layer 2 link.
- Ease of deployment--Leveraging the existing Cisco devices in a large network makes IP SLAs easier and cheaper to implement than the physical probes often required with traditional service level agreements.
- Application-aware monitoring--IP SLAs can simulate and measure performance statistics generated by applications running over Layer 3 through Layer 7. Traditional service level agreements can only measure Layer 2 performance.
- Pervasiveness--IP SLAs support exists in Cisco networking devices ranging from low-end to high-end devices and switches. This wide range of deployment gives IP SLAs more flexibility over traditional service level agreements.

When you know the performance expectations for different levels of traffic from the core of your network to the edge of your network, you can confidently build an end-to-end application-aware service level agreement.

Benefits of IP SLAs

- IP SLAs monitoring
  - Provides service level agreement monitoring, measurement, and verification.
- Network performance monitoring
  - Measures the jitter, latency, or packet loss in the network.
  - Provides continuous, reliable, and predictable measurements.
- IP service network health assessment
  - Verifies that the existing QoS is sufficient for new IP services.
- Edge-to-edge network availability monitoring

    - Provides proactive verification and connectivity testing of network resources (for example, indicates the network availability of a Network File System (NFS) server used to store business critical data from a remote site).

- Troubleshooting of network operation
    - Provides consistent, reliable measurement that immediately identifies problems and saves troubleshooting time.

- Voice over IP (VoIP) performance monitoring
- Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) performance monitoring and network verification

Restriction for IP SLAs

- With *SR_5_label_push* template, IP SLA DMM is not supported on RSP3 module.
- The maximum supported scale number of CFM and IP SLA over the port channel is only 500.

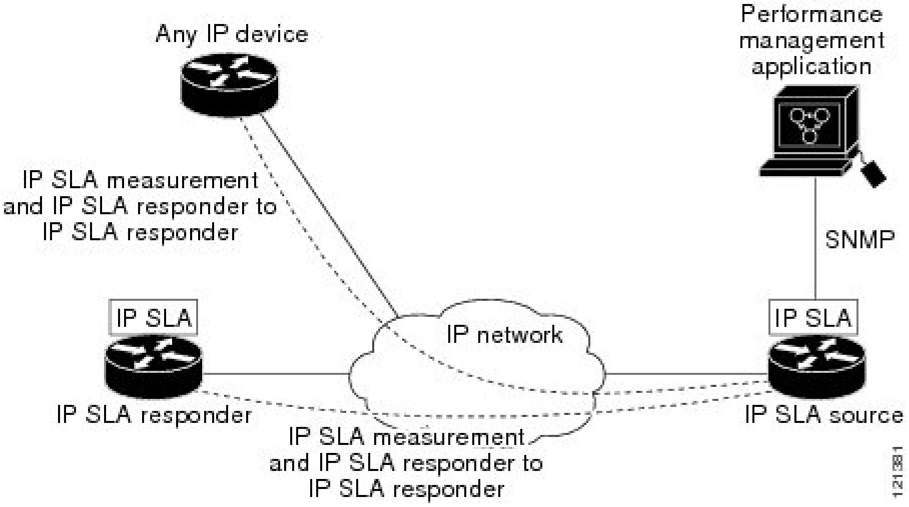
Network Performance Measurement Using IP SLAs

Using IP SLAs, a network engineer can monitor the performance between any area in the network: core, distribution, and edge. Monitoring can be done anytime, anywhere, without deploying a physical probe.

The IP SLAs Probe Enhancements feature is an application-aware synthetic operation agent that monitors network performance by measuring response time, network resource availability, application performance, jitter (interpacket delay variance), connect time, throughput, and packet loss. Performance can be measured between any Cisco device that supports this feature and any remote IP host (server), Cisco routing device, or mainframe host. Performance measurement statistics provided by this feature can be used for troubleshooting, for problem analysis, and for designing network topologies.

IP SLAs uses generated traffic to measure network performance between two networking devices. The figure below shows how IP SLAs starts when the IP SLAs device sends a generated packet to the destination device. After the destination device receives the packet, and depending on the type of IP SLAs operation, the device will respond with time-stamp information for the source to make the calculation on performance metrics. An IP SLAs operation performs a network measurement from the source device to a destination in the network using a specific protocol such as UDP.

Figure 2: IP SLAs Operations


Any IP device
Performance management application
IP SLA measurement and IP SLA responder to IP SLA responder
SNMP
IP SLA
IP network
IP SLA
IP SLA responder
IP SLA source
IP SLA measurement and IP SLA responder to IP SLA responder
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To implement IP SLAs network performance measurement you need to perform these tasks:

1. Enable the IP SLAs Responder, if appropriate.
2. Configure the required IP SLAs operation type.
3. Configure any options available for the specified IP SLAs operation type.
4. Configure threshold conditions, if required.
5. Schedule the operation to run, then let the operation run for a period of time to gather statistics.
6. Display and interpret the results of the operation using Cisco software commands or an NMS system with SNMP.

IP SLAs Responder and IP SLAs Control Protocol

The IP SLAs Responder is a component embedded in the destination Cisco routing device that allows the system to anticipate and respond to IP SLAs request packets. The IP SLAs Responder provides an enormous advantage with accurate measurements without the need for dedicated probes and additional statistics not available via standard ICMP-based measurements. The patented IP SLAs Control Protocol is used by the IP SLAs Responder providing a mechanism through which the responder can be notified on which port it should listen and respond. Only a Cisco device can be a source for a destination IP SLAs Responder.

The figure "IP SLAs Operations" in the "Network Performance Measurement Using IP SLAs" section shows where the IP SLAs Responder fits in relation to the IP network. The IP SLAs Responder listens on a specific port for control protocol messages sent by an IP SLAs operation. Upon receipt of the control message, the responder will enable the specified UDP or TCP port for the specified duration. During this time, the responder accepts the requests and responds to them. The responder disables the port after it responds to the IP SLAs packet, or when the specified time expires. For added security, MD5 authentication for control messages is available.

Enabling the IP SLAs Responder on the destination device is not required for all IP SLAs operations. For example, if services that are already provided by the destination device (such as Telnet or HTTP) are chosen, the IP SLAs Responder need not be enabled. For non-Cisco devices, the IP SLAs Responder cannot be configured and IP SLAs can send operational packets only to services native to those devices.

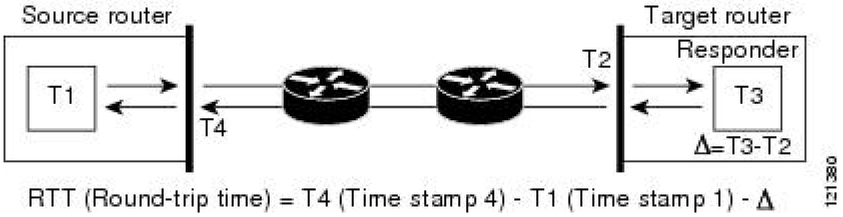
Response Time Computation for IP SLAs

Devices may take tens of milliseconds to process incoming packets, due to other high-priority processes. This delay affects the response times because the reply to test packets might be sitting on queue while waiting to be processed. In this situation, the response times would not accurately represent true network delays. IP SLAs minimizes these processing delays on the source device as well as on the target device (if IP SLAs Responder is being used), in order to determine true round-trip times. IP SLAs test packets use time stamping to minimize the processing delays.

When enabled, the IP SLAs Responder allows the target device to take two time stamps both when the packet arrives on the interface at interrupt level and again just as it is leaving, eliminating the processing time. At times of high network activity, an ICMP ping test often shows a long and inaccurate response time, while an IP SLAs test shows an accurate response time due to the time stamping on the responder.

The figure below demonstrates how the responder works. Four time stamps are taken to make the calculation for round-trip time. At the target device, with the responder functionality enabled time stamp 2 (TS2) is subtracted from time stamp 3 (TS3) to produce the time spent processing the test packet as represented by delta. This delta value is then subtracted from the overall round-trip time. Notice that the same principle is applied by IP SLAs on the source device where the incoming time stamp 4 (TS4) is also taken at the interrupt level to allow for greater accuracy.

Figure 3: IP SLAs Responder Time Stamping


Source router
T1
T4
Target router
T2
Responder
T3
Δ=T3-T2
RTT (Round-trip time) = T4 (Time stamp 4) - T1 (Time stamp 1) - Δ
121380

An additional benefit of the two time stamps at the target device is the ability to track one-way delay, jitter, and directional packet loss. Because much network behavior is asynchronous, it is critical to have these statistics. However, to capture one-way delay measurements the configuration of both the source device and target device with Network Time Protocol (NTP) is required. Both the source and target need to be synchronized to the same clock source. One-way jitter measurements do not require clock synchronization.

IP SLAs Operation Scheduling

After an IP SLAs operation has been configured, you must schedule the operation to begin capturing statistics and collecting error information. When scheduling an operation, it can start immediately or start at a certain month, day, and hour. There is a pending option to set the operation to start at a later time. The pending option is also an internal state of the operation visible through SNMP. The pending state is also used when an operation is a reaction (threshold) operation waiting to be triggered. You can schedule a single IP SLAs operation or a group of operations at one time.

Multioperations scheduling allows you to schedule multiple IP SLAs operations using a single Cisco software command or the CISCO RTTMON-MIB. This feature allows you to control the amount of IP SLAs monitoring traffic by scheduling the operations to run at evenly distributed times. This distribution of IP SLAs operations helps minimize the CPU utilization and thereby enhances the scalability of the network.

For more details about the IP SLAs multioperations scheduling functionality, see the “IP SLAs-Multioperation Scheduling of IP SLAs Operations” module of the *IP SLAs Configuration Guide* .

IP SLAs Operation Threshold Monitoring

To support successful service level agreement monitoring or to proactively measure network performance, threshold functionality becomes essential. Consistent reliable measurements immediately identify issues and can save troubleshooting time. To confidently roll out a service level agreement you need to have mechanisms that notify you immediately of any possible violation. IP SLAs can send SNMP traps that are triggered by events such as the following:

- Connection loss
- Timeout
- Round-trip time threshold
- Average jitter threshold
- One-way packet loss
- One-way jitter
- One-way mean opinion score (MOS)
- One-way latency

Alternately, an IP SLAs threshold violation can trigger another IP SLAs operation for further analysis. For example, the frequency could be increased or an ICMP path echo or ICMP path jitter operation could be initiated for troubleshooting.

Determining the type of threshold and the level to set can be complex, and it depends on the type of IP service being used in the network. For more details on using thresholds with IP SLAs operations, see the “IP SLAs-Proactive Threshold Monitoring of IP SLAs Operations” module of the *IP SLAs Configuration Guide* .

MPLS VPN Awareness

The IP SLAs MPLS VPN Awareness feature provides the capability to monitor IP service levels within Multiprotocol Label Switching (MPLS) Virtual Private Networks (VPNs). Using IP SLAs within MPLS VPNs allows service providers to plan, provision, and manage IP VPN services according to the service level agreement for a customer. IP SLAs operations can be configured for a specific VPN by specifying a VPN routing and forwarding (VRF) name.

History Statistics

IP SLAs maintains the following three types of history statistics:

- Aggregated statistics--By default, IP SLAs maintains two hours of aggregated statistics for each operation. Value from each operation cycle is aggregated with the previously available data within a given hour. The Enhanced History feature in IP SLAs allows for the aggregation interval to be shorter than an hour.

- Operation snapshot history--IP SLAs maintains a snapshot of data for each operation instance that matches a configurable filter, such as all, over threshold, or failures. The entire set of data is available and no aggregation takes place.
- Distribution statistics--IP SLAs maintains a frequency distribution over configurable intervals. Each time IP SLAs starts an operation, a new history bucket is created until the number of history buckets matches the specified size or the lifetime of the operation expires. By default, the history for an IP SLAs operation is not collected. If history is collected, each bucket contains one or more history entries from the operation. History buckets do not wrap.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
IP SLAs commands	*IP SLAs Command Reference*

Standards

Standards	Title
ITU-T G.711 u-law and G.711 a-law	Pulse code modulation (PCM) of voice frequencies
ITU-T G.729A	Reduced complexity 8 kbit/s CS-ACELP speech codec

MIBs

MIBs	MIBs Link
CISCO-RTTMON-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 3

Configuring IP SLAs for Metro-Ethernet

This module describes how to configure an IP Service Level Agreements (SLAs) for Metro-Ethernet to gather network performance metrics in service-provider Ethernet networks. Available statistical measurements for the IP SLAs Ethernet operation include round-trip time, jitter (interpacket delay variance), and packet loss.

Prerequisites for IP SLAs for Metro-Ethernet

It is recommended that the IEEE 802.1ag standard is supported on the destination devices in order to obtain complete error reporting and diagnostics information.

Restrictions for IP SLAs for Metro-Ethernet

- Memory and performance may be impacted for a given Ethernet CFM maintenance domain and Ethernet Virtual Circuit (EVC) or VLAN that has a large number of maintenance endpoints (MEPs).
- In case of PW redundancy, we need to have 2 different CFM/Y1731 sessions on active and backup PW. We cannot expect the same mpid and Y1731 session to work after PW switchover.
- Y1731 is not supported for port meps.
- CFM ans Y1731 is not supported for vpls cases, untagged EFP as well.

Information About IP SLAs for Metro-Ethernet

IP SLAs Ethernet Operation Basics

The IP SLAs for Metro-Ethernet integrates IP SLAs with the Ethernet Connectivity Fault Management (CFM) feature. Ethernet CFM is an end-to-end per-service-instance Ethernet-layer operation, administration, and management (OAM) protocol.

The IP SLAs for Metro-Ethernet feature provides the capability to gather statistical measurements by sending and receiving Ethernet data frames between Ethernet CFM maintenance endpoints (MEPs). The performance metrics for IP SLAs Ethernet operations are measured between a source MEP and a destination MEP. Unlike existing IP SLAs operations that provide performance metrics for the IP layer, the IP SLAs Ethernet operation provides performance metrics for Layer 2.

IP SLAs Ethernet operations may be configured using the command-line interface (CLI) or Simple Network Management Protocol (SNMP).

You can manually configure individual Ethernet ping or Ethernet jitter operations by specifying the destination MEP identification number, name of the maintenance domain, and EVC or VLAN identifier or port level option.

You also have the option to configure an IP SLAs auto Ethernet operation (ping or jitter) that will query the Ethernet CFM database for all maintenance endpoints in a given maintenance domain and EVC or VLAN. When an IP SLAs auto Ethernet operation is configured, individual Ethernet ping or Ethernet jitter operations are automatically created based on the MEPs that were discovered. A notification mechanism exists between the IP SLAs and Ethernet CFM subsystems to facilitate the automatic creation of Ethernet ping or Ethernet jitter operations for applicable MEPs that are added to a given maintenance domain and EVC or VLAN while an auto Ethernet operation is running.

The IP SLAs for Metro-Ethernet feature supports multioperation scheduling of IP SLAs operations and proactive threshold violation monitoring through SNMP trap notifications and syslog messages.

Statistics Measured by the IP SLAs Ethernet Operation

The network performance metrics supported by the IP SLAs Ethernet operation is similar to the metrics supported by existing IP SLAs operations. The statistical measurements supported by the IP SLAs Ethernet jitter operation include the following:

- Round-trip time latency
- Unprocessed packets
- Packet loss (source-to-destination and destination-to-source)
- Out-of-sequence, tail-dropped, and late packets

How to Configure IP SLAs for Metro-Ethernet

Note There is no need to configure an IP SLAs responder on the destination device.

Configuring an IP SLAs Auto Ethernet Operation with Endpoint Discovery on the Source Device

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla ethernet-monitor** *operation-number* **Example:** `Device(config)# ip sla ethernet-monitor 1`	Begins configuration for an IP SLAs auto Ethernet operation and enters IP SLA Ethernet monitor configuration mode.
Step 4	**type echo domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*} [**exclude-mpids** *mp-ids*] **Example:** `Device(config-ip-sla-ethernet-monitor)# type echo domain testdomain vlan 34`	• **domain** *domain-name*—Specify the name of the created domain. • **vlan***vlan-id*—Enter the service provider VLAN ID or IDs as a VLAN-ID (1 to 4094), a range of VLAN-IDs separated by a hyphen, or a series of VLAN IDs separated by comma. • **exclude-mpids***mp-ids*—Enter a maintenance end point identifier (mpid). The identifier must be unique for each VLAN (service instance). The range is 1 to 8191. For Echo operations only: Configures an auto Ethernet operation for Ethernet ping operations.

	Command or Action	Purpose
		Note Depending on your release, the **evc** *evc-id* keyword and argument combination may not be available for this command.
Step 5	**cos** *cos-value* **Example:** `Device(config-ip-sla-ethernet-params)# cos 2`	(Optional) Sets the class of service for an IP SLAs Ethernet operation.
Step 6	**owner** *owner-id* **Example:** `Device(config-ip-sla-ethernet-params)# owner admin`	(Optional) Configures the Simple Network Management Protocol (SNMP) owner of an IP SLAs operation.
Step 7	**request-data-size** *bytes* **Example:** `Device(config-ip-sla-ethernet-params)# request-data-size 64`	(Optional) Sets the padding size for the data frame of an IP SLAs Ethernet operation. • The default value for IP SLAs Ethernet ping operations is 66 bytes. • The default value for IP SLAs Ethernet jitter operations is 51 bytes.
Step 8	**tag** *text* **Example:** `Device(config-ip-sla-ethernet-params)# tag TelnetPollSever1`	(Optional) Creates a user-specified identifier for an IP SLAs operation.
Step 9	**threshold** *milliseconds* **Example:** `Device(config-ip-sla-ethernet-params)# threshold 10000`	(Optional) Sets the upper threshold value for calculating network monitoring statistics created by an IP SLAs operation.
Step 10	**timeout** *milliseconds* **Example:** `Device(config-ip-sla-ethernet-params)# timeout 10000`	(Optional) Sets the amount of time an IP SLAs operation waits for a response from its request packet.

Step 11	**end**
	Example:
	`Device(config-ip-sla-ethernet-params)# end`
		Exits to privileged EXEC configuration mode.

	Command or Action	Purpose
Step 12	**show ip sla ethernet-monitor configuration** [*operation-number*] **Example:** `Device# show ip sla ethernet-monitor configuration 1`	(Optional) Displays configuration settings for all IP SLAs auto Ethernet operations or a specified auto Ethernet operation.

What to do next

To add proactive threshold conditions and reactive triggering for generating traps, or for starting another operation, to an IP SLAs operation, see the "Configuring Proactive Threshold Monitoring" section.

Manually Configuring an IP SLAs Ethernet Ping or Jitter Operation on the Source Device

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *operation-number* **Example:** `Device(config)# ip sla 1`	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

Step 4	**ethernet echo mpid** *mp-id* **domain** *domain-name* {**evc** *evc-id* | **port** | **vlan** *vlan-id*}
	Example:
	`Device(config-ip-sla)# ethernet echo mpid 23 domain testdomain vlan 34`
		For a ping operation only: Configures the IP SLAs operation as an Ethernet ping operation and enters Ethernet echo configuration mode.
		Note Depending on your release, the **evc** evc-id keyword and argument combination may not be available for this command.

	Command or Action	Purpose
Step 5	**ethernet jitter mpid** *mp-id* **domain** *domain-name* {**evc** *evc-id* | **port** | **vlan** *vlan-id*} [**interval** *interframe-interval*] [**num-frames** *frames-number*] **Example:** `Device(config-ip-sla)# ethernet jitter mpid 23 domain testdomain evc testevc interval 20 num-frames 30`	For a jitter operation only: Configures the IP SLAs operation as an Ethernet jitter operation and enters Ethernet jitter configuration mode. **Note** Depending on your release, the **evc** evc-id keyword and argument combination may not be available for this command.
Step 6	**cos** *cos-value* **Example:** `Device(config-ip-sla-ethernet-echo)# cos 2`	(Optional) Sets the class of service for an IP SLAs Ethernet operation. **Note** For this and the remaining steps, the configuration mode shown in the example is for configuring an Ethernet echo operation. However, the commands are the same in the Ethernet jitter configuration mode.
Step 7	**frequency** *seconds* **Example:** `Device(config-ip-sla-ethernet-echo)# frequency 30`	(Optional) Sets the rate at which a specified IP SLAs operation repeats.
Step 8	**history** *history-parameter* **Example:** `Device(config-ip-sla-ethernet-echo)# history hours-of-statistics-kept 3`	(Optional) Specifies the parameters used for gathering statistical history information for an IP SLAs operation.
Step 9	**owner** *owner-id* **Example:** `Device(config-ip-sla-ethernet-echo)# owner admin`	(Optional) Configures the Simple Network Management Protocol (SNMP) owner of an IP SLAs operation.
Step 10	**request-data-size** *bytes* **Example:** `Device(config-ip-sla-ethernet-echo)# request-data-size 64`	(Optional) Sets the padding size for the data frame of an IP SLAs Ethernet operation. The default value for IP SLAs Ethernet ping operations is 66 bytes. The default value for IP SLAs Ethernet jitter operations is 51 bytes.
Step 11	**tag** *text* **Example:**	(Optional) Creates a user-specified identifier for an IP SLAs operation.

	Command or Action	Purpose
	`Device(config-ip-sla-ethernet-echo)# tag TelnetPollSever1`	
Step 12	**threshold** *milliseconds* **Example:** `Device(config-ip-sla-ethernet-echo)# threshold 10000`	(Optional) Sets the upper threshold value for calculating network monitoring statistics created by an IP SLAs operation.
Step 13	**timeout** *milliseconds* **Example:** `Device(config-ip-sla-ethernet-echo)# timeout 10000`	(Optional) Sets the amount of time an IP SLAs operation waits for a response from its request packet.

Step 14	**end**
	Example:
	`Device(config-ip-sla-ethernet-echo)# end`
		Exits to privileged EXEC mode.

Step 15	**show ip sla configuration** [*operation-number*] **Example:** `Device# show ip sla configuration 1`	(Optional) Displays configuration values including all defaults for all IP SLAs operations or a specified operation.
Step 16	**show ip sla application** **Example:** `Device# show ip sla application`	(Optional) Displays global information about supported IP SLAs features.

What to do next

To add proactive threshold conditions and reactive triggering for generating traps, or for starting another operation, to an IP SLAs operation, see the "Configuring Proactive Threshold Monitoring" section.

Scheduling IP SLAs Operations

Note

- All IP SLAs operations to be scheduled must be already configured.
- The frequency of all operations scheduled in an operation group must be the same unless you are enabling the random scheduler option for a multioperation scheduler.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. - Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	Do one of the following:
	- **ip sla ethernet-monitor schedule** *operation-number* **schedule-period** *seconds* [**frequency** [*seconds*]] [**start-time** {**after** *hh* **:** *mm* **:** *ss* | *hh* **:** *mm*[**:** *ss*] [*month day* | *day month*] | **now** | **pending**}]
	- **ip sla schedule** *operation-number* [**life** {**forever** | *seconds*}] [**start-time** {*hh* **:** *mm*[**:** *ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh* **:** *mm* **:** *ss*}] [**ageout** *seconds*] [**recurring**]
	- **ip sla group schedule** *group-operation-number operation-id-numbers* **schedule-period** *schedule-period-range* [**ageout** *seconds*] **frequency** *group-operation-frequency* [**life**{**forever** | *seconds*}] [**start-time**{*hh:mm*[*:ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh:mm:ss*}]
	Example:
	`Device(config)# ip sla ethernet-monitor schedule 10 schedule-period 60 start-time now`
	`Device(config)# ip sla schedule 1 start-time now life forever`
	`Device(config)# ip sla group schedule 1 3,4,6-9`
		- The first example shows how to configure scheduling parameters for an IP SLAs auto Ethernet operation.
		- The second example shows how to configure the scheduling parameters for an individual IP SLAs operation.
		- The third example shows how to specifiy an IP SLAs operation group number and range of operation numbers to be scheduled for a multioperation scheduler.

Step 4	**exit** **Example:** `Device(config)# exit`	Exits to the privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show ip sla group schedule** **Example:** `Device# show ip sla group schedule`	(Optional) Displays the IP SLAs group schedule details.
Step 6	**show ip sla configuration** **Example:** `Device# show ip sla configuration`	(Optional) Displays the IP SLAs configuration details.

Troubleshooting Tips

Use the **debug ip sla trace** and **debug ip sla error** commands to help troubleshoot issues with an individual IP SLAs Ethernet ping or Ethernet jitter operation. Use the **debug ip sla ethernet-monitor** command to help troubleshoot issues with an IP SLAs auto Ethernet operation.

What to Do Next

To add proactive threshold conditions and reactive triggering for generating traps (or for starting another operation) to an IP SLAs operation, see the "Configuring Proactive Threshold Monitoring" section.

operation)

To display and interpret the results of an IP SLAs operation, use the **show ip sla statistics** command. Check the output for fields that correspond to criteria in your service level agreement to determine whether the service metrics are acceptable.

Configuration Examples for IP SLAs for Metro-Ethernet

Example IP SLAs Auto Ethernet Operation with Endpoint Discovery

The following examples shows the operation parameters, proactive threshold monitoring, and scheduling options for an IP SLAs auto Ethernet operation. In Configuration A, operation 10 is configured to automatically create IP SLAs Ethernet ping operations for all the discovered maintenance endpoints in the domain named testdomain and VLAN identification number 34. In Configuration B, operation 20 is configured to automatically create IP SLAs Ethernet ping operations for all the discovered maintenance endpoints in the domain named testdomain and EVC identified as testevc. In both configurations, the proactive threshold monitoring configuration specifies that when three consecutive connection loss events occur, an SNMP trap notification should be sent. The schedule period for operation 10 and operation 20 is 60 seconds, and both operations are scheduled to start immediately.

Configuration A

```
ip sla ethernet-monitor 10
 type echo domain testdomain vlan 34
!
ip sla ethernet-monitor reaction-configuration 10 react connectionLoss threshold-type
```

```
consecutive 3 action-type trapOnly
!
ip sla ethernet-monitor schedule 10 schedule-period 60 start-time now
```

Configuration B

```
ip sla ethernet-monitor 20
 type echo domain testdomain evc testevc
!
ip sla ethernet-monitor reaction-configuration 20 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
!
ip sla ethernet-monitor schedule 20 schedule-period 60 start-time now
```

Example Individual IP SLAs Ethernet Ping Operation

The following example show the configuration for an IP SLAs Ethernet ping operation. In Configuration C, the maintenance endpoint identification number is 23, the maintenance domain name is testdomain, and the VLAN identification number is 34. In Configuration D, the maintenance endpoint identification number is 23, the maintenance domain name is testdomain, and the EVC is identified as testevc. In both configurations, the proactive threshold monitoring configuration specifies that when three consecutive connection loss events occur, an SNMP trap notification should be sent. Operation 1 and operation 5 are scheduled to start immediately.

Configuration C

```
ip sla 1
 ethernet echo mpid 23 domain testdomain vlan 34
!
ip sla reaction-configuration 1 react connectionLoss threshold-type consecutive 3 action-type
 trapOnly
!
ip sla schedule 1 start-time now
```

Configuration D

```
ip sla 5
 ethernet echo mpid 23 domain testdomain evc testevc
!
ip sla reaction-configuration 5 react connectionLoss threshold-type consecutive 3 action-type
 trapOnly
!
ip sla schedule 5 start-time now
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference, All Releases

Related Topic	Document Title
Cisco IOS IP SLAs: general information	"Cisco IOS IP SLAs Overview" module of the *Cisco IOS IP SLAs Configuration Guide*.
Multioperation scheduling for IP SLAs	"Configuring Multioperation Scheduling of IP SLAs Operations" module of the *Cisco IOS P SLAs Configuration Guide*
Proactive threshold monitoring for IP SLAs	"Configuring Proactive Threshold Monitoring of IP SLAs Operations" module of the *Cisco IOS IP SLAs Configuration Guide*

MIBs

MIBs	MIBs Link
CISCO-RTTMON-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 4

Configuring IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations

This module describes how to configure an IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) operation to gather the following performance measurements for Ethernet service:

- Ethernet Delay
- Ethernet Delay Variation
- Ethernet Frame Loss Ratio

Prerequisites for ITU-T Y.1731 Operations

IEEE-compliant Connectivity Fault Management (CFM) must be configured and enabled for Y.1731 performance monitoring to function.

Note Y1731 is supported on Port Channel interfaces.

Restrictions for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731)

- SNMP is not supported for reporting threshold events or collecting performance statistics for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) operations.

  SNMP is partially supported; the results for DM/LM can be polled for some attributes. However MIB support for all parameters is not supported.

- Continuity Check Message (CCM)-based dual-ended Ethernet frame loss operations are not supported.

- In a single-ended Ethernet operation, performance measurement statistics can be retrieved only at the device on which the sender Ethernet Connectivity Fault Management (CFM) Maintenance End Point (MEP) is configured.

- To avoid losing the CoS value configured on the frames, do not configure **rewrite** on the EFPs throughout the Layer2 circuit. The CoS value is preserved, if the Y.1731 frames are marked with specific CoS value.

- CFM over cross-connect on the routers works only if the **control-word** is configured. To start DM timestamping, switch ON the control-word if the remote end is not switched ON.

Note RSP3 module does not support Y1731 DMM when all the below configurations are enabled together on the router:

  - Two VLAN tag configurations
  - Two or more MPLS tag configurations
  - the **control-word** configurations

- To avoid errors in RX and TX timestamping, ensure to have Y1731 sender as primary PTP, and the Y1731 responder as subordinate PTP.

- Reconfigure IP SLA Y1731 while doing online insertion removal (OIR) of IM or router reload because local MEP is deleted during the course.

- A delay may be observed after issuing the **ip sla schedule** command after a reload of the router is performed, to populate with the Y.1731 PM measurements.

- The dot1q tag contains class of service (CoS) bits, which are used by IPSLA Y.1731 PM session to test delay or loss of packets with a specific CoS. This CoS cannot be a non-zero value when using EPM over untagged EFPs.

How to Configure IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations

Configuring a Dual-Ended Ethernet Delay or Delay Variation Operation

Perform the tasks for configuring a dual-ended operation in the order presented.

Note To remove the MEP configurations in an already-configured dual-ended operation, always remove the MEPs in the reverse order in which they were configured. That is, remove the scheduler first, then the threshold monitoring configuration, and then the sender MEP configuration on the source device before removing the scheduler, proactive threshold monitoring, and receiver MEP configuration on the destination device.

Configuring a Receiver MEP on the Destination Device

Before you begin

Time synchronization is required between the source and destination devices in order to provide accurate one-way delay (latency) or delay-variation measurements. Configure either Precision Time Protocol (PTP) or Network Time Protocol (NTP) on both the source and destination devices.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *operation-number* **Example:** `Router(config-term)# ip sla 501`	Begins configuring an IP SLAs operation and enters IP SLA configuration mode.

Step 4	**ethernet y1731 delay receive 1DM domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*} **cos** *cos* {**mpid** *source-mp-id* | **mac-address** *source-address*}
	Example:
	`Router(config-ip-sla)# ethernet y1731`
	`delay receive 1DM domain xxx evc yyy`
	`cos 3 mpid 101`
		Begins configuring the receiver on the responder and enters IP SLA Y.1731 delay configuration mode.
		• The *source-mp-id* or *source-address* configured by this command corresponds to that of the MEP being configured.
		Note The session with mac-address will not be inactivated when there is CFM error.

Step 5	**aggregate interval** *seconds*
	Example:
	`Router(config-sla-y1731-delay)#`
	`aggregate interval 900`
		(Optional) Configures the length of time during which the performance measurements are conducted and the results stored.

Step 6	**distribution** {**delay** | **delay-variation**} **one-way** *number-of-bins* *boundary*[**,...,***boundary*] **Example:**	(Optional) Specifies measurement type and configures bins for statistics distributions kept. Allowed number of bin upper boundaries : 9. This is applicable only for NCS 4202.

	Command or Action	Purpose
	`Router(config-sla-y1731-delay)# distribution delay-variation one-way 5 5000,10000,15000,20000,-1`	
Step 7	**frame offset** *offset-value* **Example:** `Router(config-sla-y1731-delay)# frame offset 1`	(Optional) Sets the value for calculating delay variation rates.
Step 8	**history interval** *intervals-stored* **Example:** `Router(config-sla-y1731-delay)# history interval 2`	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.
Step 9	**max-delay** *milliseconds* **Example:** `Router(config-sla-y1731-delay)# max-delay 5000`	(Optional) Sets the amount of time an MEP waits for a frame.
Step 10	**owner** *owner-id* **Example:** `Router(config-sla-y1731-delay)# owner admin`	(Optional) Configures the owner of an IP SLAs operation.

Step 11	**end**
	Example:
	`Router(config-sla-y1731-delay)# end`
		Exits to privileged EXEC mode.

What to do next

To add proactive threshold conditions and reactive triggering for generating traps, see the "Configuring Proactive Threshold Monitoring" module of the *IP SLAs Configuration Guide*.

When you are finished configuring proactive threshold monitoring for this MEP, see the "Scheduling IP SLAs Operations" section to schedule the operation.

Configuring the Sender MEP on the Source Router

Before you begin

- Time synchronization is required between the source and destination devices in order to provide accurate one-way delay (latency) or delay-variation measurements. Configure either Precision Time Protocol (PTP) or Network Time Protocol (NTP) on both the source and destination devices.
- The receiver MEP must be configured, including proacive threshold monitoring, and scheduled before you configure the sender MEP.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip sla operation-number** **Example:** `Router(config)# ip sla 500`	Begins configuring an IP SLAs operation and enters IP SLA configuration mode.

Step 4	**ethernet y1731 delay 1DM domain domain-name** {**evc** *evc-id* | **vlan** *vlan-id*} {**mpid** *target-mp-id* | **mac-address** *target-address*} **cos** *cos* {**source** {**mpid** *source-mp-id* | **mac-address** *source-address*}}
	Example:
	`Router(config-ip-sla)# ethernet y1731 delay 1DM domain xxx evc yyy mpid 101 cos 3 source mpid 100`
		Begins configuring a dual-ended Ethernet delay operation and enters IP SLA Y.1731 delay configuration mode.
		Note The session with mac-address will not be inactivated when there is CFM error.

Step 5	**aggregate interval** *seconds* **Example:** `Router(config-sla-y1731-delay)# aggregate interval 900`	(Optional) Configures the length of time during which the performance measurements are conducted and the results stored.

	Command or Action	Purpose
Step 6	**frame interval** *milliseconds* **Example:** `Router(config-sla-y1731-delay)# frame interval 100`	(Optional) Sets the gap between successive frames.
Step 7	**frame size** *bytes* **Example:** `Router(config-sla-y1731-delay)# frame size 64`	(Optional) Sets the padding size for frames.
Step 8	**history interval** *intervals-stored* **Example:** `Router(config-sla-y1731-delay)# history interval 2`	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.
Step 9	**owner** *owner-id* **Example:** `Router(config-sla-y1731-delay)# owner admin`	(Optional) Configures the owner of an IP SLAs operation.

Step 10	**end**
	Example:
	`Router(config-sla-y1731-delay)# end`
		Exits to privileged EXEC mode.

What to do next

To add proactive threshold conditions and reactive triggering for generating traps, see the "Configuring Proactive Threshold Monitoring" module of the *IP SLAs Configuration Guide*.

When you are finished configuring proactive threshold monitoring for this MEP, see the "Scheduling IP SLAs Operations" section to schedule the operation.

Configuring a Sender MEP for a Single-Ended Ethernet Delay or Delay Variation Operation

Perform this task to configure a sender MEP on the source device.

Before you begin

Time synchronization is required between the source and destination devices in order to provide accurate one-way delay (latency) or delay-variation measurements. Configure either Precision Time Protocol (PTP) or Network Time Protocol (NTP) on both the source and destination devices.

Note To display information about remote (target) MEPs on destination devices, use the **show ethernet cfm maintenance-points remote** command.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *operation-number* **Example:** `Device(config-term)# ip sla 10`	Begins configuring an IP SLAs operation and enters IP SLA configuration mode.

Step 4	**ethernet y1731 delay** {**DMM** | **DMMv1**} [**burst**] **domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*} {**mpid** *target-mp-id* | **mac-address** *target-address*} **cos** *cos* {**source** {**mpid** *source-mp-id* | **mac-address** *source-address*}}
	Example:
	`Device(config-ip-sla)# ethernet y1731 delay dmm domain xxx evc yyy mpid 101 cos 4 source mpid 100`
		Begins configuring a single-ended Ethernet delay operation and enters IP SLA Y.1731 delay configuration mode.
		• To configure concurrent operations, use the **DMMv1** keyword with this command. Repeat the preceding two steps to each concurrent operation, to be added to a single IP SLA operation number. Concurrent operations are supported for a given EVC, CoS, and remote MEP combination, or for multiple MEPs for a given multipoint EVC.
		Note The session with mac-address will not be inactivated when there is CFM error.

	Command or Action	Purpose
Step 5	**clock sync** **Example:** `Device(config-sla-y1731-delay)# clock sync`	(Optional) Indicates that the end points are synchronized and thus allows the operation to calculate one-way delay measurements.
Step 6	**aggregate interval** *seconds* **Example:** `Device(config-sla-y1731-delay)# aggregate interval 900`	(Optional) Configures the length of time during which the performance measurements are conducted and the results stored. **Note** In the case of an interface or MEP flap, the Y.1731 session recovery takes the default aggregate interval value of 900 seconds. Decrease this value for a faster recovery of the session.
Step 7	**distribution** {**delay** | **delay-variation**} **one-way** *number-of-bins* *boundary*[**,...,***boundary*] **Example:** `Device(config-sla-y1731-delay)# distribution delay-variation one-way 5 5000, 10000,15000,20000,-1`	(Optional) Specifies measurement type and configures bins for statistics distributions kept. Allowed number of bin upper boundaries : 9. This is applicable only for NCS 4202.
Step 8	**frame interval** *milliseconds* **Example:** `Device(config-sla-y1731-delay)# frame interval 100`	(Optional) Sets the gap between successive frames.
Step 9	**frame offset** *offset-value* **Example:** `Device(config-sla-y1731-delay)# frame offset 1`	(Optional) Sets value for calculating delay variation values.
Step 10	**frame size** *bytes* **Example:** `Device(config-sla-y1731-delay)# frame size 32`	(Optional) Configures padding size for frames.

	Command or Action	Purpose
Step 11	**history interval** *intervals-stored* **Example:** `Device(config-sla-y1731-delay)# history interval 2`	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.
Step 12	**max-delay** *milliseconds* **Example:** `Device(config-sla-y1731-delay)# max-delay 5000`	(Optional) Sets the amount of time an MEP waits for a frame.
Step 13	**owner** *owner-id* **Example:** `Device(config-sla-y1731-delay)# owner admin`	(Optional) Configures the owner of an IP SLAs operation.

Step 14	**end**
	Example:
	`Device(config-sla-y1731-delay)# end`
		Exits to privileged EXEC mode.

What to do next

To add proactive threshold conditions and reactive triggering for generating traps, see the "Configuring Proactive Threshold Monitoring" module of the *IP SLAs Configuration Guide*.

When you are finished configuring proactive threshold monitoring for this operation, see the "Scheduling IP SLAs Operations" section to schedule the operation.

Configuring a Sender MEP for a Single-Ended Ethernet Frame Loss Ratio Operation

Note To display information about remote (target) MEPs on destination devices, use the **show ethernet cfm maintenance-points remote** command.

Perform this task to configure a sender MEP on the source device.

Before you begin

- Class of Service (CoS)-level monitoring must be enabled on MEPs associated to the Ethernet frame loss operation by using the **monitor loss counter** command on the devices at both ends of the operation. See the *Cisco IOS Carrier Ethernet Command Reference* for command information. See the "Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations" section for configuration information.

Note Cisco IOS Y.1731 implementation allows monitoring of frame loss for frames on an EVC regardless of the CoS value (any CoS or Aggregate CoS cases). See the "Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations" section for configuration information.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *operation-number* **Example:** `Device(config-term)# ip sla 11`	Begins configuring an IP SLAs operation and enters IP SLA configuration mode.

Step 4	**ethernet y1731 loss** {**LMM** | **SLM**} [**burst**] **domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*} {**mpid** *target-mp-id* | **mac-address** *target-address*} **CoS** *CoS* {**source** {**mpid** *source-mp-id* | **mac-address** *source-address*}}
	Example:
	`Device(config-ip-sla)# ethernet y1731 loss LMM domain xxx vlan 12 mpid 34 CoS 4 source mpid 23`
		Begins configuring a single-ended Ethernet frame loss ratio operation and enters IP SLA Y.1731 loss configuration mode.
		• To configure concurrent operations, use the **SLM** keyword with this command. Repeat the preceding two steps to configure each concurrent operation to be added to a single IP SLA operation number. Concurrent operations are supported for a given EVC, CoS, and remote-MEP combination, or for multiple MEPs for a given multipoint EVC.
		Note The session with mac-address will not be inactivated when there is CFM error.

	Command or Action	Purpose
Step 5	**aggregate interval** *seconds* **Example:** `Device(config-sla-y1731-loss)# aggregate interval 900`	(Optional) Configures the length of time during which performance measurements are conducted and the results stored.

Step 6	**availability algorithm** {**sliding-window** | **static-window**}
	Example:
	`Device(config-sla-y1731-loss)# availability algorithm static-window`
		(Optional) Specifies availability algorithm used.

Step 7	**frame consecutive** *value* **Example:** `Device(config-sla-y1731-loss)# frame consecutive 10`	(Optional) Specifies number of consecutive measurements to be used to determine availability or unavailability status.
Step 8	**frame interval** *milliseconds* **Example:** `Device(config-sla-y1731-loss)# frame interval 100`	(Optional) Sets the gap between successive frames.
Step 9	**history interval** *intervals-stored* **Example:** `Device(config-sla-y1731-loss)# history interval 2`	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.
Step 10	**owner** *owner-id* **Example:** `Device(config-sla-y1731-delay)# owner admin`	(Optional) Configures the owner of an IP SLAs operation.
Step 11	**exit** **Example:** `Device(config-sla-y1731-delay)# exit`	Exits to IP SLA configuration mode.

	Command or Action	Purpose
Step 12	**exit** **Example:** `Device(config-ip-sla)# exit`	Exits to global configuration mode.
Step 13	**exit** **Example:** `Device(config)# exit`	Exits to privileged EXEC mode.

What to do next

When you are finished configuring this MEP, see the "Scheduling IP SLAs Operations" section to schedule the operation.

Scheduling IP SLAs Operations

Before you begin

- All IP Service Level Agreements (SLAs) operations to be scheduled must be already configured.
- The frequency of all operations scheduled in a multioperation group must be the same.
- The list of one or more operation ID numbers to be added to a multioperation group must be limited to a maximum of 125 characters in length, including commas (,).

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	Enter one of the following commands: • **ip sla schedule** *operation-number* [**life** {**forever** | *seconds*}] [**start-time** {[*hh***:***mm***:***ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh***:***mm***:***ss*}] [**ageout** *seconds*] [**recurring**]	• Configures the scheduling parameters for an individual IP SLAs operation. • Specifies an IP SLAs operation group number and the range of operation numbers for a multioperation scheduler.

<table>
<tr><th></th><th>Command or Action</th><th>Purpose</th></tr>
<tr><td></td><td>• <b>ip sla group schedule</b> <i>group-operation-number</i> <i>operation-id-numbers</i> {<b>schedule-period</b> <i>schedule-period-range</i> | <b>schedule-together</b>} [<b>ageout</b> <i>seconds</i>] <b>frequency</b> <i>group-operation-frequency</i> [<b>life</b> {<b>forever</b> | <i>seconds</i>}] [<b>start-time</b> {<i>hh</i><b>:</b><i>mm</i> [<b>:</b><i>ss</i>] [<i>month day</i> | <i>day month</i>] | <b>pending</b> | <b>now</b> | <b>after</b> <i>hh</i><b>:</b><i>mm</i> [<b>:</b><i>ss</i>]}]
<b>Example:</b>
<code>Device(config)# ip sla schedule 10 life forever start-time now</code>
<code>Device(config)# ip sla group schedule 10 schedule-period frequency</code>
<code>Device(config)# ip sla group schedule 1 3,4,6-9 life forever start-time now</code>
<code>Device(config)# ip sla schedule 1 3,4,6-9 schedule-period 50 frequency range 80-100</code></td><td></td></tr>
<tr><td><b>Step 4</b></td><td><b>end</b>
<b>Example:</b>
<code>Device(config)# end</code></td><td>Exits global configuration mode and returns to privileged EXEC mode.</td></tr>
<tr><td><b>Step 5</b></td><td><b>show ip sla group schedule</b>
<b>Example:</b>
<code>Device# show ip sla group schedule</code></td><td>(Optional) Displays IP SLAs group schedule details.</td></tr>
<tr><td><b>Step 6</b></td><td><b>show ip sla configuration</b>
<b>Example:</b>
<code>Device# show ip sla configuration</code></td><td>(Optional) Displays IP SLAs configuration details.</td></tr>
</table>

Enabling NTP Time of Day Synchronization

Perform additional NTP Time Of Day synchronization configuration when NTP is chosen for time synchronization for one-way delay or delay-variation measurements on source and destination devices.

Note PTP should *not* be configured when NTP Time Of Day synchronization is used as they are mutually-exclusive configuration options for time synchronization.

For information on configuring NTP, see Configuring NTP section in Cisco IOS Network Management Configuration Guide.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**platfrom time-source ntp** **Example:** `Router(config)# platform time-source ntp`	Initiates Time of Day (ToD) synchronization on the ethernet ports.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits the configuration.

Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations

Example: Dual-Ended Ethernet Delay Operation

The following sample output shows the configuration, including default values, of a receiver MEP on the responder device for a dual-ended Ethernet delay or delay variation operation:

```
Device# show ip sla configuration 501

IP SLAs Infrastructure Engine-III
Entry number: 501
Owner: admin
Tag:
Operation timeout (milliseconds): 5000
Ethernet Y1731 Delay Operation
Frame Type: 1DM
Domain: xxx
ReceiveOnly: TRUE
Evc: yyy
Local Mpid: 101
CoS: 3
   Max Delay: 5000
Threshold (milliseconds): 5000
.
.
```

```
.
Statistics Parameters
  Aggregation Period: 900
  Frame offset: 1
  Distribution Delay One-Way:
   Number of Bins 10
   Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
  Distribution Delay-Variation One-Way:
   Number of Bins 10
   Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
History
  Number of intervals: 2
```

The following sample output shows the configuration, including default values, of the sender MEP for a dual-ended IP SLAs Ethernet delay or delay variation operation:

```
Device# show ip sla configuration 500

IP SLAs Infrastructure Engine-III
Entry number: 500
Owner:
Tag:
Operation timeout (milliseconds): 5000
Ethernet Y1731 Delay Operation
Frame Type: 1DM
Domain: yyy
ReceiveOnly: FALSE
Evc: xxx
Target Mpid: 101
Source Mpid: 100
CoS: 3
   Request size (Padding portion): 64
   Frame Interval: 1000
Threshold (milliseconds): 5000
.
.
.
Statistics Parameters
  Aggregation Period: 900
  Frame offset: 1
History
  Number of intervals: 22
```

Example: Frame Delay and Frame Delay Variation Measurement Configuration

The following sample output shows the performance monitoring session summary:

```
Device# show ethernet cfm pm session summary

Number of Configured Session : 2
Number of Active Session: 2
Number of Inactive Session: 0
```

The following sample output shows the active performance monitoring session:

```
Device# show ethernet cfm pm session active

Display of Active Session
--------------------------------------------------------------------------------
EPM-ID   SLA-ID    Lvl/Type/ID/Cos/Dir     Src-Mac-address Dst-Mac-address
```

```
--------------------------------------------------------------------------------
 0     10          3/BD-V/10/2/Down     d0c2.8216.c9d7  d0c2.8216.27a3
 1     11          3/BD-V/10/3/Down     d0c2.8216.c9d7  d0c2.8216.27a3
Total number of Active Session: 2

Device# show ethernet cfm pm session db 0

----------------------------------------------------------------------------
      TX Time FWD                  RX Time FWD
      TX Time BWD                  RX Time BWD              Frame Delay
      Sec:nSec                     Sec:nSec                  Sec:nSec
----------------------------------------------------------------------------
Session ID: 0
****************************************************************************
       234:526163572                 245:305791416
       245:306761904                 234:527134653            0:593
****************************************************************************
       235:528900628                 246:308528744
       246:309452848                 235:529825333            0:601
****************************************************************************
       236:528882716                 247:308511128
       247:309450224                 236:529822413            0:601
****************************************************************************
       237:526578788                 248:306207432
       248:307157936                 237:527529885            0:593
****************************************************************************
       238:527052156                 249:306681064
       249:307588016                 238:527959717            0:609
****************************************************************************
       239:526625044                 250:306254200
       250:307091888                 239:527463325            0:593
****************************************************************************
       240:528243204                 251:307872648
       251:308856880                 240:529228021            0:585
```

Example: Sender MEP for a Single-Ended Ethernet Delay Operation

The following sample output shows the configuration, including default values, of the sender MEP for a single-ended IP SLAs Ethernet delay operation:

```
Router# show ip sla configuration 10

IP SLAs Infrastructure Engine-III
Entry number: 10
Owner:
Tag:
Operation timeout (milliseconds): 5000
Ethernet Y1731 Delay Operation
Frame Type: DMM
Domain: xxx
Vlan: yyy
Target Mpid: 101
Source Mpid: 100
CoS: 4
   Max Delay: 5000
   Request size (Padding portion): 64
   Frame Interval: 1000
   Clock: Not In Sync
Threshold (milliseconds): 5000
.
.
```

```
.
Statistics Parameters
  Aggregation Period: 900
  Frame offset: 1
  Distribution Delay Two-Way:
   Number of Bins 10
   Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
  Distribution Delay-Variation Two-Way:
   Number of Bins 10
   Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
History
  Number of intervals: 2
```

Example: Sender MEP for a Single-Ended Ethernet Frame Loss Operation

The following output shows the configuration, including default values, of the sender MEP in a basic single-ended IP SLAs Ethernet frame loss ratio operation with a start-time of now:

```
Router# show ip sla configuration 11

IP SLAs Infrastructure Engine-III
Entry number: 11
Owner:
Tag:
Operation timeout (milliseconds): 5000
Ethernet Y1731 Loss Operation
Frame Type: LMM
Domain: xxx
Vlan: 12
Target Mpid: 34
Source Mpid: 23
CoS: 4
   Request size (Padding portion): 0
   Frame Interval: 1000
Schedule:
   Operation frequency (seconds): 60  (not considered if randomly scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): 3600
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): ActiveThreshold (milliseconds): 5000
Statistics Parameters
  Aggregation Period: 900
  Frame consecutive: 10
  Availability algorithm: static-window
History
  Number of intervals: 2
```

Example: Verifying NTP Time Of Day Synchronization

Use the **show platform time-source** command to display information on the time source.

```
Router# show platform time-source
```

```
Time Source mode : NTP not Configured

Router# show platform time-source
Time Source mode : NTP
NTP State        : Not Synchronized

Router# show platform time-source
Time Source mode : NTP
NTP State        : Synchronized
```

Additional References for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations

Related Documents

Related Topic	Document Title
Cisco IOS Carrier Ethernet commands	Cisco IOS Carrier Ethernet Command Reference
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference
Ethernet CFM	“Configuring Ethernet Connectivity Fault Management in a Service Provider Network” module of the *Cisco IOS Carrier Ethernet Configuration Guide*
Network Time Protocol (NTP)	“Configuring NTP” module of the *Cisco IOS Network Management Configuration Guide*
Proactive threshold monitoring for Cisco IOS IP SLAs	“Configuring Proactive Threshold Monitoring of IP SLAs Operations” module of the *Cisco IOS IP SLAs Configuration Guide*

Standards and RFCs

Standard/RFC	Title
ITU-T Y.1731	*OAM functions and mechanisms for Ethernet-based networks*
No specific RFCs are supported by the features in this document.	--

MIBs

MIB	MIBs Link
• CISCO-IPSLA-ETHERNET-MIB • CISCO-RTTMON-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 5

Configuring an SLM

Synthetic loss measurement (SLM) is part of the ITU-T Y.1731 standard. It can be used to periodically measure Frame Loss and Forward Loss Ratio (FLR) between a pair of point to point MEPs. Measurements are made between two MEPs that belong to the same domain and MA.

Configuring SLM over VPLS

This section describes the procedure for configuring SLM over VPLS.

Note The EVC name is mandatory in the VPLS configuration methods.

Procedure

Step 1 Configure CFM on PE Device

For configuration details, see Configuring Ethernet Connectivity Fault Management in a Service Provider Network. In case of H-VPLS configuration, see CFM Configuration over EFP Interface with Cross Connect Feature.

Step 2 Configure CFM over VPLS using **l2 vfi** *vfi-name* **manual** *evc* command or **l2vpn vfi context** *vfi-name* command.

The evc should be the EVC name used in the CFM on PE device configuration. For configuration details, see Configuring the VFI in the PE.

Note The EVC name is mandatory in both the above mentioned VPLS configuration methods.

Step 3 Configure a Sender MEP (optional task).

For configuration details, see Configuring a Sender MEP for a Single-Ended Ethernet Frame Loss Ratio Operation.

Restrictions for SLM support over VPLS

- Only Up MEP (Maintenance End Point) on EVC (ethernet virtual circuit) BD (bridge domain) with VPLS towards the core is supported. Down MEP on VFI is not supported.
- To send unicast packets (LBR, LTM/R, Y1731 packets), port-emulation method is used. The access interface (the interface where Up MEP is configured) needs to be up to send unicast packets.
- SLM is not supported with TEFP in access.
- SLM scales with frame interval of 100ms.

Configuring an SLM

To configure an SLM, execute the following commands:

Procedure

Step 1 **enable**

Example:

```
Router > enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal** *operation number*

—Identifies the IP SLAs' operation you want to configure.

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 **ip sla** *operation number*

Example:

```
Router(config)# ip sla 11
```

Configures an IP SLA operation and enters IP SLA configuration mode.

- *operation-number*—Identifies the IP SLAs' operation you want to configure.

Step 4 **ethernet y1731 loss SLM domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*}{**mpid** *target-mp-id* | **mac-address**-*target -address*}**cos** *cos*{**source**{**mpid** *source-mp-id* | **mac-address** *source-address*}}

Example:

```
Router(config-ip-sla)# ethernet y1731 loss SLM domain xxx evc yyy mpid 101 cos 4 source
mpid 100
```

Configures a single-ended synthetic loss measurement and enters IP SLA Y.1731 loss configuration mode.

- **EVC**—Specifies the ethernet virtual circuit name.
- **SLM**—Specifies that the frames sent are Synthetic Loss Measurement (SLM) frames.
- **domain** *domain-name*—Specifies the name of the Ethernet Connectivity Fault Management (CFM) maintenance domain.
- **vlan** *vlan-id*—Specifies the VLAN identification number. The range is from 1 to 4094.
- **mpid** *target-mp-id*—Specifies the maintenance endpoint identification numbers of the MEP at the destination. The range is from 1 to 8191.
- **mac-address** *target-address*—Specifies the MAC address of the MEP at the destination.
- **cos** *cos*—Specifies, for this MEP, the class of service (CoS) that will be sent in the Ethernet message. The range is from 0 to 7.
- **source**—Specifies the source MP ID or MAC address.
- **mpid** *source-mp-id*—Specifies the maintenance endpoint identification numbers of the MEP being configured. The range is from 1 to 8191.
- **mac-address** *source-address*—Specifies the MAC address of the MEP being configured.

Step 5 **aggregate interval** *seconds*

Example:

```
Router(config-sla-y1731-loss)# aggregate interval 900
```

(Optional) Configures the length of time during which the performance measurements are conducted and the results stored.

- *seconds*—Specifies the length of time in seconds. The range is from 1 to 65535. The default is 900.

Step 6 **availability algorithm**{ **sliding-window** | **static-window 1**} **symmetric**

Example:

```
Router(config-sla-y1731-loss)# availability algorithm static-window
```

(Optional) Specifies availability algorithm used.

- **sliding-window**—Specifies a sliding-window control algorithm.
- **static-window**—Specifies static-window control algorithm.

Step 7 **frame consecutive** *value*

Example:

```
Router(config-sla-y1731-loss)# frame consecutive 10.
```

(Optional) Specifies number of consecutive measurements to be used to determine availability or unavailability status.

- *value*—Specifies the number of consecutive measurements. The range is from 1 to 10. The default is 10.

Step 8 **frame interval** *milliseconds*

Example:

```
Router(config-sla-y1731-loss)# frame interval 1000
```

(Optional) Sets the gap between successive frames.

- *milliseconds*—Specifies the length of time in milliseconds (ms) between successive synthetic frames. The default is 1000

Step 9 **frame size** *bytes*

Example:

```
Router(config-sla-y1731-loss)# frame size 64
```

(Optional) Configures padding size for frames.

- *bytes*—Specifies the padding size, in four-octet increments, for the synthetic frames. The default is 64.

Step 10 **history interval** *intervals-stored*

Example:

```
Router(config-sla-y1731-loss)# history interval 2
```

(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.

- *intervals-stored*—Specifies the number of statistics distributions. The range is from 1 to 10. The default is 2.

Step 11 **owner** *owner-id*

Example:

```
Router(config-sla-y1731-loss)# owner admin
```

(Optional) Configures the owner of an IP SLAs operation.

- *owner-id*—Specified the name of the SNMP owner. The value is from 0 to 255 ASCII characters.

Step 12 **exit**

Example:

```
Router(config-sla-y1731-loss)# exit
```

Exits IP SLA Y.1731 loss configuration mode and enters IP SLA configuration mode.

Step 13 **ip sla reaction-configuration** *operation-number* [**react** {**unavailableDS** |**unavailableSD** | **loss-ratioDS** | **loss-ratioSD**}] [**threshold-type** {**average** [*number -of-measurements*] | **consecutive** [*occurences*] | **immediate**}] [**threshold-value** *upper -threshold lower-threshold*]

Example:

```
Router(config)# ip sla reaction-configuration 11 react unavailableDS
```

(Optional) Configures proactive threshold monitoring for frame loss measurements.

- *operation-number*—Identifies the IP SLAs operation for which reactions are to be configured.
- **react**—(Optional) Specifies the element to be monitored for threshold violations.
- **unavailableDS**—Specifies that a reaction should occur if the percentage of destination-to-source Frame Loss Ratio (FLR) violates the upper threshold or lower threshold.
- **unavailableSD**—Specifies that a reaction should occur if the percentage of source-to-destination FLR violates the upper threshold or lower threshold.
- **loss-ratioDS**—Specifies that a reaction should occur if the one-way destination-to-source loss-ratio violates the upper threshold or lower threshold.
- **loss-ratioSD**—Specifies that a reaction should occur if the one way source-to-destination loss-ratio violates the upper threshold or lower threshold.
- **threshold-type average**[*number-of-measurements*]—(Optional) When the average of a specified number of measurements for the monitored element exceeds the upper threshold or when the average of a specified number of measurements for the monitored element drops below the lower threshold, perform the action defined by the action-type keyword. The default number of 5 averaged measurements can be changed using the number-of-measurements argument. The range is from 1 to 16.
- **threshold-type consecutive**[*occurrences*] —(Optional) When a threshold violation for the monitored element is met consecutively for a specified number of times, perform the action defined by the action-type keyword. The default number of 5 consecutive occurrences can be changed using the occurrences argument. The range is from 1 to 16.
- **threshold-type immediate**—(Optional) When a threshold violation for the monitored element is met, immediately perform the action defined by the **action-type** keyword.
- **threshold-value***upper-threshold lower-threshold*—(Optional) Specifies the upper-threshold and lower-threshold values of the applicable monitored elements.

Step 14 **ip sla logging traps**

Example:

```
Router(config)# ip sla logging traps
```

(Optional) Enables IP SLAs syslog messages from CISCO-RTTMON-MIB.

Step 15 **exit**

Example:

```
Router(config)# exit
```

Exits global configuration mode and enters privileged EXEC mode.

What to do next

Once the SLM is configured, you have to schedule an IP SLA operation.

Scheduling an IP SLA Operation

To schedule an IP SLA operation, execute the following commands:

Procedure

Step 1 **enable**

Example:

```
Router> enable
```

Enables the privileged EXEC mode.

Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters the global configuration mode.

Step 3 **ip sla schedule** *operation-number* [**life** { **forever** | *seconds* }] [**start-time** {*hh* **:** *mm* [**:** *ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh* **:** *mm* **:** *ss* | **random** *milliseconds*}]

Example:

```
Router(config)# ip sla schedule 10 start-time now life forever
```

Configures the scheduling parameters for an individual IP SLA operation or Specifies an IP SLA operation group number and the range of operation numbers to be scheduled for a multi-operation scheduler.

- *operation-number*—Identifies the IP SLAs operation for which reactions are to be configured.
- **life forever**— (Optional) Schedules the operation to run indefinitely.
- **life** *seconds* —(Optional) Number of seconds the operation actively collects information. The default is 3600 seconds (one hour).
- **start-time** —(Optional) Time when the operation starts.
- *hh***:***mm*[**:***ss*]—Specifies an absolute start time using hour, minute, and (optionally) second. Use the 24-hour clock notation. For example, start-time 01:02 means "start at 1:02 a.m.," and start-time 13:01:30 means "start at 1:01 p.m. and 30 seconds." The current day is implied unless you specify a month and day.
- *month* —(Optional) Name of the month to start the operation in. If month is not specified, the current month is used. Use of this argument requires that a day be specified. You can specify the month by using either the full English name or the first three letters of the month.
- *day* —(Optional) Number of the day (in the range 1 to 31) to start the operation on. If a day is not specified, the current day is used. Use of this argument requires that a month be specified.
- **pending** —(Optional) No information is collected. This is the default value.

- **now** —(Optional) Indicates that the operation should start immediately.
- **after** *hh***:***mm***:***ss*—(Optional) Indicates that the operation should start hh hours, mm minutes, and ss seconds after this command was entered.
- **random** *milliseconds*—(Optional) Adds a random number of milliseconds (between 0 and the specified value) to the current time, after which the operation will start. The range is from 0 to 10000.

Step 4 **exit**

Example:

```
Router(config)# exit
```

Exits the global configuration mode and enters the privileged EXEC mode.

Configuration Example for SLM over VPLS

This section lists the CLIs and their corresponding outputs of SLM configuration over VPLS that are generated.

- **sh run | i evc**

```
ethernet evcEVC_100
```

- **sh run | sec cfm**

```
ethernet cfm global
ethernet cfm domain CFM-VPLS level 5
service ser1 evc EVC_100 vlan 100
continuity-check
continuity-check interval 1s
```

- **sh run | sec 12 vfi**

```
l2 vfi VPLS-CFM manual EVC_100
vpn id 100
bridge-domain 100
neighbor 2.2.2.2 encapsulation mpls
```

- **sh run int g0/4/4**

```
interface GigabitEthernet0/4/4
service instance 100 ethernet EVC_100
encapsulation dot1q 100

cfm mep domain CFM-VPLS mpid 1001
bridge-domain 100
```

- **sh run | sec ip sla**

```
ip sla 200
ethernet y1731 loss SLM domain CFM-VPLS evc EVC_100 mpid 1002 cos 7 source mpid 1001
ip sla schedule 200 start-time now
```

CHAPTER 6

Configuring DMM over VPLS

Delay Measurement Message (DMM) is part of the ITU-T Y.1731 standard. It can be used to periodically measure Frame Delay and Frame Delay Variation between a pair of point to point MEPs. Measurements are made between two MEPs belonging to the same domain and MA.

Note Delay Management is not supported on Cisco RSP3 Module

Restrictions for DMM support over VPLS

- With *SR_5_label_push* template, IP SLA DMM is not supported on RSP3 module.
- Only Up MEP(Maintenance End Point) on EVC(ethernet virtual circuit) BD(bridge domain) with VPLS towards the core is supported. Down MEP on VFI is not supported.
- To send unicast packets (LBR, LTM/R, Y1731 packets), port-emulation method is used. The access interface (the interface where Up MEP is configured) needs to be up to send unicast packets.

Configuring DMM over VPLS

Procedure

Step 1 Configure CFM on PE Device.

For configuration details see, Configuring Ethernet Connectivity Fault Management in a Service Provider Network .

In case of H-VPLS configuration, see, CFM Configuration over EFP Interface with Cross Connect Feature.

Step 2 Configure CFM over VPLS using **l2 vfi** *vfi-name* **manual** *evc* command or **l2vpn vfi context** *vfi-name* command.

The evc should be the EVC name used in the CFM on PE device configuration. For configuration details, see, Configuring the VFI in the PE.

Step 3 Configure a Sender MEP.

For configuration details see, *Configuring a Sender MEP for a Single-Ended Ethernet Delay or Delay Variation Operation*.

Configuration Example for DMM over VPLS

The following sample output shows the configuration of DMM over VPLS:

```
ethernet evc EVC_100
ethernet cfm global
ethernet cfm domain CFM-VPLS level 5
service ser1 evc EVC_100 vlan 100
continuity-check
continuity-check interval 1s
l2 vfi VPLS-CFM manual EVC_100
vpn id 100
bridge-domain 100
neighbor 2.2.2.2 encapsulation mpls
interface GigabitEthernet0/4/4
service instance 100 ethernet EVC_100
encapsulation dot1q 100
cfm mep domain CFM-VPLS mpid 1001
bridge-domain 100
ip sla 200
ethernet y1731 delay DMM domain CFM-VPLS evc EVC_100 mpid 1002 cos 7 source mpid 1001
ip sla schedule 200 start-time now
```

The following sample output shows the configuration of DMM over VPLS using the **l2vpn vfi context** command:

```
ethernet evc EVC_100
ethernet cfm global
ethernet cfm domain CFM-VPLS level 5
service ser1 evc EVC_100 vlan 100
continuity-check
continuity-check interval 1s
l2vpn vfi context VPLS-CFM
vpn id 100
evc EVC_100
neighbor 2.2.2.2 encapsulation mpls
interface GigabitEthernet0/4/4
service instance 100 ethernet EVC_100
encapsulation dot1q 100
cfm mep domain CFM-VPLS mpid 1001
bridge-domain 100
member GigabitEthernet0/4/4 service-instance 100
member vfi VPLS-CFM
ip sla 200
ethernet y1731 delay DMM domain CFM-VPLS evc EVC_100 mpid 1002 cos 7 source mpid 1001
ip sla schedule 200 start-time now
```

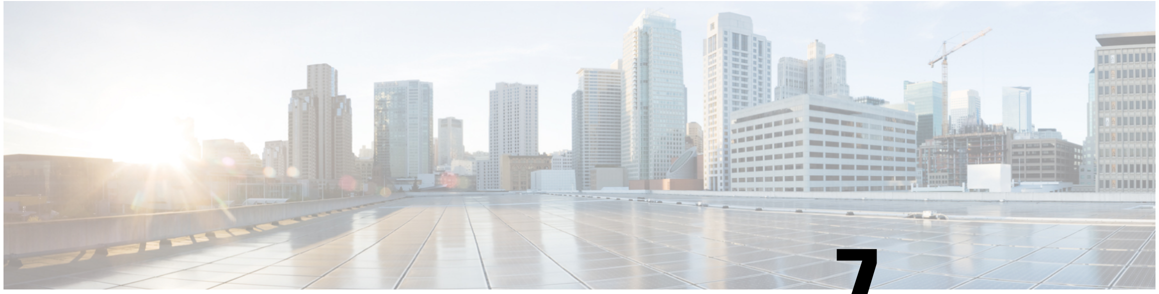
Note The EVC name is mandatory and should be the same as the one configured in CFM.

Configuration Verification Example for DMM over VPLS

The following sample output shows the configuration verification of DMM over VPLS:

```
Router#sh ip sla configuration
IP SLAs Infrastructure Engine-III
Entry number: 200
Owner:
Tag:
Operation timeout (milliseconds): 5000
Ethernet Y1731 Delay Operation
Frame Type: DMM
Domain: CFM_VPLS
Evc: EVC_100
Target Mpid: 1002
Source Mpid: 1001
CoS: 7
   Max Delay: 5000
   Request size (Padding portion): 64
   Frame Interval: 1000
   Clock: Not In Sync
Threshold (milliseconds): 5000
Schedule:
   Operation frequency (seconds): 900  (not considered if randomly scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): 3600
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): Active
Statistics Parameters
  Frame offset: 1
  Distribution Delay Two-Way:
   Number of Bins 10
   Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
  Distribution Delay-Variation Two-Way:
   Number of Bins 10
   Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
  Aggregation Period: 900
History
  Number of intervals: 2


Router#
```



CHAPTER 7

IPSLA Y1731 On-Demand and Concurrent Operations

This module describes how to configure the IPSLA Y1731 SLM Feature Enhancements feature for enabling real-time Ethernet service troubleshooting for users without configuration privileges. This feature supports on-demand Synthetic Loss Measurement (SLM) operations that can be run by issuing a single command in privileged EXEC mode.

Prerequisites for ITU-T Y.1731 Operations

IEEE-compliant Connectivity Fault Management (CFM) must be configured and enabled for Y.1731 performance monitoring to function.

Note Y1731 is supported on Port Channel interfaces.

Restrictions for IP SLAs Y.1731 On-Demand Operations

- SNMP is not supported for reporting threshold events or collecting performance statistics for on-demand operations.
- On-demand operation statistics are not stored and are not supported by the statistic history and aggregation functions.

Information About IP SLAs Y.1731 On-Demand and Concurrent Operations

IPSLA Y1731 SLM Feature Enhancements

On-demand IP SLAs Synthetic Loss Measurement (SLM) operations, in the IPSLA Y1731 SLM Feature Enhancements feature, enable users without configuration access to perform real-time troubleshooting of Ethernet services. There are two operational modes for on-demand operations: direct mode that creates and runs an operation immediately and referenced mode that starts and runs a previously configured operation.

- In the direct mode, a single command can be used to create multiple pseudo operations for a range of class of service (CoS) values to be run, in the background, immediately. A single command in privileged EXEC mode can be used to specify frame size, interval, frequency, and duration for the direct on-demand operation. Direct on-demand operations start and run immediately after the command is issued.
- In the referenced mode, you can start one or more already-configured operations for different destinations, or for the same destination, with different CoS values. Issuing the privileged EXEC command creates a pseudo version of a proactive operation that starts and runs in the background, even while the proactive operation is running.
- Once an on-demand operation is completed, statistical output is displayed on the console. On-demand operation statistics are not stored and are not supported by the statistic history and aggregation functions.
- After an on-demand operation is completed, and the statistics handled, the direct and referenced on-demand operation is deleted. The proactive operations are not deleted and continue to be available to be run in referenced mode, again.

A concurrent operation consists of a group of operations, all configured with the same operation ID number, that run concurrently. Concurrent operations are supported for a given Ethernet Virtual Circuit (EVC), CoS, and remote Maintenance End Point (MEP) combination, or for multiple MEPs for a given multipoint EVC, for delay or loss measurements. A new keyword was added to the appropriate commands to specify that concurrent Ethernet frame Delay Measurement (ETH-DM) synthetic frames are sent during the operation.

The IPSLA Y.1731 SLM Feature Enhancements feature also supports burst mode for concurrent operations, one-way dual-ended, and single-ended delay and delay variation operations, as well as for single-ended loss operations. A new keyword was added to the appropriate commands to support bursts of PDU transmission during an aggregation interval. The maximum number of services monitored is 50 every 30 minutes, with an average of 25 services every 2 hours.

How to Configure IP SLAs Y.1731 On-Demand and Concurrent Operations

Configuring a Direct On-Demand Operation on a Sender MEP

Before you begin

Class of Service (CoS)-level monitoring must be enabled on MEPs associated to the Ethernet frame loss operation by using the **monitor loss counter** command on the devices at both ends of the operation. See the *Cisco IOS Carrier Ethernet Command Reference* for command information. See the “Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations” section for configuration information.

Note The Cisco IOS Y.1731 implementation allows monitoring of frame loss on an EVC regardless of the CoS value (any CoS or aggregate CoS cases). See the “Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations” section for configuration information.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

Step 2	**ip sla on-demand ethernet** {**DMMv1** | **SLM**} **domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*} {**mpid** *target-mp-id* | **mac-address** *target-address*} **cos** *cos* {**source** {**mpid** *source-mp-id* | **mac-address** *source-address*}} {**continuous** [**interval** *milliseconds*] | **burst** [**interval** *milliseconds*] [**number** *number-of-frames*] [**frequency** *seconds*]} [**size** *bytes*] **aggregation** *seconds* {**duration** *seconds* | **max** *number-of-packets*}
	Example:
	`Device# ip sla on-demand ethernet SLM domain xxx vlan 12 mpid 34 cos 4 source mpid 23 continuous aggregation 10 duration 60`
		Creates and runs an on-demand operation in direct mode.
		• To create and run concurrent on-demand operations, configure this command using the **DMMv1** keyword.
		• Statistical output is posted on the console after the operation is finished.
		• Repeat this step for each on-demand operation to be run.
		• After an on-demand operation is finished and the statistics handled, the operation is deleted.

Configuring a Referenced On-Demand Operation on a Sender MEP

Note After an on-demand operation is finished and the statistics handled, the on-demand version of the operation is deleted.

Before you begin

- Single-ended and concurrent Ethernet delay, or delay variation, and frame loss operations to be referenced must be configured. See the "Configuring IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations" module of the *IP SLAs Configuration Guide*.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**ip sla on-demand ethernet** [**dmmv1** | **slm**] *operation-number* {**duration** *seconds* | **max** *number-of-packets* **Example:** `Device# ip sla on-demand ethernet slm 11 duration 38`	Creates and runs a pseudo operation of the operation being referenced, in the background. • Statistical output is posted on the console after the operation is finished. • Repeat this step for each on-demand operation to be run.

Configuring an IP SLAs Y.1731 Concurrent Operation on a Sender MEP

To configure concurrent Ethernet delay, delay variation, and frame loss operations, see the "Configuring IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations" module of the

IP SLAs Configuration Guide.

Configuration Examples for IP SLAs Y.1731 On-Demand and Concurrent Operations

Example: On-Demand Operation in Direct Mode

```
Device# ip sla on-demand ethernet SLM domain xxx vlan 10 mpid 3 cos 1 source mpid 1 continuous
 aggregation 35 duration 38
```

```
Loss Statistics for Y1731 Operation 2984884426
Type of operation: Y1731 Loss Measurement
Latest operation start time: *20:17:41.535 PST Wed May 16 2012
Latest operation return code: OK
Distribution Statistics:


Interval 1
 Start time:  *20:17:41.535 PST Wed May 16 2012
 End time:  *20:18:16.535 PST Wed May 16 2012
 Number of measurements initiated: 35
 Number of measurements completed: 35
 Flag: OK

Forward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps forward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
Backward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps backward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
Loss Statistics for Y1731 Operation 2984884426
Type of operation: Y1731 Loss Measurement
Latest operation start time: *20:17:41.535 PST Wed May 16 2012
Latest operation return code: OK
Distribution Statistics:


Interval 1
 Start time:  *20:17:41.535 PST Wed May 16 2012
 End time:  *20:18:16.535 PST Wed May 16 2012
 Number of measurements initiated: 35
 Number of measurements completed: 35
 Flag: OK

Forward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps forward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
Backward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps backward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
```

Example: On-Demand Operation in Referenced Mode

```
Device(config)# ip sla 11
Device(config-ip-sla)# ethernet y1731 loss SLM domain xxx vlan 10 mpid 3 cos 1 source mpid
 1
Device(config-sla-y1731-loss)# end
Device# ip sla on-demand ethernet slm 11 duration 38

Loss Statistics for Y1731 Operation 2984884426
Type of operation: Y1731 Loss Measurement
Latest operation start time: *20:17:41.535 PST Wed May 16 2012
Latest operation return code: OK
Distribution Statistics:


Interval 1
 Start time:  *20:17:41.535 PST Wed May 16 2012
 End time:  *20:18:16.535 PST Wed May 16 2012
 Number of measurements initiated: 35
 Number of measurements completed: 35
 Flag: OK

Forward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps forward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
Backward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps backward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
Loss Statistics for Y1731 Operation 2984884426
Type of operation: Y1731 Loss Measurement
Latest operation start time: *20:17:41.535 PST Wed May 16 2012
Latest operation return code: OK
Distribution Statistics:
```

```
Interval 1
 Start time:  *20:17:41.535 PST Wed May 16 2012
 End time:  *20:18:16.535 PST Wed May 16 2012
 Number of measurements initiated: 35
 Number of measurements completed: 35
 Flag: OK

Forward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps forward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
Backward
  Number of Observations 3
  Available indicators: 0
  Unavailable indicators: 3
  Tx frame count: 30
  Rx frame count: 30
    Min/Avg/Max - (FLR % ): 0:9/000.00%/0:9
  Cumulative - (FLR % ): 000.00%
  Timestamps backward:
    Min - *20:18:10.586 PST Wed May 16 2012
    Max - *20:18:10.586 PST Wed May 16 2012
```

Additional References for IP SLAs Y.1731 On-Demand and Concurrent Operations

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Cisco IOS Carrier Ethernet commands	Cisco IOS Carrier Ethernet Command Reference
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference
Ethernet CFM for ITU-T Y.1731	“ITU-T Y.1731 Performance Monitoring in a Service Provider Network” module of the *Carrier Ethernet Configuration Guide*

Related Topic	Document Title
Ethernet operations	“Configuring IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations” module of the *IP SLAs Configuration Guide*
Network Time Protocol (NTP)	“Configuring NTP” module of the *Network Management Configuration Guide*

Standards and RFCs

Standard/RFC	Title
ITU-T Y.1731	*OAM functions and mechanisms for Ethernet-based networks*

MIBs

MIB	MIBs Link
• CISCO-IPSLA-ETHERNET-MIB • CISCO-RTTMON-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 8

Configuring an IP SLAs Multioperation Scheduler

This document describes how to schedule multiple operations at once using the IP Service Level Agreements (SLAs) Multioperations Scheduler feature.

Prerequisites for an IP SLAs Multioperation Scheduler

- Configure the IP SLAs operations to be included in a group before scheduling the group.
- Determine the IP SLAs operations you want to schedule as a single group.
- Identify the network traffic type and the location of your network management station.
- Identify the topology and the types of devices in your network.
- Decide on the frequency of testing for each operation.

Information About an IP SLAs Multioperation Scheduler

IP SLAs Multioperations Scheduler

Normal scheduling of IP SLAs operations allows you to schedule one operation at a time. If you have large networks with thousands of IP SLAs operations to monitor network performance, normal scheduling (scheduling each operation individually) will be inefficient and time-consuming.

Multiple operations scheduling allows you to schedule multiple IP SLAs operations using a single command through the command line interface (CLI) or the CISCO-RTTMON-MIB. This feature allows you to control the amount of IP SLAs monitoring traffic by scheduling the operations to run at evenly distributed times. You must specify the operation ID numbers to be scheduled and the time range over which all the IP SLAs operations should start. This feature automatically distributes the IP SLAs operations at equal intervals over a specified time frame. The spacing between the operations (start interval) is calculated and the operations are started.

This distribution of IP SLAs operations helps minimize the CPU utilization and thereby enhances the scalability of the network.

The IP SLAs multiple operations scheduling functionality allows you to schedule multiple IP SLAs operations as a group, using the following configuration parameters:

- Group operation number--Group configuration or group schedule number of the IP SLAs operation to be scheduled.
- Operation ID numbers--A list of IP SLAs operation ID numbers in the scheduled operation group.
- Schedule period--Amount of time for which the IP SLAs operation group is scheduled.
- Ageout--Amount of time to keep the operation in memory when it is not actively collecting information. By default, the operation remains in memory indefinitely.
- Frequency--Amount of time after which each IP SLAs operation is restarted. When the frequency option is specified, it overwrites the operation frequency of all operations belonging to the group. Note that when the frequency option is not specified, the frequency for each operation is set to the value of the schedule period.
- Life--Amount of time the operation actively collects information. The operation can be configured to run indefinitely. By default, the lifetime of an operation is one hour.
- Start time--Time when the operation starts collecting information. You can specify an operation to start immediately or at an absolute start time using hours, minutes, seconds, day, and month.

The IP SLAs multiple operations scheduling functionality schedules the maximum number of operations possible without terminating. However, this functionality skips those IP SLAs operations that are already running or those that are not configured and hence do not exist. The total number of operations will be calculated based on the number of operations specified in the command, irrespective of the number of operations that are missing or already running. The IP SLAs multiple operations scheduling functionality displays a message showing the number of active and missing operations. However, these messages are displayed only if you schedule operations that are not configured or are already running.

A main benefit for scheduling multiple IP SLAs operations is that the load on the network is reduced by distributing the operations equally over a scheduled period. This distribution helps you to achieve more consistent monitoring coverage. To illustrate this scenario, consider configuring 60 operations to start during the same 1-second interval over a 60-second schedule period. If a network failure occurs 30 seconds after all 60 operations have started and the network is restored before the operations are due to start again (in another 30 seconds), then this failure would never be detected by any of the 60 operations. However, if the 60 operations are distributed equally at 1-second intervals over a 60-second schedule period, then some of the operations would detect the network failure. Conversely, if a network failure occurs when all 60 operations are active, then all 60 operations would fail, indicating that the failure is possibly more severe than it really is.

Operations of the same type and same frequency should be used for IP SLAs multiple operations scheduling. If you do not specify a frequency, the default frequency will be the same as that of the schedule period. The schedule period is the period of time in which all the specified operations should run.

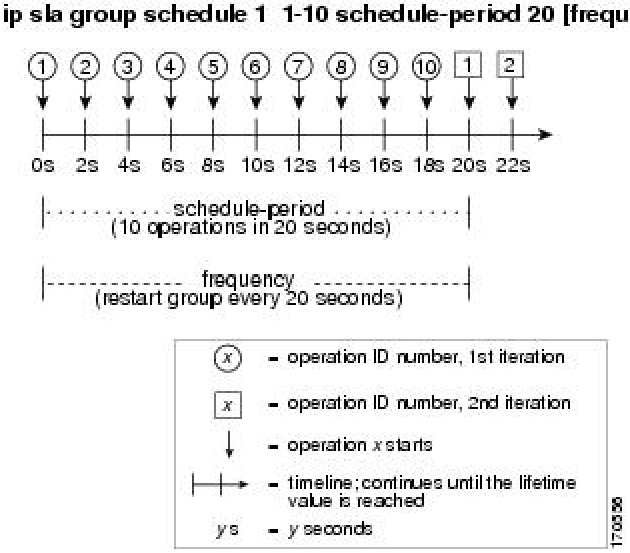
The following sections focus on the interaction of the schedule period and frequency values, additional values, such as start time and lifetime values, are not included in the illustrations.

Default Behavior of IP SLAs Multiple Operations Scheduling

The IP SLAs Multiple Operations Scheduling feature allows you to schedule multiple IP SLAs operations as a group.

The figure below illustrates the scheduling of operation group 1 that includes operation 1 to operation 10. Operation group 1 has a schedule period of 20 seconds, which means that all operations in the group will be started at equal intervals within a 20-second period. By default, the frequency is set to the same value as the configured schedule period. As shown in the figure below, configuring the frequencyis optional because 20 is the default.

Figure 4: Schedule Period Equals Frequency--Default Behavior


ip sla group schedule 1 1-10 schedule-period 20 [frequency 20]
1 2 3 4 5 6 7 8 9 10 1 2
0s 2s 4s 6s 8s 10s 12s 14s 16s 18s 20s 22s
schedule-period
(10 operations in 20 seconds)
frequency
(restart group every 20 seconds)
x - operation ID number, 1st iteration
x - operation ID number, 2nd iteration
- operation x starts
- timeline; continues until the lifetime value is reached
ys - y seconds
170338

In this example, the first operation (operation 1) in operation group 1 will start at 0 seconds. All 10 operations in operation group 1 (operation 1 to operation 10) must be started in the schedule period of 20 seconds. The start time of each IP SLAs operation is evenly distributed over the schedule period by dividing the schedule period by the number of operations (20 seconds divided by 10 operations). Therefore, each operation will start 2 seconds after the previous operation.

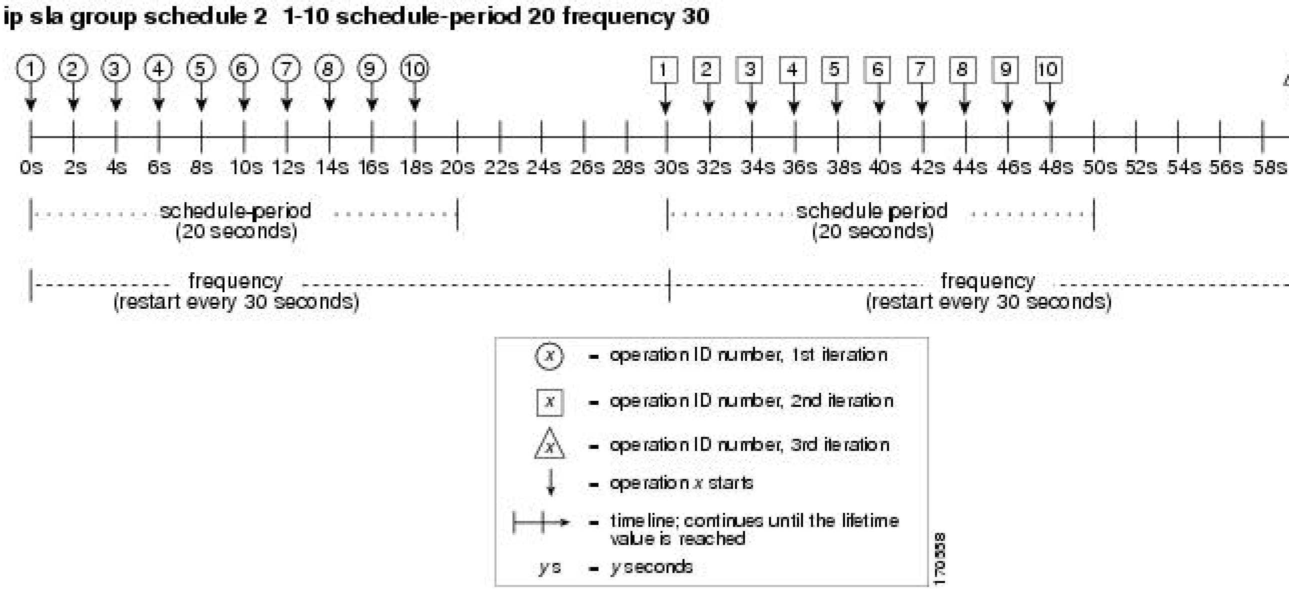
The frequency is the period of time that passes before the operation group is started again (repeated). If the frequency is not specified, the frequency is set to the value of the schedule period. In the example shown above, operation group 1 will start again every 20 seconds. This configuration provides optimal division (spacing) of operations over the specified schedule period.

IP SLAs Multiple Operations Scheduling with Scheduling Period Less Than Frequency

The frequency value is the amount of time that passes before the schedule group is restarted, if the schedule period is less than the frequency, there will be a period of time in which no operations are started.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 2. Operation group 2 has a schedule period of 20 seconds and a frequency of 30 seconds.

Figure 5: Schedule Period Is Less Than Frequency


ip sla group schedule 2 1-10 schedule-period 20 frequency 30
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10
0s 2s 4s 6s 8s 10s 12s 14s 16s 18s 20s 22s 24s 26s 28s 30s 32s 34s 36s 38s 40s 42s 44s 46s 48s 50s 52s 54s 56s 58s
schedule-period (20 seconds)
schedule period (20 seconds)
frequency (restart every 30 seconds)
frequency (restart every 30 seconds)
x - operation ID number, 1st iteration
x - operation ID number, 2nd iteration
x - operation ID number, 3rd iteration
- operation x starts
- timeline; continues until the lifetime value is reached
ys - y seconds
170558

In this example, the first operation (operation 1) in operation group 2 will start at 0 seconds. All 10 operations in operation group 2 (operation 1 to operation 10) must be started in the schedule period of 20 seconds. The start time of each IP SLAs operation is evenly distributed over the schedule period by dividing the schedule period by the number of operations (20 seconds divided by 10 operations). Therefore, each operation will start 2 seconds after the previous operation.

In the first iteration of operation group 2, operation 1 starts at 0 seconds, and the last operation (operation 10) starts at 18 seconds. However, because the group frequency has been configured to 30 seconds each operation in the operation group is restarted every 30 seconds. So, after 18 seconds, there is a gap of 10 seconds as no operations are started in the time from 19 seconds to 29 seconds. Hence, at 30 seconds, the second iteration of operation group 2 starts. As all ten operations in the operation group 2 must start at an evenly distributed interval in the configured schedule period of 20 seconds, the last operation (operation 10) in the operation group 2 will always start 18 seconds after the first operation (operation 1).

As illustrated in the figure above, the following events occur:

- At 0 seconds, the first operation (operation 1) in operation group 2 is started.
- At 18 seconds, the last operation (operation 10) in operation group 2 is started. This means that the first iteration (schedule period) of operation group 1 ends here.
- From 19 to 29 seconds, no operations are started.
- At 30 seconds, the first operation (operation 1) in operation group 2 is started again. The second iteration of operation group 2 starts here.
- At 48 seconds (18 seconds after the second iteration started) the last operation (operation 10) in operation group 2 is started, and the second iteration of operation group 2 ends.
- At 60 seconds, the third iteration of operation group 2 starts.

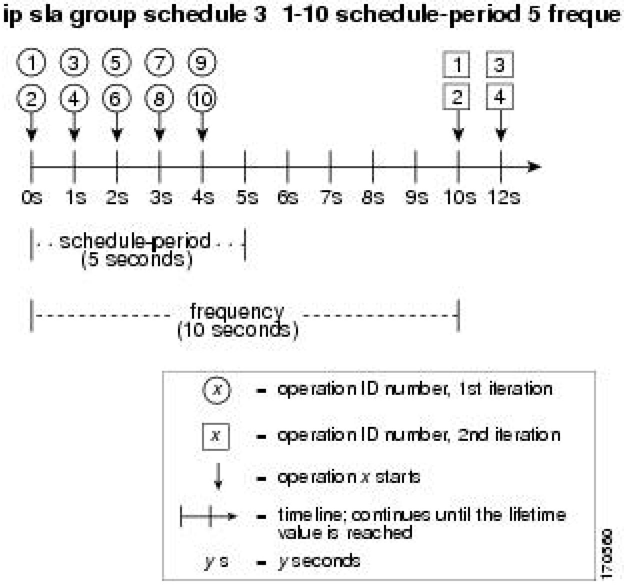
This process continues until the lifetime of operation group 2 ends. The lifetime value is configurable. The default lifetime for an operation group is forever.

Multiple Operations Scheduling When the Number of IP SLAs Operations Are Greater Than the Schedule Period

The minimum time interval between the start of IP SLAs operations in a group operation is 1 second. Therefore, if the number of operations to be multiple scheduled is greater than the schedule period, the IP SLAs multiple operations scheduling functionality will schedule more than one operation to start within the same 1-second interval. If the number of operations getting scheduled does not equally divide into 1-second intervals, then the operations are equally divided at the start of the schedule period with the remaining operations to start at the last 1-second interval.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 3. Operation group 3 has a schedule period of 5 seconds and a frequency of 10 seconds.

Figure 6: Number of IP SLAs Operations Is Greater Than the Schedule Period--Even Distribution


ip sla group schedule 3 1-10 schedule-period 5 frequency 10
1
2
3
4
5
6
7
8
9
10
1
2
3
4
0s
1s
2s
3s
4s
5s
6s
7s
8s
9s
10s
12s
schedule-period
(5 seconds)
frequency
(10 seconds)
x - operation ID number, 1st iteration
x - operation ID number, 2nd iteration
- operation x starts
- time line; continues until the lifetime value is reached
y s - y seconds
170580

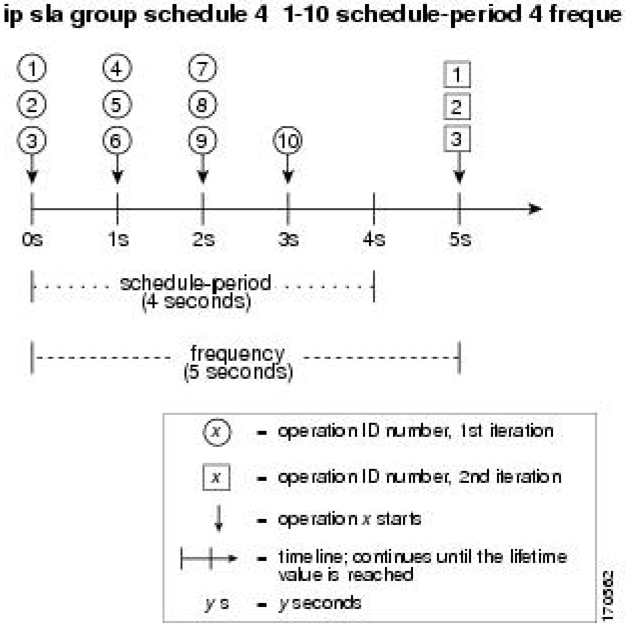
In this example, when dividing the schedule period by the number of operations (5 seconds divided by 10 operations, which equals one operation every 0.5 seconds) the start time of each IP SLAs operation is less than 1 second. Since the minimum time interval between the start of IP SLAs operations in a group operation is 1 second, the IP SLAs multiple operations scheduling functionality instead calculates how many operations it should start in each 1-second interval by dividing the number of operations by the schedule period (10 operations divided by 5 seconds). Therefore, as shown in the figure above, two operations will be started every 1 second.

As the frequency is set to 10 in this example, each iteration of operation group 3 will start 10 seconds after the start of the previous iteration. However, this distribution is not optimal as there is a gap of 5 seconds (frequency minus schedule period) between the cycles.

If the number of operations getting scheduled does not equally divide into 1-second intervals, then the operations are equally divided at the start of the schedule period with the remaining operations to start at the last 1-second interval.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 4. Operation group 4 has a schedule period of 4 seconds and a frequency of 5 seconds.

Figure 7: Number of IP SLAs Operations Is Greater Than the Schedule Period--Uneven Distribution


ip sla group schedule 4 1-10 schedule-period 4 frequency 5
1
2
3
4
5
6
7
8
9
10
1
2
3
0s
1s
2s
3s
4s
5s
schedule-period
(4 seconds)
frequency
(5 seconds)
x - operation ID number, 1st iteration
x - operation ID number, 2nd iteration
- operation x starts
- time line; continues until the lifetime value is reached
y s - y seconds
170562

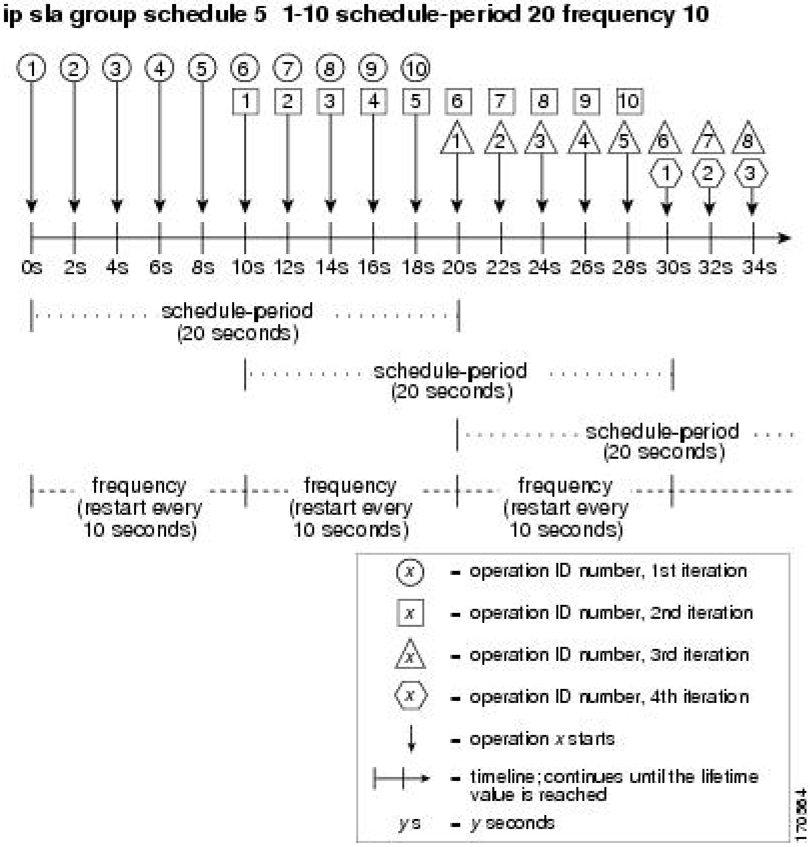
In this example, the IP SLAs multiple operations scheduling functionality calculates how many operations it should start in each 1-second interval by dividing the number of operations by the schedule period (10 operations divided by 4 seconds, which equals 2.5 operations every 1 second). Since the number of operations does not equally divide into 1-second intervals, this number will be rounded off to the next whole number (see the figure above) with the remaining operations to start at the last 1-second interval.

IP SLAs Multiple Operations Scheduling with Scheduling Period Greater Than Frequency

The value of frequency is the amount of time that passes before the schedule group is restarted. If the schedule period is greater than the frequency, there will be a period of time in which the operations in one iteration of an operation group overlap with the operations of the following iteration.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 5. Operation group 5 has a schedule period of 20 seconds and a frequency of 10 seconds.

Figure 8: IP SLAs Group Scheduling with Schedule Period Greater Than Frequency


ip sla group schedule 5 1-10 schedule-period 20 frequency 10
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8
1 2 3
0s 2s 4s 6s 8s 10s 12s 14s 16s 18s 20s 22s 24s 26s 28s 30s 32s 34s
schedule-period (20 seconds)
schedule-period (20 seconds)
schedule-period (20 seconds)
frequency (restart every 10 seconds)
frequency (restart every 10 seconds)
frequency (restart every 10 seconds)
x - operation ID number, 1st iteration
x - operation ID number, 2nd iteration
x - operation ID number, 3rd iteration
x - operation ID number, 4th iteration
- operation x starts
- timeline; continues until the lifetime value is reached
ys - y seconds
170384

In this example, the first operation (operation 1) in operation group 5 will start at 0 seconds. All 10 operations in operation group 5 (operation 1 to operation 10) must be started in the schedule period of 20 seconds. The start time of each IP SLAs operation is evenly distributed over the schedule period by dividing the schedule period by the number of operations (20 seconds divided by 10 operations). Therefore, each operation will start 2 seconds after the previous operation.

In the first iteration of operation group 5, operation 1 starts at 0 seconds, and operation 10, the last operation in the operation group, starts at 18 seconds. Because the operation group is configured to restart every 10 seconds (**frequency 10**), the second iteration of operation group 5 starts again at 10 seconds, before the first iteration is completed. Therefore, an overlap of operations 6 to 10 of the first iteration occurs with operations 1 to 5 of the second iteration during the time period of 10 to 18 seconds (see the figure above). Similarly, there is an overlap of operations 6 to 10 of the second iteration with operations 1 to 5 of the third iteration during the time period of 20 to 28 seconds.

In this example, the start time of operation 1 and operation 6 need not be at exactly the same time, but will be within the same 2-second interval.

The configuration described in this section is not recommended as you can configure multiple operations to start within the same 1-second interval by configuring the number of operations greater than the schedule period. For information, see the "Multiple Operations Scheduling When the Number of IP SLAs Operations Are Greater Than the Schedule Period" section.

IP SLAs Random Scheduler

The IP SLAs Random Scheduler feature is an enhancement to the existing IP SLAs Multioperation Scheduling feature. The IP SLAs Multioperation Scheduling feature provides the capability to easily schedule multiple IP SLAs operations to begin at intervals equally distributed over a specified duration of time and to restart at a specified frequency. With the IP SLAs Random Scheduler feature, you can now schedule multiple IP SLAs operations to begin at random intervals uniformly distributed over a specified duration of time and to restart at uniformly distributed random frequencies within a specified frequency range. Random scheduling improves the statistical metrics for assessing network performance.

Note The IP SLAs Random Scheduler feature is not in compliance with RFC2330 because it does not account for inter-packet randomness.

The IP SLAs random scheduler option is disabled by default. To enable the random scheduler option, you must set a frequency range when configuring a group schedule in global configuration mode. The group of operations restarts at uniformly distributed random frequencies within the specified frequency range. The following guidelines apply for setting the frequency range:

- The starting value of the frequency range should be greater than the timeout values of all the operations in the group operation.
- The starting value of the frequency range should be greater than the schedule period (amount of time for which the group operation is scheduled). This guideline ensures that the same operation does not get scheduled more than once within the schedule period.

The following guidelines apply if the random scheduler option is enabled:

- The individual operations in a group operation will be uniformly distributed to begin at random intervals over the schedule period.
- The group of operations restarts at uniformly distributed random frequencies within the specified frequency range.
- The minimum time interval between the start of each operation in a group operation is 100 milliseconds (0.1 seconds). If the random scheduler option is disabled, the minimum time interval is 1 second.
- Only one operation can be scheduled to begin at any given time. If the random scheduler option is disabled, multiple operations can begin at the same time.
- The first operation will always begin at 0 milliseconds of the schedule period.
- The order in which each operation in a group operation begins is random.

How to Configure an IP SLAs Multioperation Scheduler

Scheduling Multiple IP SLAs Operations

Note

- All IP SLAs operations to be scheduled must be already configured.
- The frequency of all operations scheduled in a multioperation group should be the same.
- List of one or more operation ID numbers to be added to a multioperation group is limited to a maximum of 125 characters, including commas (,).

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla group schedule** *group-operation-number operation-id-numbers* **schedule-period** *schedule-period-range* [**ageout** *seconds*] [**frequency** *group-operation-frequency*] [**life**{**forever** | *seconds*}] [**start-time**{*hh:mm*[*:ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh:mm:ss*}] **Example:** `Device(config)# ip sla group schedule 1 3,4,6-9 schedule-period 50 frequency range 80-100`	Specifies an IP SLAs operation group number and the range of operation numbers to be scheduled in global configuration mode.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to the privileged EXEC mode.
Step 5	**show ip sla group schedule** **Example:** `Device# show ip sla group schedule`	(Optional) Displays the IP SLAs group schedule details.

	Command or Action	Purpose
Step 6	**show ip sla configuration** **Example:** `Device# show ip sla configuration`	(Optional) Displays the IP SLAs configuration details.

Enabling the IP SLAs Random Scheduler

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla group schedule** *group-operation-number operation-id-numbers* **schedule-period** *seconds* [**ageout** *seconds*] [**frequency** [*seconds*| **range** *random-frequency-range*]] [**life**{**forever** | *seconds*}] [**start-time**{*hh:mm*[*:ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh:mm:ss*}] **Example:** `Device(config)# ip sla group schedule 2 1-3 schedule-period 50 frequency range 80-100`	Specifies the scheduling parameters of a group of IP SLAs operations. • To enable the IP SLAs random scheduler option, you must configure the **frequency range** *random-frequency-range* keywords and argument.
Step 4	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.

Verifying IP SLAs Multiple Operations Scheduling

Procedure

	Command or Action	Purpose
Step 1	**show ip sla statistics** **Example:** `Device# show ip sla statistics`	(Optional) Displays the IP SLAs operation details.
Step 2	**show ip sla group schedule** **Example:** `Device# show ip sla group schedule`	(Optional) Displays the IP SLAs group schedule details.
Step 3	**show ip sla configuration** **Example:** `Device# show ip sla configuration`	(Optional) Displays the IP SLAs configuration details.

Examples

After you have scheduled the multiple IP SLAs operations, you can verify the latest operation details using the appropriate **show** commands.

The following example schedules IP SLAs operations 1 through 20 in the operation group 1 with a schedule period of 60 seconds and a life value of 1200 seconds. By default, the frequency is equivalent to the schedule period. In this example, the start interval is 3 seconds (schedule period divided by number of operations).

```
Device# ip sla group schedule 1 1-20 schedule-period 60 life 1200
```

The following example shows the details of the scheduled multiple IP SLAs operation using the **show ip sla group schedule** command.

```
Device# show ip sla group schedule
Group Entry Number: 1
Probes to be scheduled: 1-20
Total number of probes: 20
Schedule period: 60
Group operation frequency: Equals schedule period
Status of entry (SNMP RowStatus): Active
Next Scheduled Start Time: Start Time already passed
Life (seconds): 1200
Entry Ageout (seconds): never
```

The following example shows the details of the scheduled multiple IP SLAs operation using the **show ip sla configuration** command. The last line in the example indicates that the IP SLAs operations are multiple scheduled (TRUE).

```
Device# show ip sla configuration 1
```

```
Entry number: 1
Owner:
Tag:
Type of operation to perform: udpEcho
Target address: 10.2.31.121
Source address: 0.0.0.0
Target port: 9001
Source port: 0
Request size (ARR data portion): 16
Operation timeout (milliseconds): 5000
Type Of Service parameters: 0x0
Verify data: No
Data pattern:
Vrf Name:
Control Packets: enabled
Operation frequency (seconds): 60
Next Scheduled Start Time: Start Time already passed
Life (seconds): 1200
Entry Ageout (seconds): never
Recurring (Starting Everyday): FALSE
Status of entry (SNMP RowStatus): Active
Threshold (milliseconds): 5000
Number of statistic hours kept: 2
Number of statistic distribution buckets kept: 1
Statistic distribution interval (milliseconds): 20
Enhanced History:
Number of history Lives kept: 0
Number of history Buckets kept: 15
History Filter Type: None
Group Scheduled : TRUE
```

The following example shows the latest operation start time of the scheduled multiple IP SLAs operation, when the operations are scheduled at equal intervals, using the **show ip sla statistics** command:

```
Device# show ip sla statistics | include Latest operation start time
Latest operation start time: *03:06:21.760 UTC Tue Oct 21 2003
Latest operation start time: *03:06:24.754 UTC Tue Oct 21 2003
Latest operation start time: *03:06:27.751 UTC Tue Oct 21 2003
Latest operation start time: *03:06:30.752 UTC Tue Oct 21 2003
Latest operation start time: *03:06:33.754 UTC Tue Oct 21 2003
Latest operation start time: *03:06:36.755 UTC Tue Oct 21 2003
Latest operation start time: *03:06:39.752 UTC Tue Oct 21 2003
Latest operation start time: *03:06:42.753 UTC Tue Oct 21 2003
Latest operation start time: *03:06:45.755 UTC Tue Oct 21 2003
Latest operation start time: *03:06:48.752 UTC Tue Oct 21 2003
Latest operation start time: *03:06:51.753 UTC Tue Oct 21 2003
Latest operation start time: *03:06:54.755 UTC Tue Oct 21 2003
Latest operation start time: *03:06:57.752 UTC Tue Oct 21 2003
Latest operation start time: *03:07:00.753 UTC Tue Oct 21 2003
Latest operation start time: *03:07:03.754 UTC Tue Oct 21 2003
Latest operation start time: *03:07:06.752 UTC Tue Oct 21 2003
Latest operation start time: *03:07:09.752 UTC Tue Oct 21 2003
Latest operation start time: *03:07:12.753 UTC Tue Oct 21 2003
Latest operation start time: *03:07:15.755 UTC Tue Oct 21 2003
Latest operation start time: *03:07:18.752 UTC Tue Oct 21 2003
```

Configuration Examples for an IP SLAs Multioperation Scheduler

Example Scheduling Multiple IP SLAs Operations

The following example shows how to scheduls IP SLAs operations 1 to 10 in the operation group 1 with a schedule period of 20 seconds. By default, the frequency is equivalent to the schedule period.

```
Device# ip sla group schedule 1 1-10 schedule-period 20
```

The following example shows the details of the scheduled multiple IP SLAs operation using the **show ip sla group schedule** command. The last line in the example indicates that the IP SLAs operations are multiple scheduled (TRUE).

```
Device# show ip sla group schedule
Multi-Scheduling Configuration:
Group Entry Number: 1
Probes to be scheduled: 1-10
Schedule period :20
Group operation frequency: 20
Multi-scheduled: TRUE
```

Example Enabling the IP SLAs Random Scheduler

The following example shows how to schedule IP SLAs operations 1 to 3 as a group (identified as group 2). In this example, the operations are scheduled to begin at uniformly distributed random intervals over a schedule period of 50 seconds. The first operation is scheduled to start immediately. The interval is chosen from the specified range upon every invocation of the probe. The random scheduler option is enabled and the uniformly distributed random frequencies at which the group of operations will restart is chosen within the range of 80-100 seconds.

```
ip sla group schedule 2 1-3 schedule-period 50 frequency range 80-100 start-time now
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference, All Releases
Cisco IOS IP SLAs: general information	“Cisco IOS IP SLAs Overview” module of the *Cisco IOS IP SLAs Configuration Guide*.
Multioperation scheduling for IP SLAs	“Configuring Multioperation Scheduling of IP SLAs Operations” module of the *Cisco IOS P SLAs Configuration Guide*

Related Topic	Document Title
Proactive threshold monitoring for IP SLAs	“Configuring Proactive Threshold Monitoring of IP SLAs Operations” module of the *Cisco IOS IP SLAs Configuration Guide*

MIBs

MIBs	MIBs Link
CISCO-RTTMON-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 9

IP SLAs TWAMP Responder

The Two-Way Active Measurement Protocol (TWAMP) defines a flexible method for measuring round-trip IP performance between any two devices.

TWAMP enables complete IP performance measurement. TWAMP also provides a flexible choice of solutions because it supports all devices deployed in the network.

This chapter describes how to configure the Two-Way Active Measurement Protocol (TWAMP) responder on a Cisco device to measure IP performance between the Cisco device and a non-Cisco TWAMP control device on your network.

Note IPv6 is supported for IP SLA TWAMP Responder on the RSP3 module.

NTP and PTP time stamping for TWAMP test packet

- To enable NTP time stamping for TWAMP test packet, run the following commands:
  - If TWAMP sender has epoch 1900 clock reference, enable the **platform time-source ntp time-scale epoch-1900** command.
  - If TWAMP sender has epoch 1970 clock reference, enable the **platform time-source ntp time-scale epoch-1970** command.

Table 1: Feature History

Feature Name	Release Information	Description
PTP time stamping	Cisco IOS XE Cupertino 17.9.1	Starting with Cisco IOS XE 17.9.x, TWAMP with PTP time stamping is supported.

- To enable PTP time stamping for TWAMP test packet, run the following commands:
  - If you need time stamps with leap seconds granularity, enable the **platform twamp_ptp_utc_time_scale_epoch_1900** command.
  - If you need time stamps without leap seconds granularity, enable the **platform twamp_ptp_time_scale_epoch_1900** command.

Prerequisites for IP SLAs TWAMP Responder

- A TWAMP control-client and the session-sender must be configured in your network.
- IP SLA server must be configured on the IP Server. Use the **ip sla server twamp** command to configure the sever.
- The TWAMP server and the session reflector must be configured on the same Cisco device.
- Enable NTP time stamping for TWAMP test packet on the NCS 4201 and 4202 series routers.
- Enable PTP time stamping for TWAMP test packet on the NCS 4201 and 4202 series routers.

Restrictions for IP SLAs TWAMP Responder

- Time stamping is not supported for TWAMP test packets that ingress or egress through management interfaces. Time stamping is supported only on routed interfaces and BDI interfaces.
- TWAMP client and session sender are not supported.
- Up to nine session-senders can be configured for one TWAMP responder.
- Effective Cisco IOS XE Bengaluru 17.5.1 TWAMP Light mode is supported.

  TWAMP Light mode is not supported in releases pror to Cisco IOS XE Bengaluru 17.5.1 release.
- TWAMP with NTP displays timestamp that does not match with the system clock. This is due to the hardware limitation.
- IPv6 TWAMP test packets are sent back with a hop limit of 64 instead of the value 255.
- IPv6 TWAMP test packets that are fragmented are not reflected back correctly.
- Custom DSCP values are not supported on TWAMP. The DSCP values used in the control phase are populated in the TWAMP test packets irrespective of whatever may be the DSCP value in the test packets incoming to the reflector.

IP SLAs TWAMP Architecture

Two-Way Active Measurement Protocol (TWAMP)

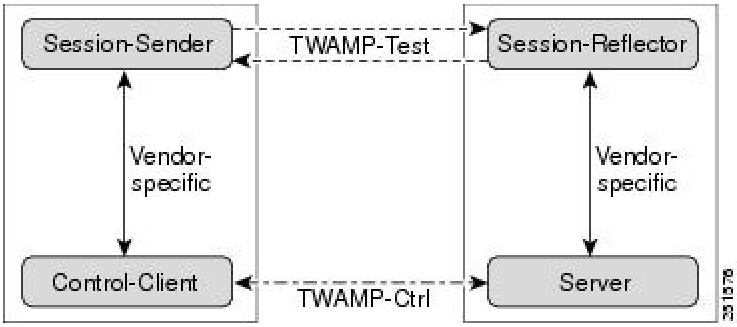
The IETF Two-Way Active Measurement Protocol (TWAMP) defines a standard for measuring round-trip network performance between any two devices that support the TWAMP protocols. The TWAMP-Control protocol is used to set up performance measurement sessions. The TWAMP-Test protocol is used to send and receive performance measurement probes.

The TWAMP architecture is composed of the following four logical entities that are responsible for starting a monitoring session and exchanging packets:

- The control client: It sets up, starts, and stops TWAMP test sessions.
- The session sender: It instantiates TWAMP test packets that are sent to the session reflector.
- The session reflector: It reflects a measurement packet upon receiving a TWAMP test packet. The session reflector does not collect packet statistics in TWAMP.
- The TWAMP server: It is an end system that manages one or more TWAMP sessions and is also capable of configuring each session ports in the end points. The server listens on the TCP port. The session-reflector and server make up the TWAMP responder in an IP SLAs operation.

Although TWAMP defines the different entities for flexibility, it also allows for logical merging of the roles on a single device for ease of implementation. The figure below shows the interactions of four entities of the TWAMP architecture.

Figure 9: TWAMP Architecture

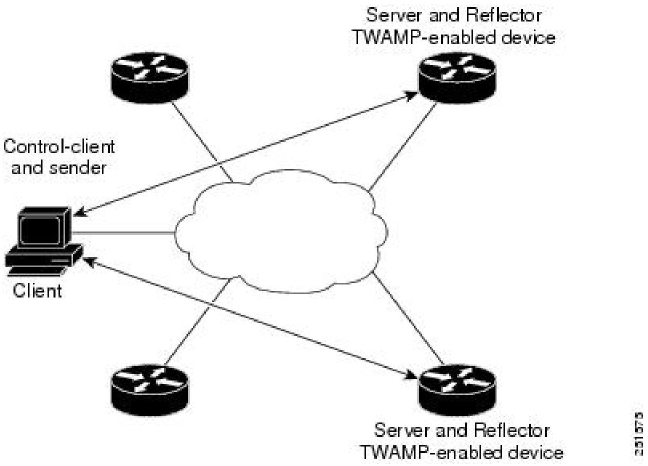


IP SLAs TWAMP Responder v1.0

A TWAMP responder interoperates with the control-client and session-sender on another device that supports TWAMP. In the IP SLAs TWAMP Responder v1.0 feature, the session-reflector and TWAMP server that make up the responder must be co-located on the same device.

In the figure below, there are two Cisco devices that are configured as IP SLAs TWAMP responders. Each IP SLAs TWAMP responder acts as both, a TWAMP server and a session-reflector.

Figure 10: IP SLAs TWAMP Responders in a Basic TWAMP Deployment



Note Only software time stamping for TWAMP is supported.

Two-Way Active Measurement Protocol

The Two-Way Active Measurement Protocol (TWAMP) defines a flexible method for measuring round-trip IP performance between any two devices.

- Advantages of TWAMP, on page 82
- The TWAMP entities, on page 82
- TWAMP Message Exchange Categories, on page 83

Advantages of TWAMP

- TWAMP enables complete IP performance measurement.
- TWAMP provides a flexible choice of solutions as it supports all devices deployed in the network.

The TWAMP entities

The TWAMP system consists of four logical entities:

- server -- manages one or more TWAMP sessions and also configures per-session ports in the end-points.
- session-reflector - reflects a measurement packet as soon as it receives a TWAMP test packet.
- control-client - initiates the start and stop of TWAMP test sessions.
- session-sender - instantiates the TWAMP test packets sent to the session reflector.

TWAMP Message Exchange Categories

The TWAMP protocol includes three distinct message exchange categories, they are:

- Connection set-up exchange: Messages establish a session connection between the Control-Client and the server. First the identities of the communicating peers are established via a challenge response mechanism. The server sends a randomly generated challenge, to which the Control-Client then sends a response by encrypting the challenge using a key derived from the shared secret. Once the identities are established, the next step negotiates a security mode that is binding for the subsequent TWAMP-Control commands as well as the TWAMP-Test stream packets.

Note A server can accept connection requests from multiple control clients.

- TWAMP-control exchange: The TWAMP-Control protocol runs over TCP and is used to instantiate and control measurement sessions. The sequence of commands is as follows, but unlike, the Connection setup exchanges, the TWAMP-Control commands can be sent multiple times. However, the messages cannot occur out of sequence although multiple request-session commands can be sent before a session-start command.
    - request-session
    - start-session
    - stop-session
- TWAMP-test stream exchange: The TWAMP-Test runs over UDP and exchanges TWAMP-Test packets between Session-Sender and Session-Reflector. These packets include timestamp fields that contain the instant of packet egress and ingress. The packet also includes a Sequence Number.

TWAMP-Control and TWAMP-test stream support only unauthenticated security mode.

Configure an IP SLAs TWAMP Responder

Note Effective Cisco IOS-XE Everest 16.6.1, time stamping for sender (T1, T4) and receiver (T3, T2) is performed by the hardware, instead of the software. This time stamping is done bythe hardware to improve the accuracy of jitter and latency measurements.

Note Software time stamping is implemented for TWAMP IP SLA packets on the RSP3 module.

Configuring the TWAMP Server

Note In the current implementation of IP SLAs TWAMP Responder, the TWAMP server and the session reflector must be configured on the same device.

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 **ip sla server twamp**

Example:

```
Device(config)#  ip sla server twamp
```

Configures the device as a TWAMP server and enters TWAMP server configuration mode.

Step 4 **port** *port-number*

Example:

```
Device(config-twamp-srvr)# port 9000
```

(Optional) Configures the port to be used by the TWAMP server to listen for connection and control requests.

Step 5 **timer inactivity** *seconds*

Example:

```
Device(config-twamp-srvr)# timer inactivity 300
```

(Optional) Configures the inactivity timer for a TWAMP control session.

Step 6 **end**

Example:

```
Device(config-twamp-srvr)# end
```

Returns to privileged EXEC mode.

Configuring the Session Reflector

Note In the current implementation of IP SLAs TWAMP Responder, the TWAMP server and the session reflector must be configured on the same device.

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 **ip sla responder twamp**

Example:

```
Device(config)# ip sla responder twamp
```

Configures the device as a TWAMP responder and enters TWAMP reflector configuration mode.

Step 4 **timeout** *seconds*

Example:

```
Device(config-twamp-ref)#  timeout 300
```

(Optional) Configures an inactivity timer for a TWAMP test session.

Step 5 **end**

Example:

```
Device(config-twamp-ref)# end
```

Exits to privileged EXEC mode.

Configuration Examples for IP SLAs TWAMP Responder

Configuration Example for IP SLAs TWAMP Responder for IPv6

The following example and partial output shows how to configure the TWAMP server and the session reflector on the same Cisco device. In this configuration, port 862 is the (default) port to be used by the IP SLAs TWAMP Responder v1.0

For the IP SLAs TWAMP responder to function, a control client and the session sender must be configured in your network.

Note The following example is for non-VRF scenarios (default):

```
Device> enable
Device# configure terminal
Router(config)# ip sla serv twamp
Router(config-twamp-srvr)# port 9000
Router(config-twamp-srvr)# timer inactivity 1200
Router(config-twamp-srvr)# exit
Router(config)# ip sla responder tw
Router(config)# ip sla responder twamp
Router(config-twamp-ref)# resp
Router(config-twamp-ref)# time
Router(config-twamp-ref)# timeout 2000
Router(config-twamp-ref)# exit
```

Configuration Example for IP SLAs TWAMP Responder for IPv6

```
twamp_RTR2#show ip sla twamp connection detail
Connection Id:          3
  Client IP Address:    2001:16::F
  Client Port:          54015
  Client VRF:           default
  Mode:                 Unauthenticated
  Connection State:     Connected
  Control State:        Active
  Number of Test Requests - 0:1
```

```
twamp_RTR2#show ip sla twamp session
IP SLAs Responder TWAMP is: Enabled
Recvr Addr: 2001:16::1
Recvr Port: 9
Sender Addr: 2001:16::8
Sender Port: 7
Sender VRF: default
Session Id: 0.0.0.8:16217652433068140527:DC98A400
Connection Id: 2A
```

```
twamp_RTR2#show ip sla twamp session
IP SLAs Responder TWAMP is: Enabled
Recvr Addr: 2001:16::1
Recvr Port: 9
Sender Addr: 2001:16::8
Sender Port: 7
Sender VRF: default
```

```
Session Id: 0.0.0.8:16217652433068140527:DC98A400
Connection Id: 2A
```

```
twamp_RTR2#show ip sla twamp session source-ip 2001:16::8 source-port 7
IP SLAs Responder TWAMP is: Enabled
Recvr Addr: 2001:16::1
Recvr Port: 9
Sender Addr: 2001:16::8
Sender Port: 7
Sender VRF: default
Session Id: 0.0.0.8:16217652433068140527:DC98A400
Connection Id: 2A
Mode: UnAuthorized
DSCP: 0
Pad Length: 128
Number of Packets Received: 81004
```

Configuration Example for IP SLAs TWAMP Responder

The following example and partial output shows how to configure the TWAMP server and the session reflector on the same Cisco device. In this configuration, port 862 is the (default) port to be used by the TWAMP server to listen for connection and control requests. The port for the server listener is the RFC-specified port and if required, can be reconfigured.

Note For the IP SLAs TWAMP responder to function, a control client and the session sender must be configured in your network.

The following examples are for non-VRF scenarios (default):

```
Device> enable
Device# configure terminal
Router(config)# ip sla serv twamp
Router(config-twamp-srvr)# port 12000
Router(config-twamp-srvr)# timer inactivity 1200
Router(config-twamp-srvr)# exit
Router(config)# ip sla responder tw
Router(config)# ip sla responder twamp
Router(config-twamp-ref)# resp
Router(config-twamp-ref)# time
Router(config-twamp-ref)# timeout 2000
Router(config-twamp-ref)# exit

Router# show ip sla twamp connection requests
    Connection-Id     Client Address   Client Port      Client VRF
          A3              100.1.0.1         59807         default

Router# show ip sla twamp connection detail
Connection Id:          A3
  Client IP Address:    100.1.0.1
  Client Port:          59807
  Client VRF:           intf2
  Mode:                 Unauthenticated
  Connection State:     Connected
  Control State:        Active
  Number of Test Requests - 0:1

Router# show ip sla twamp session
IP SLAs Responder TWAMP is: Enabled
```

```
Recvr Addr: 100.1.0.2
Recvr Port: 7
Sender Addr: 100.1.0.1
Sender Port: 34608
Sender VRF: default
Session Id: 100.1.0.2:15833604877498391199:6D496912
Connection Id: 101

Router# sh running-config | b twamp
ip sla responder twamp
 timeout 2000
ip sla responder
ip sla enable reaction-alerts
ip sla server twamp
 port 12000
 timer inactivity 1200
!
!
```

The following examples are for VRF scenarios:

```
Router# show ip sla twamp session
IP SLAs Responder TWAMP is: Enabled
Recvr Addr: 100.1.0.2
Recvr Port: 7
Sender Addr: 100.1.0.1
Sender Port: 51486
Sender VRF: intf1
Session Id: 100.1.0.2:9487538053959619969:73D5EDEA
Connection Id: D0

Router# show ip sla twamp connection detail
Connection Id:          A3
  Client IP Address:    100.1.0.1
  Client Port:          52249
  Client VRF:           intf2
  Mode:                 Unauthenticated
  Connection State:     Connected
  Control State:        Active
  Number of Test Requests - 0:1

Router# show ip sla twamp connection requests
  Connection-Id    Client Address   Client Port    Client VRF
             A3       100.1.0.1       52249          intf2
 Total number of current connections: 1
```

Note The default port for IP SLA server is 862.

IP SLAs TWAMP Light

TWAMP Light is a light-weight model of TWAMP, which eliminates the need for a TWAMP control session. The test session parameters exchanged over the control session in TWAMP preconfigured at both endpoints of the TWAMP Light test session. This reduces the overhead of configuring a control session and eliminates the need for a TWAMP server that is maintained at the reflector end.

Table 2: Feature History

Feature Name	Release Information	Feature Description
TWAMP Light	Cisco IOS XE Bengaluru 17.5.1	This feature enables you to configure a TWAMP Light session using the **ip sla responder twamp-light test-session** command on the Cisco RSP2 module.

Restrictions for IP SLAs TWAMP Light

- UDP port configured on IP SLA Permanent Port cannot be configured on TWAMP Light session.
- TWAMP Light Responder and TWAMP Responder cannot be enabled simultaneously on the same UDP port.
- If a TWAMP test session is in progress, a TWAMP-Light session cannot be configured on the same port.
- If a request test session message is received from the TWAMP control client for the same port number that is used by the TWAMP Light test session, then the message will not be accepted.
- You can configure a maximum of 100 TWAMP Light sessions as allowed by the Control Plane.
- Custom DSCP values are **not** supported on TWAMP Light sessions. The DSCP value of the incoming packet is **not** used to mark the reflected packet. The default DSCP best effort value is marked in the reflected packets.

Configuring TWAMP Light

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**ip sla responder twamp-light test-session** *1 local-ip 10.0.0.1 local-port 1234 remote-ip 2.2.2.2 remote-port 3456*
	Example:
	`Device(config)#ip sla responder twamp-light test-session 1 local-ip 10.0.0.1 local-port 1234 remote-ip 2.2.2.2 remote-port 3456`
	`Device(config)#show run | sec twamp-light`
		Configures the TWAMP Light test session on the Cisco router.

	Command or Action	Purpose

	`ip sla responder twamp-light test-session 1`
	`local-ip 10.0.0.1 local-port 1234`
	`remote-ip 2.2.2.2 remote-port 3456`	

Step 4	**end**
	Example:
	`Device(config)# end`
		Returns to privileged EXEC mode.

Verifying TWAMP Light

The **show ip sla twamp-light session** command displays the TWAMP Light statistics

```
Device#show ip sla twamp-light session
Session ID: 1
Status: Active
Mode: Unauthenticated
Local Addr:10.0.0.1
Local Port: 15001
Remote Addr:1.1.1.2
Remote Port: 15002
Test packet received: 100
Test packet sent: 100
```

Feature Information for IP SLAs TWAMP Responder

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 3: Feature Information for IP SLAs TWAMP Responder

Feature Name	Releases	Feature Information
IP SLAs TWAMP Responder v1.0	Cisco IOS XE Everest 16.5.1	This feature was introduced on the Cisco ASR 900 Series Aggregation Services Router.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases

Related Topic	Document Title
IP SLAs commands	Cisco IOS IP SLAs Command Reference

Standards and RFCs

Standard/RFC	Title
RFC 5357	*Two-Way Active Measurement Protocol (TWAMP)*
RFC 4656	*One-way Active Measurement Protocol (OWAMP)*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 10

IP SLA—Service Performance Testing

This module describes how to configure the ITU-T Y.1564 Ethernet service performance test methodology that measures the ability of a network device to enable movement of traffic at the configured data rate.

Information About Service Performance Operations

Y.1564 is an Ethernet service activation test methodology and is the standard for turning up, installing, and troubleshooting Ethernet and IP based services. Y.1564 is the only standard test methodology that allows a complete validation of Ethernet service-level agreements (SLAs) in a single test.

Service activation testing (SAT) is designed to measure the ability of a Device Under Test (DUT) or a network under test to properly forward traffic in different states.

Effective with Cisco IOS XE Everest Release 16.5.1, 10 Gigabit (10G) SAT session is supported on Cisco RSP2 and Cisco RSP3 Modules. Any SAT session with a rate-step greater than or equal to 1 Gbps is considered as 10G SAT session.

Cisco implementation of ITU-T Y.1564 has three key objectives:

- To serve as a network SLA validation tool, ensuring that a service meets its guaranteed performance settings in a controlled test time.

- To ensure that all services carried by the network meet their SLA objectives at their maximum committed rate, thus proving that under maximum load, network devices and paths can support all traffic as designed.
- To perform medium-term and long-term service testing, confirming that network elements can properly carry all services while under stress during a soaking period.

The following Key Performance Indicators (KPI) metrics are collected to ensure that the configured SLAs are met for the service or stream. These are service acceptance criteria metrics.

- Information Rate (IR) or throughput—Measures the maximum rate at which none of the offered frames are dropped by the device under test (DUT). This measurement translates into the available bandwidth of the Ethernet virtual connection (EVC).
- Frame Transfer Delay (FTD) or latency—Measures the round-trip time (RTT) taken by a test frame to travel through a network device, or across the network and back to the test port.
- Frame Loss Ratio (FLR)—Measures the number of packets lost from the total number of packets sent. Frame loss can be due to a number of issues such as network congestion or errors during transmissions.
- Frame Delay Variation (FDV) or jitter—Measures the variations in the time delays between packet deliveries.

The below table presents the KPI support matrix for RSP3 Module:

Table 4: Supported Key Performance Indicators Matrix for Cisco RSP3 Module

KPI	**ASIC-Based SADT**		**FPGA-Based SADT**	
	Internal Direction	**External Direction**	**Internal Direction**	**External Direction**
Delay	N	N	Y	Y
Jitter	N	N	Y	Y
Loss	Y	Y	Y	Y
Throughput	Y	Y	Y	Y

Note We always recommend that you use FPGA-based SADT.

SADT Internal sessions do not support ASIC-based SAT.

Because they interconnect segments, forwarding devices (switches and routers) and network interface units are the basis of any network. If a service is not correctly configured on any one of these devices within the end-to-end path, network performance can be greatly affected, leading to potential service outages and network-wide issues such as congestion and link failures. Service performance testing is designed to measure the ability of DUT or network under test, to correctly forward traffic in different states. The Cisco implementation of ITU-T Y.1564 includes the following service performance tests:

- Minimum data rate to CIR—Bandwidth is generated from the minimum data rate to the committed information rate (CIR) for the test stream. KPI for Y.1564 are then measured to ensure that the configured service acceptance criteria (SAC) are met.

- CIR to EIR—Bandwidth is ramped up from the CIR to the excess information rate (EIR) for the test stream. Because EIR is not guaranteed, only the transfer rate is measured to ensure that CIR is the minimum bandwidth up to the maximum EIR. Other KPI is not measured.

Service performance supports four operational modes: two-way statistics collection, one-way statistics collection, passive measurement mode, and traffic generator mode. Statistics are calculated, collected, and reported to the IP SLAs module. The statistics database stores historical statistics pertaining to the operations that have been executed.

- One-way statistics collection—Both the passive measurement mode and the traffic generator mode are used in conjunction with each other. One device sends traffic as the generator and another device receives traffic in the passive mode and records the statistics. The passive mode is distinct from the two-way mode, where the remote device records statistics instead of looping back the traffic and the sending device records only the transmit statistics.
- Two-way statistics collection—All the measurements are collected by the sender. The remote target must be in the loopback mode for the two-way statistics to work. Loopback mode enables the traffic from the sender to reach the target and be returned to the sender.
- Passive measurement mode—This mode is enabled by excluding a configured traffic profile. A passive measurement operation does not generate live traffic. The operation collects only statistics for the target configured for the operation.
- Traffic generator mode—This mode records transmit statistics for the number of packets and bytes sent.

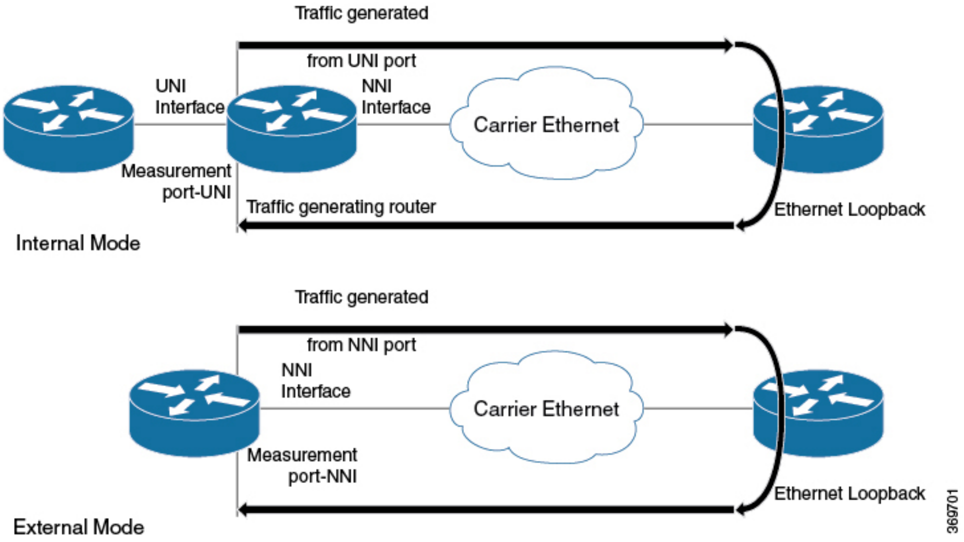
Information About Configuring Y.1564 to Generate and Measure Ethernet Traffic

Y.1564 is an ethernet service activation or performance test methodology for turning up, installing, and troubleshooting ethernet and IP based services. This test methodology allows for complete validation of ethernet service-level agreements (SLAs) in a single test. Using the traffic generator performance profile, you can create the traffic based on your requirements. Network performance indicators like throughput, loss, and availability are analyzed using layer 2 traffic with various bandwidth profiles. Availability is inversely proportional to frame loss ratio.

The figure below shows the Traffic Generator topology describing the traffic flow in the external and internal modes. The traffic is generated at the wire-side of Network-to-Network Interface (NNI) and is transmitted to the responder through the same interface for the external mode. The traffic is generated at the User-to-Network Interface (UNI) and transmitted to the responder through NNI respectively for the internal mode. The external mode is used to measure the throughput and loss at the NNI port whereas internal mode is used to measure the throughput and loss at the UNI port. During traffic generation, traffic at other ports is not affected by the generated traffic and can continue to switch network traffic.

Effective from the Cisco IOS XE 16.12.x release, 10G SAT External is supported on the Cisco Router.

Figure 11: Traffic Generator Topology



The following table provides details of the different service types and traffic directions supported for each service typeon the Cisco RSP2 Module.

Table 5: Service Types and Their Corresponding Traffic Direction for IP Target SLA on the Cisco RSP2 Module

Service Type	Traffic Direction for IP Target SLA
Service Instance	Internal
Interface (Physical)	Internal
Bridge Domain	Internal
VRF	Internal

Table 6: Service Types and Their Corresponding Traffic Direction for Ethernet Target SLA on the Cisco RSP2 Module

Service Type	Traffic Direction for Ethernet Target SLA
Service Instance	Internal and External
Bridge Domain	Internal

The following table provides details of the different service types and traffic directions supported for each service type on the RSP3 module.

Table 7: Service Types and Their Corresponding Traffic Direction on the Cisco RSP3 Module

Target	ASIC based SAT		FPGA based SAT	
	Internal Direction	External Direction	Internal Direction	External Direction
L2 Interface (color-blind)	N	N	Y	Y

Target	ASIC based SAT		FPGA based SAT	
	Internal Direction	External Direction	Internal Direction	External Direction
L2 Interface (color-aware)	N	N	Y	N
L2 EFP (color-blind)	Y	Y	Y	Y
L2 EFP (color-aware)	N	N	Y	N
L2 TEFP (color-blind)	N	N	Y	Y
L2 TEFP (color-aware)	N	N	Y	N
L2 VLAN/Bridge-domain (color-blind)	N	N	Y	N
L2 VLAN/Bridge-domain (color-aware)	N	N	N	N
L2 PW (color-blind)	Y	N	Y	N
L2 PW (color-aware)	N	N	Y	N
L3 Routed Interface	N	N	N	N
L3 EFP/TEFP	N	N	N	N
L3 VRF	N	N	N	N
L3 PW	N	N	N	N
L3 Loopback	N	N	N	N

Prerequisites for IP SLA - Service Performance Testing

Ensure that the direction configured for the **measurement-type direction {internal | external}** and the **profile traffic direction {internal | external}** commands is the same.

Restrictions for IP SLA - Service Performance Operation

- The IP SLA sender egress and ingress VLAN should match. Ensure to configure VLAN translation in the same context.
- IP SLA classification is supported only for the DSCP/TOS marking from IP SLA command.
- One-way statistics collection is not supported.
- Layer 2 Color-Aware IP SLA is not supported for external traffic direction.
- The bridge-domain target type is not supported for external traffic direction.
- Color-Aware SLA for bridge-domain target type is not supported.
- Since SAT traffic is intrusive, any other traffic is dropped for a particular EFP.
- IPv6 address is not supported as a destination address.
- For two-way mode, the Multicast destination support is not available for IP SLA (layer 3 SLA).
- IP SLA does not support enabling a signature.
- SLA on the target with Custom Ethertype encapsulation is not supported.
- SLA on the target with 802.1ad enabled is not supported.
- Multiple active sessions are not supported on the same Ethernet EFP.
- For operations with two-way measurements, any one of the parameters, namely, port, destination MAC address, and encapsulation VLANs, should be different for SLA sessions that are simultaneously active.
- Scaling is dependent on the availability of the terminal SAT session, terminal loopback session, and egress Span session.
- For layer 2 virtual forwarding instance (VFI) or Switched Virtual Interface (SVI), only target type EFP and generator or measurement type terminal sessions should be used.
- For IMIX traffic, packet sizes of 64 bytes, 512 bytes, and 1518 bytes are supported. These packet sizes are forwarded in the ratio 7:4:1.
- For operations with layer 2 and layer 3 SLA on Trunk EFP, outer VLAN tag of the packet is mandatory.
- While a SLA session is in progress, dynamic addition of MAC access lists (ACLs) does not affect the SLA traffic.
- Priority tag SLA in external direction is supported only when the inner tag and outer tag are marked as priority tags.
- Terminal and Facility SLA sessions cannot be started on a port configured as a SPAN destination.
- Source MAC address should not be configured as multicast or broadcast MAC address.
- PIM Sparse mode is not supported for traffic generator mode and passive mode.
- SAT session fails with proper syslog messages for the following reasons:
- Only interface or service instance is supported for external session.

- VLAN or Bridge-domain service types are not supported for facility Traffic Generator and Traffic Measurement.
- EFP or Trunk EFP or bridge-domain is shut.
- The following table shows the supported egress and ingress QOS on the sender side core interface for Ethernet and IP target SLA.

Table 8: IP SLA and Type of QOS supported

IP SLA	Type of QOS	Supported on sender side core interface
IP Target SLA	Egress	Yes
IP Target SLA	Ingress	No
Ethernet Target SLA	Egress	No
Ethernet Target SLA	Ingress	Yes

- The following table shows how Ethernet Target SLA with multicast or broadcast source MAC address is supported on different operational modes.

Table 9: Multicast or Broadcast MAC support criteria for SLA

Source or destination MAC address	Operational mode	Support for Ethernet Target SLA
Multicast or broadcast source MAC address	Traffic generator mode	Not supported
	Passive measurement mode	
	Two-way statistics collection mode	
Multicast or broadcast destination MAC address	Traffic generator mode	SLA generates the traffic
	Passive measurement mode	SLA receives the traffic
	Two-way statistics collection mode	Not supported

- Service Activation layer 3 Loopback is not supported with the target interface belonging to ASIC 1 in RSP2.
- Generation of burst traffic is not supported; therefore, configuration of CBS and EBS is not supported.
- IP SLAs configured with *start-time now* keyword need to be restarted after reload.
- PPS mode is *not* supported with IMIX packet size.
- IP SLA V2 (RFC 6812) and V3 are not supported on RSP3.
- For the color aware SADT to work as expected, rewrite EFP should be present.

Restrictions on the Cisco RSP2 Module

- Only DSCP-based marking is supported for IP Target operations.
- The session duration is limited to multiples of 10; user input is rounded down to the nearest multiple of 10.
- Quality of Service (QOS) on any target type with IP SLA is not supported on layer 2 and layer 3 routers.
- Layer 3 IP SLA is not supported on external traffic direction.
- Layer 3 SLA Loopback is not supported for labelled incoming packets.
- For layer 3 Loopback, if the target type is service instance, the core and access side EFP should have the same encapsulation.
- For layer 3 Loopback, if the target type is VRF, only encapsulation untagged is supported. The loopback session is not supported for the VRF target types even for same encapsulation on access and core EFPs.
- For layer 3 Loopback, if the target type is bridge domain, only encapsulation untagged is supported. The loopback session is not supported for the bridge domain target types, even for the same encapsulation on access and core EFPs.
- For operations with passive measurement mode and target type EFP, the same destination MAC address cannot be used for any other traffic on a port as the loopback MAC Address Tables (CAM) tables contain the channel numbers and the destination MAC address. As a result, multiple SLAs with the same destination MAC address, on the same port active at the same time, are not supported for passive measurement mode.
- For operations with EFP using XConnect, only the target type EFP and terminal sessions for Tx and Rx statistics are supported.
- For layer 2 internal sessions with Rx statistics, either only four non-color-aware sessions, or one color-aware session and one non-color-aware session are supported.
- Port channel is not supported.
- For operations with SLA in PPS mode, an additional packet is forwarded.
- The minimum supported value for rate step is 1024 pps.
- While running SADT, the packet that matches the SLA profile source MAC, VLAN or untagged, is counted in the RX. For example, if you schedule an SLA and start PING in the same time frame, PING fails, since the ping acknowledgement packet is accounted in SLA RX packet. Similarly, the LL discovery packet from the responder is accounted in SLA RX. So, there is one extra packet and the same packet is not accounted in the LL discovery counter.

Restrictions for 10G SAT

- The IP SLA packets are generated and forwarded in ratio of 1:1:1:1:1 from UNI or NNI port based on your configuration.
- 10G service activation test (SAT) is supported only for Layer 2 traffic in external and internal direction.
- 10G SAT is not supported in internal direction for releases prior to 16.12.x.
- Only color blind configurations are supported. CIR, EIR, and other color aware parameters is not supported.

- 10G SAT can only run in two-way mode.
- Effective from Cisco IOS XE Gibraltar 16.12.1, Delay, and Jitter measurements are supported.
- 10G SAT target type that is supported is only on access EFP.
- A combination of 1G and 10G SAT sessions cannot be run in parallel.
- At SLA run time, SAT statistics may not match. Statistics must be validated only after SLA completes. While SAT SLA is running, there might be instances where Rx might be greater than Tx. This is because of slow retrieval of statistics from the hardware. Statistics should be verified only after SAT operation is complete.
- Layer 3 packets for Layer 2 facility SAT 10G session is not supported.
- Only Layer 2 related parameters (SRC, MAC, VLAN, COS) should be configured while constructing the packet profile.
- Ethertype of IPv4 or IPv6 is not supported.
- Layer 3 packet headers should not be used in profile packet.
- Multiple rate-steps that are mentioned in a single command can only be mentioned in incremental order.
- With 10G SAT running in external mode, while QoS egress shaper policy is applied on the same SAT interface, SAT traffic generation is being affected based on the shaper value. SAT rate-step is adjusted by shaper policy. However, when policer based policy is applied inbound, there is no impact with regards to SAT traffic being policed. Despite the policer value configured, no policing happens for the return traffic on SAT interface. This is due to the configured internal ACL to handle the SAT statistics.
- If a 10G SAT session is running (with a rate-step greater than or equal to 1 Gbps), a second 1G or 10G SAT session should not be executed parallely.
- The SAT rate-step upper limits should be defined in such a way that BFD has some bandwidth for itself and ensures that the OSPF flaps do not occur. The upper limit for FPGA traffic generation for SAT is same in both SAT 1G and 10G. So, the upper limit of SAT 1G x 10 are applicable for SAT 10G to avoid the OSPF flaps.
- OIR and SSO are not supported with SAT. SLA is to be stopped and re-started manually after these triggers.
- SADT session and Ethernet loopback (ELB) on the same service instance of an interface is not supported.
- 10G SAT with 802.1ad is not supported.
- A delay of 10 seconds is recommended between two 10G SAT iterations or between two SLA runs (serial run).
- A combination of untagged and default should never be configured on an interface for launching 10G SLA session. 10G SAT on encapsulation default does not work when encapsulation untagged is configured on the interface.
- Even with 10G SAT, maximum FPGA available for 920 is 1G. 10G SAT rate is achieved by generating the packets in FPGA (upto 1 Gbps) and multiplying it by 10 on the hardware. Hence, a maximum of 1G FPGA is only available for all processes including BFD, SAT, NetFlow, and so on So, crossing the 1G cumulative threshold in FPGA causes flaps on the various interfaces that involve FPGA.
- 10G SAT is not supported over VRF and Port-Channel interfaces.

- SADT 10G session uses a shadow session with given MAC + 1 (0011.1111.2222 to 0011.1111.2223).
- 10G SADT internal is supports only Xconnect EFP and Plain EFP.
- 10G SADT is not supported on L2VFI (Virtual Forwarding Interface) and local connect.
- 10G SADT Color-aware configurations are not supported.

Note

- Overall throughput in the system slightly varies up to +/- 2% from the mentioned rate-step value.
- Color-aware case "rewrite ingress tag pop 1 symmetric" is mandatory under the efp configuration.

Restrictions for SAT Two-Way Sessions on EFP Xconnect on the Cisco RSP2 Module

- For operations with EFP using XConnect, the rewrite ingress tag pop 1 symmetric command is not supported for two-way sessions when Class of Service (COS) value is a part of the packet profile.
- For operations with EFP using XConnect, the rewrite command is not supported when Class of Service (COS) value is configured for the SLA.
- For EVC with XConnect targets, CoS marking based on color for the color-aware cases is performed on the outer layer 2 header VLAN tags (if applicable). As a result, this marking should be retained across the network so that it is available on the packet, which is received at the remote end (passive measurement mode) or the same end after loopback at the remote end (two-way mode). If this CoS marking is not retained, there is no way identifying the color of the different packets and perform color-aware measurement.
- Color-aware two-way sessions measurement is not supported for the restrictions listed above.

Restrictions on Cisco RSP3 Module for ASIC-Based SAT

The following restrictions are applicable only on the Cisco RSP3 Module:

- The Tx and Rx counters are not synchronized during aggregation interval.
- Traffic generation and measurement on target Bridge-domain, layer 3 interfaces, MPLS PWs, and BDI are not supported.
- A maximum of four concurrent sessions are supported.
- Each session should run on a different bridge-domain with unique packet VLAN parameters.
- Color aware statistics are not supported.
- EFP port-channel is not supported.
- On target type EFP, bridge-domain specific features like L2PT, CEM, CFM, G.8032, STP, RSTP, and MSTP are not supported.
- Target type EFP should not have any ingress or egress QoS applied on it. No port level QoS should be present.
- Delay and jitter are not supported.

- IMIX packet type is not supported, if configured, it will generate 64 bytes of packets.
- Maximum traffic generation/measurement time is 11 hours.
- If SPAN is configured, there is double Rx counters in statistics for external mode and double Tx counters in statistics for internal mode.
- Traffic is not generated for priority tag (VLAN 0).
- On test EFP/interface Shutdown, the test packets do not egress out of any interface on the device, and after unshut, the traffic does not resume to egress. The test has to be restarted.
- Test on TEFP is not supported.
- Double tag packet with outer and inner COS and rewrite POP1 is not supported.
- Double tag packet with outer and inner COS and EFP with two VLAN and rewrite POP2 is not supported.
- Only half of the line-rate (interface rate) is supported on a two-way session in internal mode. This limitation is not applicable for passive measurement and generator only sessions.
- The service instance statistics on EFP, on which the internal session runs, has double the actual output packet count (synthetic packets are accounted twice.)
- For higher step rate (1G,10G) Tx and Rx counters may not be accurate. A maximum of 10 Gbps is supported.
- Configured step rate will not be the same as overall throughput, it varies based on the configured packet size.
- Tx and Rx bytes may not be the same in **show ip sla <> statistics** CLI, though Tx and Rx packet are same.
- There is no check if the destination MAC address is configured as all zero (0000.0000.0000) in IP SLA session.

Restrictions on Cisco RSP3 Module for FPGA Based SAT

The following restrictions ae applicable only on the Cisco RSP3 Module :

- For two-way sessions, source MAC address (last 2 bytes) of configured IP SLA sessions should be unique.
- For passive measurement sessions, destination MAC address (last 2 bytes) of configured IP SLA sessions should be unique.
- PPS may not match exactly.
- FPGA supports a minimum of 16 Kbps and a maximum of 10 Gbps. FPGA cannot generate traffic with 100 percent accuracy. There may be a little difference between configured bandwidth and actual bandwidth.
- For external direction SADT session, Rx and Tx packet count are same but Rx bytes and Tx bytes may not match exactly if the target EFP is configured with a rewrite action.
- In some scenarios, SLA statistics collection is delayed by 1 second. This may impact the overall throughput.
- Color aware statistics do not work if BDI is present for the bridge domain.

- Dynamic modification is not supported while the session is running.
- VLAN should be configured at the target interface in the SLA session. If the VLAN is not part of the interface configuration, packets are not handled properly.
- If the outer VLAN is not specified but the inner VLAN is specified for the target EFP, by default the outer VLAN is 4095, the outer COS is 7, and the CFI is 1. If both the outer and the inner VLAN is not specified, the VLAN tags are fetched from the EFP.
- The outer VLAN is required for the target TEFP.
- Color-aware SADT is not supported on Cisco RSP3-200 module .
- SADT supports only two rate three color policy.
- Starting with Cisco IOS XE Release 16.6.1, for Cisco NCS 4216 routers, do *not* use any IM on slot 14 with FS or default mode. For Cisco NCS 4206 routers, do *not* use 8X10 Gigabit interface module on slot 2 with SADT.

Scale and Limitations for Configuring IP SLA - Service Performance Operation

The following tables shows the scaling numbers supported for different SAT sessions.

Table 10: Scaling Numbers for IP SLA on the Cisco RSP2 Module

IP SLA	1G Scaling Numbers Supported	10G Scaling Numbers Supported
IP Target Color Aware SLA	5	NA
IP Target Color Blind SLA	15	
Ethernet Target Color-Aware SLA	1	NA
Ethernet Target Color Blind SLA	8 (4 Internal SLA + 4 External SLA)	1
IP Target Loopback SLA	4	NA

Table 11: Scaling numbers for ASIC and FPGA based SAT on the Cisco RSP3 Module

IP SLA	ASIC Based SAT	FPGA Based SAT
Color-Blind Sessions	4	16
Color-Aware Sessions	Not supported	5

Note The scale limit with the combination of Color-Aware and Color Blind IP SLA depends on the number of TCAM entries that the combination of SAT sessions consume. The Color-Aware session takes 3 entries for each session and the Color Blind consumes 1 entry for each session. Hence, the maximum scale for Color-Aware sessions is 15 (3 * 5 = 15 entries) and that for the Color Blind sessions is 15 (15 * 1 = 15 entries). Combination of Color-Aware and Color Blind depends on the number of TCAM entries consumed by the SAT profile and it is limited to entries.

Note If a 10G SADT session is running then no other 1G or 10G session can be started on the Cisco RSP2 Module.

The following table lists the Y.1564 two-way throughput measurement.

Table 12: Throughput Measurement for Each Packet Size on the Cisco RSP2 Module

Packet Size (Bytes)	1G Max Rate (kbps)	10G Max Rate (kbps)
64	469848	4698480
128	638061	6380610
256	775123	7751230
512	867758	8677580
1024	922728	9227280
1280	934554	9345540
1518	942124	9421240
9216	977675	9776750
IMIX	788000	7880000

Table 13: Throughput Measurement for Each Packet Size for ASIC Based SAT on the Cisco RSP3 Module

Packet Size	Internal	External
Max Rate (kbps) rate:1G, IM:10G		
64	986169	925157
128	982719	975951
256	1018034	986169
512	1009204	988579
1024	1016314	997530
1280	1009846	1012763

Packet Size	Internal	External
1518	1014998	1039846
9216	1003852	1006002
Max Rate (kbps) rate:4G, IM:10G		
64	3822359	3604502
128	3884910	3893062
256	3938838	3960314
512	4080777	4010879
1024	4000000	4017306
1280	4123842	3981764
1518	4069995	4032446
9216	4004198	4075513
Max Rate (kbps) rate:8G, IM:10G		
64	5359118	7409427
128	5604487	7627530
256	5450054	8035130
512	5940545	8038857
1024	6048404	8118077
1280	6244374	8157713
9216	5632151	8182673
Max Rate (kbps) rate:10G, IM:10G		
64	5984087	7950793
128	6178049	8839840
256	6163375	9605736
512	6523558	9831282
1024	6836542	9797476
1280	6896587	10123292
9216	6798517	10250879

Table 14: Throughput Measurement for Each Packet Size for FPGA Based SAT on the Cisco RSP3 Module

Packet Size	Internal
Max Rate (Kbps): 1G	
64	999998 kbps
512	999998 kbps
1518	999996 kbps
Max Rate (Kbps): 5G	
64	4999990 kbps
512	4999990 kbps
1518	4999988 kbps
Max Rate (Kbps): 6.5G	
64	6499995 kbps
512	6499986 kbps
1518	6499997 kbps
Max Rate (Kbps): 10G	
64	6.9-7.2 Gbps
512	9554557 kbps
1518	9863795 kbps

Note For 10G SADT Traffic, for packet size 64, the throughput would be between 6.9-7.2Gbps, based on the router slots and the interface combination

Note The Max Rate mentioned in the tables above is the maximum SLA rate supported by router and it is independent of SLA sessions. Max Rate can be achieved in a single SLA session or combination of two or more SLA sessions. Exceeding the supported Max Rate might impact other services.

Generating Traffic Using Y.1564

Follow these steps to generate traffic using Y.1564:

Procedure

<table>
<tr><th></th><th>Command or Action</th><th>Purpose</th></tr>
<tr><td><b>Step 1</b></td><td>Configure Ethernet Virtual Circuits (EVC).</td><td>EVC is configured on the interface path such that the layer 2 path between the transmitter and the receiver is complete. For more information, see the "Configuring Ethernet Virtual Connections (EVCs)" section in the <i>Carrier Ethernet Configuration Guide, Cisco IOS XE Release</i> .</td></tr>
<tr><td><b>Step 2</b></td><td>Configure Traffic Generator on the transmitter.
<b>Example:</b>
The following is a sample configuration of the traffic generator.
<pre>
Device(config)# ip sla 100
Device(config-ip-sla)#
service-performance type ethernet
dest-mac-addr 0001.0002.0003 interface
TenGigabitEthernet0/0/4 service instance
 100
Device(config-ip-sla-service-performance)#
 aggregation interval buckets 2
Device(config-ip-sla-service-performance)#
 frequency iteration 2 delay 10
Device(config-ip-sla-service-performance)#
 profile packet
Device(config-sla-service-performance-packet)#
 packet-size 256
Device(config-sla-service-performance-packet)#
 outer-vlan 100
Device(config-sla-service-performance-packet)#
 profile traffic direction external
Device(config-sla-service-performance-traffic)#
 rate-step kbps 1000
Device(config-ip-sla-service-performance)#
 end
Device #
</pre></td><td></td></tr>
<tr><td><b>Step 3</b></td><td>Configure Ethernet Loopback at the remote end.</td><td>For information on Ethernet Loopback, see "Understanding Ethernet Loopback" section in the <i>Layer 2 Configuration Guide, Cisco IOS XE Release</i> .</td></tr>
<tr><td><b>Step 4</b></td><td>Configure loopback on SAT IP SLA configuration itself at the remote end.
<b>Example:</b>
<pre>
ip sla 1
 service-performance type ethernet
dest-mac-addr 0001.0001.0001 interface
GigabitEthernet0/0/3 service instance 2
  loopback direction external
  profile packet
   inner-vlan 20
   outer-vlan 10
</pre></td><td></td></tr>
</table>

	Command or Action	Purpose

	`  src-mac-addr 0002.0002.0002`
	`  duration time 5000`	

Step 5	Start the IP SLA session: **Example:** `Router(config)# ip sla schedule [sla_id] start-time [hh:mm | hh:mm:ss | now | pending | random]`	**Note** Due to packet overhead (64-byte packets), a total of only 469 Mbit/sec of traffic is supported at a time. This bandwidth is shared by all active sessions. This is applicable only for Cisco RSP2 module. For more information, see Table 4.

How to Configure IP SLA - Service Performance Testing

Y.1564 support on dot1ad Encapsulation

Table 15: Feature History

Feature Name	Release Information	Feature Description
Y.1564 support on dot1ad	Cisco IOS XE Cupertino 17.8.1	This feature enables Y.1564 Ethernet service activation test methodology support on interfaces that are configured with 802.1ad encapsulation. It allows you to perform medium-term and long-term service testing, confirming that the interfaces that are configured with 802.1ad can properly carry all services while under stress during a soaking period. The following commands are introduced: - **inner-eth-type** - **outer-eth-type**

Configuring QoS on SADT External Sessions

1. Configure the policy map on the SAT external session on the 10G port.

```
policy-map egress_sat_external
 class cos2
  set cos 4
!
policy-map ingress_sat_external
```

```
 class cos4
!
```

2. Configure the class map on the SAT external session on the 10G port.

```
class-map match-all cos2
 match cos  2
!
class-map match-all cos4
 match cos  4
```

3. Apply the configuration on the interface. In this example, the interface is TenGigabitEthernet0/0/24.

```
interface TenGigabitEthernet0/0/24
 no ip address
 cdp enable
 service-policy input ingress_sat_external
 service-policy output egress_sat_external
 service instance 10 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 10
 !
```

4. Verify the IP SLA configuration.

```
show running-config | sec ip sla 1
 service-performance type ethernet dest-mac-addr 0010.0010.0010 interface
TenGigabitEthernet0/0/24 service instance 10
  measurement-type direction external
   delay
   jitter
   loss
   receive
   throughput
  profile packet
   outer-cos 2
   outer-vlan 10
   packet-size 1024
   src-mac-addr 0020.0020.0020
   ethertype ipv4
   src-ip-addr 10.1.1.1
   dest-ip-addr 20.1.1.1
  profile traffic direction external
   rate-step kbps 30000
```

Out-of-order Packet Counter on the Cisco RSP3 Module

Table 16: Feature History

Feature Name	Release Information	Feature Description
Out-of-order Packet Counter on the Cisco RSP3 Module	Cisco IOS XE 17.13.1	You can configure Out-of-order packet counter for FPGA-based SAT on the Cisco RSP3 module.

An Out-of-order packet counter is used in network protocols to detect and handle packets that arrive out of order, ensuring reliable data delivery over networks.

When data is transmitted over a network, it’s divided into packets for efficient transmission. These packets can travel through different paths in the network and may arrive at the destination out of order. An Out-of-order packet counter keeps track of the sequence numbers of received packets and allows the receiver to reorder them correctly before delivering them to the application layer.

Note Out-of-order packet counter is only supported for FPGA-based SAT.

Configuring Out-of-order Packet Counter

Run the following command to configure the Out-of-order packet counter in the IP SLA session:

```
ip sla 1
    service-performance type ethernet dest-mac-addr 0010.0010.0010 interface
TenGigabitEthernet0/0/24 service instance 10
        measurement-type direction external
            out-of-order-packets
```

Verifying Out-of-order Packet Counter

Run the following command to verify if the out-of-order packet counter is enabled in the IP SLA session:

```
show running-config | sec ip sla 1
    service-performance type ethernet dest-mac-addr 0010.0010.0010 interface
TenGigabitEthernet0/0/24 service instance 10
        measurement-type direction external
            delay
            jitter
            out-of-order-packets
            loss
            receive
            throughput
        profile packet
            outer-cos 2
            outer-vlan 10
            packet-size 1024
            src-mac-addr 0020.0020.0020
            ethertype ipv4
            src-ip-addr 10.1.1.1
            dest-ip-addr 20.1.1.1
        profile traffic direction external
            rate-step kbps 30000
```

Example

Following is an example of the CLI output for SAT session with out-of-order packet counter configured. During the session, 10308227 out-of-order packets were detected, which accounts for approximately 6.46% of the total packets transmitted or received.

```
Router#sh ip sla statistics 102
IPSLAs Latest Operation Statistics

IPSLA operation id: 1031
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 6000000
Test duration: 540 seconds

Latest measurement:  *11:47:49.305 IST Thu Oct 19 2023
Latest return code:  OK
```

```
Overall Throughput: In Progress

Step 1 (6000000 kbps):
Stats:
IR(kbps)  FL          FLR      Avail    FTD Min/Avg/Max      FDV Min/Avg/Max
5999407   0           0.00%    100.00%  12.40us/33.65us/37.92us  0ns/556ns/24.24us
Tx Packets: 159345228  Tx Bytes: 53300978766
Rx Packets: 159345228  Rx Bytes: 53300978766
Out of order Packets: 10308227/(6.46%    )
Step Duration: 71 seconds
```

Enabling FPGA-Based SAT on the Cisco RSP3 Module

Follow these steps to enable FPGA-based SAT :

Procedure

Step 1 **license feature service-offload enable**

Enables the FPGA license.

Step 2 **license feature service-offload bandwidth 10gbps npu-0** OR **license feature service-offload bandwidth 10gbps npu-1**

Enables the SAT FPGA mode.

- npu-0—Use for Cisco RSP3 Module .

Step 3 **write**

Writes the configuration to nvram before the reload.

Step 4 Reboot the router.

Disabling FPGA-Based SAT on the Cisco RSP3 Module

If the FPGA-based SAT is enabled, follow these steps to disable it:

Procedure

	Command or Action	Purpose
Step 1	**no license feature service-offload bandwidth 10gbps npu-0** OR **no license feature service-offload bandwidth 10gbps npu-1**	Disables the SAT FPGA mode. • npu-0—Use for Cisco RSP3 Module .
Step 2	**no license feature service-offload enable**	Disables the FPGA license.
Step 3	**write**	Writes the configuration to nvram before the reload.

	Command or Action	Purpose
Step 4	Reboot the router.	

Configuring Ethernet Target Two-Way Color Blind Session

Perform the following steps to configure ethernet target color blind traffic generation.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. - Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ethernet dest-mac-addr** *dest-mac* { **service instance | bridge**} **Example:** `Device(config-ip-sla))#service-performance type ethernet dest-mac-addr 0001.0001.0001 interface gigabitEthernet0/10 service instance 10`	Specifies the service performance type as Ethernet and the destination MAC address in H.H.H format. Specifies the target for the SLA session. The options are: - service instance - bridge Only service instance is supported as target-type on 10G SAT.
Step 5	**aggregation** | **default** | **description** | **duration** | **exit** | **frequency** | **no** | **profile** **Example:** `Device(config-ip-sla-service-performance)# duration time 60`	Specifies the type of service performance. The options are: - **aggregation** - Represents the statistics aggregation. - **default** - Sets a command to its defaults. - **description** - Describes the operation. - **duration** - Sets the service performance duration configuration. - **frequency** - Represents the scheduled frequency. The options available are

	Command or Action	Purpose
		iteration and time. The range in seconds is from 20 to 65535. • **profile** - Specifies the service performance profile. If you use the packet or traffic options, go to Step 9 or Step 12, respectively.

Step 6	**measurement-type direction** {**internal** | **external**}
	Example:
	`Device(config-ip-sla-service-performance)# measurement-type direction`
		Specifies the statistics to measure traffic. The options available are external or internal; the default option is internal.
		Only external measurement-type direction is supported for 10G.

Step 7	**default** | **exit** | **loss** | **no** | **throughput** | **receive** | **delay** | **jitter** **Example:** `Device(config-ip-sla-service-performance-measurement)# throughput`	Specifies the measurement type based on the service performance is calculated. The options are: • **default** - Sets a command to its defaults. • **loss** - Specifies the measurement, such as frame loss. • **throughput** - Specifies the measurement such as average rate of successful frame delivery. • **receive** - Specifies the passive measurement mode. • **delay** - Specifies the measurement that is frame delay (FTD). This is not supported on 10G. • **jitter** - Specifies the measurement that is frame delay variation (FDV). This is not supported on 10G.
Step 8	**exit**	Exits the measurement mode.
Step 9	**profile packet** **Example:** `Device(config-ip-sla-service-performance)#profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 10	**default** | **exit** | **inner-cos** | **inner-vlan** | **no** | **outer-cos** | **outer-vlan** | **packet-size** | **src-mac-addr** | **outer-eth-type** | **inner-eth-type** **Example:**	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **inner-cos** - Specifies the class of service (CoS) value for the inner VLAN tag of

	Command or Action	Purpose
	`Device(config-ip-sla-service-performance-packet)#src-mac-addr 4055.3989.7b56`	the interface from which the message will be sent. • **inner-vlan** - Specifies the VLAN ID for the inner vlan tag of the interface from which the message will be sent. • **outer-cos** - Specifies the CoS value that will be populated in the outer VLAN tag of the packet. • **outer-vlan** - Specifies the VLAN ID that will be populated in the outer VLAN tag of the packet. • **packet-size** - Specifies the packet size; the default size is 64 bytes. The supported packet sizes are 64 bytes,128 bytes, 256 bytes, 512 bytes, 1024 bytes, 1280 bytes, 1518 bytes, 9216 bytes, and IMIX. • **src-mac-addr** - Specifies the source MAC address in H.H.H format. • **outer-eth-type** - Specifies the encapsulation type for the outer VLAN tag of the packet as dot1ad or dot1q. • **inner-eth-type** - Specifies the encapsulation type for the inner VLAN tag of the interface from which the message is sent as dot1ad or dot1q. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session. **Note** If you do not specify the encapsulation type in the packet profile, `dot1q` is used by default.
Step 11	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)# exit`	Exits the packet mode.

Step 12	**profile traffic direction**{**external** | **internal**}
	Example:
	`Device(config-ip-sla-service-performance)#profile traffic direction external`
		Specifies the direction of the profile traffic. The options are external and internal.
		Only external profile traffic direction is supported for 10G.

	Command or Action	Purpose
		Note This command is required to configure the **rate step kbps** command.
Step 13	**default** or **exit** or **no** or **rate step kbps | pps** **Example:** `Device(config-ip-sla-service-performance-traffic)#rate-step kbps 1000`	Specifies the traffic type. The options are: • **default** - Sets a command to its defaults. • **rate step kbps** - Specifies the transmission rate in kbps. The rate-step range is from 1-10000000 (1 Kbps to 10 Gbps). • **rate step pps** - Specifies the transmission rate in pps. The rate-step range is from 1-1000000 (1 to 1000000 pps). **Note** The command **rate-step kbps | pps number** is mandatory for traffic generation.
Step 14	**exit**	Exits the traffic mode.

Configuring Ethernet Target Color-Aware Traffic Generation

Perform the following steps to configure ethernet target color-aware traffic generation.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ethernet dest-mac-addr** *dest-mac-addr* {**bridge-domain** *domain_id* | **interface** *interface* [**service instance** *efp-id*]} **Example:**	Specifies the service performance type as Ethernet and the destination MAC address in H.H.H format. Specifies the target for the SLA session. The option is:

	Command or Action	Purpose
	`Device(config-ip-sla))#service-performance type ethernet dest-mac-addr 0001.0001.0001 interface gigabitEthernet0/0/10 service instance 10`	• service instance
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iteration.
Step 6	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.
Step 7	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 8	**default** | **exit** | **inner-cos** | **inner-vlan** | **no** | **outer-cos** | **outer-vlan** | **packet-size** | **src-mac-addr** | **outer-eth-type** | **inner-eth-type** **Example:** `Device(config-ip-sla-service-performance-packet)#src-mac-addr 4055.3989.7b56`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **inner-cos** - Specifies the class of service (CoS) value for the inner VLAN tag of the interface from which the message is sent. • **inner-vlan** - Specifies the VLAN ID for the inner vlan tag of the interface from which the message is sent. • **outer-cos** - Specifies the CoS value that is populated in the outer VLAN tag of the packet. • **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **src-mac-addr** - Specifies the source MAC address in H.H.H format. • **outer-eth-type** - Specifies the encapsulation type for the outer VLAN tag of the packet as dot1ad or dot1q.

	Command or Action	Purpose
		• **inner-eth-type** - Specifies the encapsulation type for the inner VLAN tag of the interface from which the message is sent as dot1ad or dot1q. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session. **Note** If you do not specify the encapsulation type in the packet profile, `dot1q` is used by default.
Step 9	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the profile packet mode.

Step 10	**profile traffic direction** [**internal** | **external**] **cir** *number* or **eir** *number* or **cbs** *number* or **ebs** *number* or **conform-color set-cos-transmit** *cos_value* or **exceed-color set-cos-transmit** *cos_value* or **default** or **exit** or **no** or **rate step kbps | pps** *number*
	Example:
	`Device(config-ip-sla-service-performance)# profile traffic direction internal`
	`Device(config-ip-sla-service-performance-traffic)# cir 45000`
	`Device(config-ip-sla-service-performance-traffic)# eir 45000`
	`Device(config-ip-sla-service-performance-traffic)# conform-color set-cos-transmit 4`
	`Device(config-ip-sla-service-performance-traffic)# exceed-color set-cos-transmit 5`
	`Device(config-ip-sla-service-performance-traffic)# rate-step kbps 5000 9000`
		Defines an upper limit on the volume of the expected service frames belonging to a particular service instance. If a Traffic profile is not specified, the Service Performance probe is in passive measurement mode.
		• **cir** - Committed Information Rate.
		• **cbs** - Committed Burst Size.
		• **conform-color** - Sets the color conform.
		Note **coform-color** and **exceed-color** keywords are available only when **cir** or **eir** is configured.
		• **default** - Sets a command to its defaults.
		• **drop** - Drops the packet.
		• **eir** - Excess Information Rate.
		• **ebs** - Excess Burst Size.
		• **exceed-color** - Sets the color-exceed.
		• **exit** - Exits the traffic mode.
		• **no** - Negates a command or sets its defaults.
		• **set-cos-transmit** *cos_value* - Sets the CoS value to a new value and sends the packet. The valid range is from 0 to 7.

	Command or Action	Purpose
		• **transmit** - Sends the packet without altering it. This is the default value. • **default** - Sets a command to its defaults. • **rate step kbps** - Specifies the transmission rate in kbps. The rate-step range is from 1 to 1000000 (1 Kbps to 1 Gbps). • **rate step pps** - Specifies the transmission rate in pps. The rate-step range is from 1 to 1000000. **Note** The command **rate-step kbps | pps number** is mandatory for traffic generation.

Example

```
Device(config-ip-sla-service-performance)#profile packet
Device(config-ip-sla-service-performance-packet)#outer-vlan 100
Device(config-ip-sla-service-performance-packet)#outer-cos 5
Device(config-ip-sla-service-performance-packet)#exit
Device(config-ip-sla-service-performance)#profile traffic direction internal
Device(config-ip-sla-service-performance-traffi c)# cir 45000
Device(config-ip-sla-service-performance-traffi c)# eir 45000
Device(config-ip-sla-service-performance-traffic)# conform-color set-cos-transmit 4
Device(config-ip-sla-service-performance-traffic)# exceed-color set-cos-transmit 5
Device(config-ip-sla-service-performance-traffic)# rate-step kbps 1000
Device(config-ip-sla)# duration time 15
Device(config-ip-sla)# frequency iteration 4 delay 1
```

Configuring Ethernet Target Two-Way Color-Aware Session

Perform the following steps to configure ethernet target two-way color-aware session.

Note The default **frequency iteration** command value may cause the duration command to be rejected for higher values. In this case, the **frequency iteration** command is recommended before the execution of **duration** command.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:**	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ethernet dest-mac-addr** *dest-mac-addr* |**interface** *interface* [**service instance** *efp-id*] **Example:** `Device(config-ip-sla))#service-performance type ethernet dest-mac-addr 0001.0001.0001 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as Ethernet and the destination MAC address in H.H.H format. Specifies the target for the SLA session. The options are: • service instance • bridge
Step 5	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.
Step 6	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated. It also defines the filter for incoming packets to be measured.
Step 7	**default** | **exit** | **inner-cos** | **inner-vlan** | **no** | **outer-cos** | **outer-vlan** | **packet-size** | **src-mac-addr** | **outer-eth-type** | **inner-eth-type** **Example:** `Device(config-ip-sla-service-performance-packet)#src-mac-addr 4055.3989.7b56`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **inner-cos** - Specifies the class of service (CoS) value for the inner VLAN tag of the interface from which the message is sent. • **inner-vlan** - Specifies the VLAN ID for the inner vlan tag of the interface from which the message is sent. • **outer-cos** - Specifies the CoS value that is populated in the outer VLAN tag of the packet. • **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet.

	Command or Action	Purpose
		• **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **src-mac-addr** - Specifies the source MAC address in H.H.H format. • **outer-eth-type** - Specifies the encapsulation type for the outer VLAN tag of the packet as dot1ad or dot1q. • **inner-eth-type** - Specifies the encapsulation type for the inner VLAN tag of the interface from which the message is sent as dot1ad or dot1q. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session. **Note** If you do not specify the encapsulation type in the packet profile, `dot1q` is used by default.
Step 8	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the profile packet mode.

Step 9	**profile traffic direction** [**internal** |**external**] **cir** *number* or **eir** *number* or **cbs** *number* or **ebs** *number* or **conform-color set-cos-transmit** *cos_value* or **exceed-color set-cos-transmit** *cos_value* or **default** or **exit** or **no** or **rate step kbps | pps** *number*
	Example:
	`Device(config-ip-sla-service-performance)# profile traffic direction internal`
	`Device(config-ip-sla-service-performance-traffic)# cir 45000`
	`Device(config-ip-sla-service-performance-traffic)# eir 45000`
	`Device(config-ip-sla-service-performance-traffic)# conform-color set-cos-transmit 4`
	`Device(config-ip-sla-service-performance-traffic)# exceed-color set-cos-transmit 5`
	`Device(config-ip-sla-service-performance-traffic)# rate-step kbps 1000`
		Specifies the in-line traffic profile or enables the selection of a preconfigured traffic profile. A traffic profile defines an upper limit on the volume of the expected service frames belonging to a particular service instance. If a Traffic profile is not specified, the Service Performance probe is in passive measurement mode.
		• **cir** - Committed Information Rate.
		• **cbs** - Committed Burst Size.
		• **conform-color** - Sets the color conform.
		• **default** - Sets a command to its defaults.
		• **drop** - Drops the packet.
		• **eir** - Excess Information Rate.
		• **ebs** - Excess Burst Size.

	Command or Action	Purpose
		• **exceed-color** - Sets the color-exceed. • **exit** - Exits the traffic mode. • **no** - Negates a command or sets its defaults. • **set-cos-transmit** *cos_value* - Sets the CoS value to a new value and sends the packet. The valid range is from 0 to 7. • **transmit** - Sends the packet without altering it. This is the default value. **Note** This command is required to configure the **rate step kbps** command. • **default** - Sets a command to its defaults. • **rate step kbps** - Specifies the transmission rate in kbps. The rate-step range is from 1 to 1000000 (1 Kbps to 1 Gbps). **Note** The command **rate-step kbps | pps number** is mandatory for traffic generation.
Step 10	**measurement-type direction** [**internal** |**external**] **conform-color cos** *cos_value* **exceed-color cos** *cos value* **Example:** `Device(config-ip-sla)# measurement-type direction internal cos 7`	Specifies the direction of measurement.
Step 11	**default** | **exit** | **loss** | **throughput** | **receive** | **delay** | **jitter** **Example:** `Device(config-ip-sla-service-performance-measurement)# throughput`	Specifies the measurement type based on which the service performance is calculated. The options are: • **default**: Sets a command to its defaults. • **loss**: Specifies the measurement such as frame loss. • **throughput**: Specifies the measurement such as average rate of successful frame delivery. • **receive**: Specifies the passive measurement mode.

	Command or Action	Purpose
		• **delay** - Specifies the measurement that is frame delay (FTD). • **jitter** - Specifies the measurement that is frame delay variation (FDV).
Step 12	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iterations.

Example

```
ip sla 3
service-performance type ether des
0033.3333.3333 interface gig 0/0/3
service instance 1
profile packet
outer-vlan 100
outer-cos 5
packet-size 128
ethertype ipv4
exit
profile traffic direction internal
cir 45000
eir 45000
cbs 45000
ebs 45000
conform-color set-cos-transmit 7
exceed-color set-cos-transmit 5
rate-step kbps 30000 45000 65000
90000
exit
measurement-type direction internal
conform-color cos 7
exceed-color cos 5
receive
throughput
loss
delay
jitter
duration time 20
frequency iteration 1 delay 2
```

Configuring Ethernet Target Passive Color-Aware Measurement

Perform the following steps to configure ethernet target passive color-aware measurement.

Procedure

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	- Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ethernet dest-mac-addr** *dest_mac_addr* {**bridge-domain** *domain_id* | **interface** *interface* [**service instance** *efp-id*]} **Example:** `Device(config-ip-sla))#service-performance type ethernet dest-mac-addr 0001.0001.0001 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as Ethernet and the destination MAC address in H.H.H format. Specifies the target for the SLA session. The options are: - service instance - bridge
Step 5	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.
Step 6	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the filter for incoming packets to be measured.
Step 7	**default** | **exit** | **inner-cos** | **inner-vlan** | **no** | **outer-cos** | **outer-vlan** | **packet-size** | **src-mac-addr** | **outer-eth-type** | **inner-eth-type** **Example:** `Device(config-ip-sla-service-performance-packet)#src-mac-addr 4055.3989.7b56`	Specifies the packet type. The options are: - **default** - Sets a command to its defaults. - **inner-cos** - Specifies the class of service (CoS) value for the inner VLAN tag of the interface from which the message is sent. - **inner-vlan** - Specifies the VLAN ID for the inner vlan tag of the interface from which the message is sent. - **outer-cos** - Specifies the CoS value that is populated in the outer VLAN tag of the packet. - **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet.

	Command or Action	Purpose
		• **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **src-mac-addr** - Specifies the source MAC address in H.H.H format. • **outer-eth-type** - Specifies the encapsulation type for the outer VLAN tag of the packet as dot1ad or dot1q. • **inner-eth-type** - Specifies the encapsulation type for the inner VLAN tag of the interface from which the message is sent as dot1ad or dot1q. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session. **Note** If you do not specify the encapsulation type in the packet profile, `dot1q` is used by default.
Step 8	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the profile packet mode.
Step 9	**measurement-type direction** [**internal** |**external**] **conforn-color cos** *cos_value* **exceed-color cos** *cos_value* **Example:** `Device(config-ip-sla)# measurement-type direction internal cos 7`	Specifies the direction of measurement.
Step 10	**default** | **exit** | **loss** | **throughput** | **receive** **Example:** `Device(config-ip-sla-service-performance-measurement)# throughput`	Specifies the measurement type based on which the service performance is calculated. The options are: • **default** - Sets a command to its defaults. • **loss** - Specifies the measurement such as frame loss. • **throughput** - Specifies the measurement such as average rate of successful frame delivery.

	Command or Action	Purpose
		- **receive** - Specifies the passive measurement mode.
Step 11	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iterations.

Example

```
ip sla 3
service-performance type ether des
0033.3333.3333 interface gig 0/0/3
service instance 1
profile packet
outer-vlan 100
outer-cos 5
packet-size 128
ethertype ipv4
exit
measure direction internal
conform-color cos 7
exceed-color cos 5
receive
throughput
loss
duration time 20
frequency iteration 1 delay 2
```

Configuring Ethernet Target for Color-Aware Traffic Generation with IMIX

Perform the following steps to configure ethernet target for color-aware traffic generation with IMIX.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.

	Command or Action	Purpose
Step 4	**service-performance type ethernet dest-mac-addr** *dest_mac_addr* {**bridge-domain** *domain_id* | **interface** *interface* [**service instance** *efp-id*]} **Example:** `Device(config-ip-sla))#service-performance type ethernet dest-mac-addr 0001.0001.0001 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as Ethernet and the destination MAC address in H.H.H format. Specifies the target for the SLA session. The options are: • service instance • bridge
Step 5	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.
Step 6	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 7	**default** | **exit** | **inner-cos** | **inner-vlan** | **no** | **outer-cos** | **outer-vlan** | **packet-size imix** | **src-mac-addr** | **outer-eth-type** | **inner-eth-type** **Example:** `Device(config-ip-sla-service-performance-packet)#packet-size imix`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **inner-cos** - Specifies the class of service (CoS) value for the inner VLAN tag of the interface from which the message is sent. • **inner-vlan** - Specifies the VLAN ID for the inner vlan tag of the interface from which the message is sent. • **outer-cos** - Specifies the CoS value that is populated in the outer VLAN tag of the packet. • **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **src-mac-addr** - Specifies the source MAC address in H.H.H format.

	Command or Action	Purpose
		• **outer-eth-type** - Specifies the encapsulation type for the outer VLAN tag of the packet as dot1ad or dot1q. • **inner-eth-type** - Specifies the encapsulation type for the inner VLAN tag of the interface from which the message is sent as dot1ad or dot1q. **Note** For IMIX, the packet-size should be explicitly mentioned as IMIX. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session. **Note** If you do not specify the encapsulation type in the packet profile, `dot1q` is used by default.
Step 8	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the profile packet mode.

Step 9	**profile packet direction** [**internal** | **external**] **cir** *number* or **eir** *number* or **cbs** *number* or **ebs** *number* or **conform-color set-cos-transmit** *cos_value* or **exceed-color set-cos-transmit** *cos_value* or **default** or **exit** or **no** or **rate step kbps**
	Example:
	`Device(config-ip-sla-service-performance)#`
	` profile traffic direction internal`
	`Device(config-ip-sla-service-performance-traffic)#`
	` cir 45000`
	`Device(config-ip-sla-service-performance-traffic)#`
	` eir 45000`
	`Device(config-ip-sla-service-performance-traffic)#`
	` cbs 45000`
	`Device(config-ip-sla-service-performance-traffic)#`
	` ebs 45000`
	`Device(config-ip-sla-service-performance-traffic)#`
	` conform-color set-cos-transmit 4`
	`Device(config-ip-sla-service-performance-traffic)#`
	` exceed-color set-cos-transmit 5`
	`Device(config-ip-sla-service-performance-traffic)#`
	` rate-step kbps 1000`
		Specifies the in-line traffic profile or enables the selection of a pre-configured traffic profile. A traffic profile defines an upper limit on the volume of the expected service frames belonging to a particular service instance. If a traffic profile is not specified, the Service Performance probe is in passive measurement mode.
		• **cir** - It is the Committed Information Rate.
		• **cbs** - It is the Committed Burst Size.
		• **conform-color** - Sets the conform color.
		• **default** - Sets a command to its defaults.
		• **drop** - Drops the packet.
		• **eir** - It is the Excess Information rate.
		• **ebs** - It is the Excess Burst Size.
		• **exceed-color** - Sets the exceed color.
		• **exit** - Exits the traffic mode.

	Command or Action	Purpose
		- **no** - Negates a command or sets its defaults. - **rate step kbps** - Sets the rate step. - **set-cos-transmit** *cos_value* - Sets the CoS value to a new value, and sends the packet. The valid range is from 0 to 7. - **transmit** - Sends the packet without altering it. This is the default value. - **default** - Sets a command to its defaults. **Note** This command is required to configure the **rate step kbps** command.
Step 10	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iterations.

Example

```
ip sla 3
service-performance type ether des 0033.3333.3333 interface gig 0/0/3
service instance 1
profile packet
outer-vlan 100
outer-cos 5
packet-size mix
ethertype ipv4
exit
profile traffic direction internal
cir 45000
eir 45000
cbs 45000
ebs 45000
conform-color set-cos-transmit 7
exceed-color set-cos-transmit 5
rate-step kbps 30000 45000 65000
90000
exit
duration time 20
frequency iteration 1 delay 2
```

Configuration Examples for Configuring Y.1564 to Generate and Measure Ethernet Traffic

This section shows sample configurations for traffic generation.

Example: Traffic Generation — Target Service Instance

This section shows sample configuration for traffic generation – target service instance.

```
ip sla 100
service-performance type ethernet dest-mac-addr 0001.0002.0003 interface
TenGigabitEthernet0/0/4 service instance 100
profile packet
packet-size 256
outer-vlan 100
profile traffic direction internal
rate-step kbps 1000
aggregation interval buckets 2
frequency iteration 2 delay 10
end
```

Example: Traffic Generation — Target Bridge Domain

This section shows sample configuration for traffic generation – target bridge domain.

```
ip sla 100
service-performance type ethernet dest-mac-addr 0001.0002.0003 bridge-domain 100
profile packet
packet-size 256
outer-vlan 100
aggregation interval buckets 2
frequency iteration 2 delay 10
end
```

Example: Two-Way Session—Target Service Instance

The following is a sample configuration for a two-way measurement session of service instance internal target type.

```
ip sla 100
service-performance type ethernet dest-mac-addr 0001.0002.0003 interface
TenGigabitEthernet0/0/2 service instance 100
measurement-type direction internal
loss
throughput

delay
jitter
profile packet
packet-size 64
outer-vlan 100
inner-vlan 200
profile traffic direction internal
rate-step kbps 1000
```

```
aggregation interval buckets 2
frequency iteration 2 delay 10
end
```

Example: Two-Way Session — Target Bridge Domain

The following is a sample configuration for a two-way internal measurement and generation session with target type Bridge Domain.

```
ip sla 100
service-performance type ethernet dest-mac-addr 0001.0002.0003 bridge-domain 100
measurement-type direction internal
loss
throughput
delay
jitter
profile packet
packet-size 64
outer-vlan 100
inner-vlan 200
profile traffic direction internal
rate-step kbps 1000
aggregation interval buckets 2
frequency iteration 2 delay 10
end
```

Example: Passive Measurement Mode — Target Service Instance

The following is a sample configuration for passive measurement session for target service instance.

```
ip sla 100
service-performance type ethernet dest-mac-addr 0001.0002.0003 interface
TenGigabitEthernet0/0/4 service instance 100
measurement-type direction internal
loss
throughput
aggregation interval buckets 2
frequency iteration 2 delay 10
end
```

Example: Passive Measurement Mode — Target Bridge Domain

The following is a sample configuration for passive measurement session for bridge domain target.

```
ip sla 100
service-performance type ethernet dest-mac-addr 0001.0002.0003 bridge-domain 100
measurement-type direction internal
loss
throughput
aggregation interval buckets 2
frequency iteration 2 delay 10
end
```

Example: Traffic Generation Mode — Color Aware

The following is a sample output for traffic generation mode—color aware.

```
ip sla 3
service-performance type ether des 0033.3333.3333 int gig 0/0/7 service instance 1
 profile packet
outer-vlan 100
outer-cos 5 packet-size 128 ethertype ipv4 exit
profile traffic dir int cir 45000
eir 45000
 cbs 45000
ebs 45000
conform-color set-cos-transmit 7 exceed-color set-cos-transmit 5
rate-step kbps 30000 45000 65000 90000 exit
duration time 20
frequency iteration 1 delay 2
```

Example: Traffic Generation Mode with IMIX — Color Aware

The following is a sample output for traffic generation mode with IMIX — color aware.

```
ip sla 3
service-performance type ether des 0033.3333.3333 int gig 0/0/7 service instance 1
 profile packet
outer-vlan 100 outer-cos 5 packet-size imix ethertype ipv4 exit
profile traffic dir int
cir 45000 eir 45000
 cbs 45000
ebs 45000
conform-color set-cos-transmit 7
exceed-color set-cos-transmit 5
rate-step kbps 30000 45000 65000 90000 exit
duration time 20
frequency iteration 1 delay 2
```

Example: Two-way Color-Aware Measurement Session

The following is a sample configuration for a two-way color-aware measurement session.

```
ip sla 3
service-performance type ether des 0033.3333.3333 int gig 0/0/7 service instance 1
 profile packet
outer-vlan 100
outer-cos 5 packet-size 128 ethertype ipv4 exit
profile traffic dir int cir 45000
eir 45000
 cbs 45000
ebs 45000
conform-color set-cos-transmit 7 exceed-color set-cos-transmit 5
rate-step kbps 30000 45000 65000 90000 exit
measure dir internal conform-color cos 7 exceed-color cos 5 receive
throughput loss delay jitter
duration time 20
frequency iteration 1 delay 2
```

Example: Passive Color-Aware Measurement Session

The following is a sample configuration for a passive color-aware measurement session.

```
ip sla 3
service-performance type ether des 0033.3333.3333 int gig 0/0/7 service instance 1
 profile packet
outer-vlan 100 outer-cos 5 packet-size 128 ethertype ipv4 exit
measure dir internal conform-color cos 7 exceed-color cos 5 receive
throughput
loss
duration time 20
frequency iteration 1 delay 2
```

Example: Two-Way Session

The following is a sample configuration for a two-way session.

```
show ip sla statistics 12345

IPSLAs Latest Operation Statistics

IPSLA operation id: 12345
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 10000 20000 25000
Test duration: 20 seconds

Latest measurement:  *15:54:44.007 IST Mon May 18 2015
Latest return code:  Oper End of Life

Overall Throughput: 24850 kbps

Step 1 (10000 kbps):
Stats:
IR(kbps) FL   FLR      Avail              FTD Min/Avg/Max    FDV Min/Avg/Max
9944      0     0.00%  100.00%  41.44us/46.06us/77.68us  0ns/12.08us/34.52us
Tx Packets: 16377 Tx Bytes: 24860286
Rx Packets: 16377 Rx Bytes: 24860286
Step Duration: 20 seconds
```

Example: 10G Ethernet Two-Way Color Blind Session

The following is a sample configuration for a 10G ethernet two-way color blind session:

```
router#show run | sec ip sla 200
ip sla 200
service-performance type ethernet dest-mac-addr 0000.0000.2200 interface
TenGigabitEthernet0/0/2 service instance 200
  frequency iteration 2 delay 10
  aggregation interval buckets 2
  measurement-type direction external
   loss
   receive
   throughput
  profile packet
   outer-cos 2
   outer-vlan 200
   packet-size 1024
   src-mac-addr 0000.0000.4400
  profile traffic direction external
   rate-step kbps 9000000
  duration time 60
```

The following is the sample output for the 10G ethernet two-way color blind session:

```
router#show ip sla statistics 200
IPSLAs Latest Operation Statistics

IPSLA operation id: 200
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 9000000
Test duration: 60 seconds

Latest measurement:  *18:04:34.975 IST Wed Mar 29 2017
Latest return code:  Oper End of Life

Overall Throughput: 8943460 kbps

Step 1 (9000000 kbps):
Stats:
IR(kbps)  FL          FLR      Avail
8943460   0           0.00%    100.00%
Tx Packets: 65503860  Tx Bytes: 67075952640
Rx Packets: 65503860  Rx Bytes: 67075952640
Step Duration: 60 seconds
```

How to Configure Y.1564 to Generate and Measure IP Traffic

This section shows how to configure Y.1564 to generate and measure IP traffic.

Effective Cisco IOS XE Release 3.16, the following features are supported on the routers:

- IP flow parameters (DA/SA) Generation
- IP flow parameters (DA/SA) Measurement
- Color-Blind IP flow Generation and Measurement
- Color-Aware IP flow Generation: Differentiated services code point (DSCP) based
- Color-Aware IP flow Measurement: DSCP based
- IMIX Traffic Generation type (combination of 64, 512, and 1518 byte packets)

Note For vrf targets, the vrf-id specified in the SLA configuration should be the VRF Id derived from the output of the show vrf detail | include VRF Id STR

```
#sh vrf det | i VRF Id
VRF Mgmt-intf (VRF Id = 1); default RD <not set>; default VPNID <not set>
VRF SAT (VRF Id = 2); default RD 100:1; default VPNID <not set>
```

Configuring IP Target Color-Aware Traffic Generation

Perform the following steps to configure IP target color-aware traffic generation.

Note The **default frequency iteration** command value may cause the duration command to be rejected for higher values. In this case, the **frequency iteration** command is recommended before the execution of the **duration** command.

Note Configuring **source-ip-addr** is mandatory for layer 3 IP SLA.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ip dest-ip-addr** *dest-ip-addr* {**interface** *interface* | **interface** *interface* [**service instance** *efp-id* | **vrf** *vrf_id*} **Example:** `Device(config-ip-sla))# service-performance type ip dest-ip-addr 194.168.1.1 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as IP and the destination IP address. Specifies the target for the SLA session. The options are: • service instance • interface • vrf
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iteration.
Step 6	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.

	Command or Action	Purpose
Step 7	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 8	**default** | **exit** | **no** | **outer-vlan** | **packet-size** | **source-ip-addr** **Example:** `Device(config-ip-sla-service-performance-packet)#src-ip-addr 193.168.1.1`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **exit** - Exists the packet mode. • **no** - Negates a command or sets its defaults. • **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **src-ip-addr** - Specifies the source IP address. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session.
Step 9	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the IP SLA Service Performance packet mode.

Step 10	**profile traffic direction** [**internal**] **cir** *number* or **eir** *number* or **cbs** *number* or **ebs** *number* or **conform-color set-dscp-transmit** *dscp_value* or **exceed-color set-dscp-transmit** *dscp_value* or **default** or **exit** or **no** or **rate step kbps** | **pps** *number*
	Example:
	`Device(config-ip-sla-service-performance)# profile traffic direction internal`
	`Device(config-ip-sla-service-performance-traffic)# cir 45000`
	`Device(config-ip-sla-service-performance-traffic)# eir 45000`
	`Device(config-ip-sla-service-performance-traffic)# conform-color set-dscp-transmit af43`
	`Device(config-ip-sla-service-performance-traffi`
		Specifies the in-line traffic profile or selection of a pre-configured traffic profile. A traffic profile defines an upper bound on the volume of the expected service frames belonging to a particular service instance. If a traffic profile is not specified, the Service Performance probe is in passive measurement mode.
		• **cir** - It is the Committed Information Rate.
		• **cbs** - It is the Committed Burst Size.
		• **conform-color** - Sets the color conform.
		• **default** - Sets a command to its defaults.

	Command or Action	Purpose

	`c)# exceed-color set-dscp-transmit af41`
	`Device(config-ip-sla-service-performance-traffi`
	`c)# rate-step kbps 1000`
		- **drop** - Drops the packet.
		- **eir** - It is Excess Information Rate.
		- **ebs** - It is the Excess Burst Size.
		- **exceed-color** - Sets the color-exceed.
		- **exit** - Exits the traffic mode.
		- **no** - Negates a command or sets its defaults.
		- **rate step kbps** - Sets the rate step.
		- **set-dscp-transmit** *dscp_value* - Sets the IP DSCP value to a new value and sends the packet. The valid range is from 0 to 63. You also can enter nemonic name for a commonly used value.
		- **transmit** - Sends the packet without altering it. This is the default value.
		Note This command is required to configure the **rate step kbps** command.
		- **default** - Sets a command to its defaults.
		- **rate step kbps** - Specifies the transmission rate in kbps. The rate-step range is from 1 to 1000000 (1 Kbps to 1 Gbps).
		- **rate step pps** - Specifies the transmission rate in pps. The rate-step range is from 1 to 1000000 (1 pps to 1000000 pps).
		Note The **rate-step kbps | pps number** is mandatory for traffic generation to happen.

Example

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 vrf 2
frequency iteration 1 delay 1
duration time 50
profile packet
source-ip-addr 193.168.1.1
packet-size 512
profile traffic direction internal
cir 45000
```

```
eir 45000
cbs 45000
ebs 45000
rate-step kbps 50000 90000
conform-color set-dscp-transmit af43
exceed-color set-dscp-transmit af41
```

Configuring IP Target Color Blind Traffic Generation

Perform the following steps to configure IP target color blind traffic generation.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ip dest-ip-addr** *dest-ip-addr* {**interface** *interface* | **bridge domain** *domain_id* | **interface** *interface* [**service instance** *efp-id* | **vrf** *vrf_id*} **Example:** `Device(config-ip-sla)# service-performance type ip dest-ip-addr 194.168.1.1 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as IP and the destination IP address. Specifies the target for the SLA session. The options are: • service instance • interface • vrf • bridge domain
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iteration.
Step 6	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Sets the service performance duration configuration.

	Command or Action	Purpose
Step 7	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 8	**default** | **exit** | **no** | **outer-vlan** | **packet-size** | **source-ip-addr** **Example:** `Device(config-ip-sla-service-performance-packet)#src-ip-addr 193.168.1.1`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **exit** - Exists the packet mode. • **no** - Negates a command or sets its defaults. • **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **src-ip-addr** - Specifies the source IP address. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session.
Step 9	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the IP SLA Service Performance packet mode.
Step 10	**profile traffic direction internal** **Example:** `Device(config-ip-sla-service-performance)# profile traffic direction internal`	Specifies the in-line traffic profile or selection of a pre-configured traffic profile. A traffic profile defines an upper bound on the volume of the expected service frames belonging to a particular service instance. If a traffic profile is not specified, the Service Performance probe is in passive measurement mode.
Step 11	**default** or **exit** or **no** or **rate step kbps** | **pps** **Example:** `Device(config-ip-sla-service-performance-traffic)# rate-step kbps 1000`	Specifies the traffic type. The options are: • **default** - Sets a command to its defaults. • **rate step kbps** - Specifies the transmission rate in kbps. The rate-step range is from 1 to 1000000 (1 Kbps to 1 Gbps).

	Command or Action	Purpose
		- **rate step pps** - Specifies the transmission rate in pps. The rate-step range is from 1 to 1000000 (1 pps to 1000000 pps). **Note** The command **rate-step kbps | pps number** is mandatory for traffic generation.

Example

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 vrf 2
frequency iteration 1 delay 1
duration time 50
profile packet
source-ip-addr 193.168.1.1
packet-size 512
profile traffic direction internal
rate-step kbps 50000 90000
```

Configuring IP Target Color Blind Passive Measurement

Perform the following steps to configure IP target color blind passive measurement.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. - Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ip dest-ip-addr** *dest_ip_addr* {**interface** *interface* | **bridge domain** *domain_id* | **interface** *interface* [**service instance** *efp-id*] | **vrf** *vrf_id*} **Example:**	Specifies the service performance type as IP and the destination IP address. Specifies the target for the SLA session. The options are: - service instance

	Command or Action	Purpose
	`Device(config-ip-sla)# service-performance type ip dest-ip-addr 194.168.1.1 interface gigabitEthernet0/0/10 service instance 10`	• interface • vrf • bridge domain
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iteration.
Step 6	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Sets the service performance duration configuration.
Step 7	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 8	**default** | **exit** | **no** | **packet-size** | **source-ip-addr** **Example:** `Device(config-ip-sla-service-performance-measurement)# throughput`	Specifies the measurement type based on which the service performance is calculated. The options are: • **default** - Sets a command to its default values. • **exit** - Exists the packet mode. • **no** - Negates a command or sets its defaults. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, and 9216 bytes. • **source-ip-addr** - Specifies the source IP address.
Step 9	**measurement-type direction internal** **Example:** `config-ip-sla-service-performance)#measurement-type direction internal`	Specifies the direction of measurement.
Step 10	**default** | **exit** | **loss** | **throughput** | **receive** **Example:** `Device(config-ip-sla-service-performance-measurement)# throughput`	Specifies the measurement type based on which the service performance is calculated. The options are: • **default** - Sets a command to its default values.

	Command or Action	Purpose
		• **loss** - Specifies the measurement such as frame loss. • **throughput** - Specifies the measurement such as average rate of successful frame delivery. • **receive** - Specifies the passive measurement mode.

Example

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 vrf 2
frequency iteration 1 delay 1
duration time 50
measurement-type direction internal
receive
profile packet
source-ip-addr 193.168.1.1
packet-size 512
```

Configuring IP Target Two-Way Color-Aware Session

Perform the following steps to configure IP target two-way color-aware session.

Note The default **frequency iteration** command value may cause the **duration** command to be rejected for higher values. In this case, the **frequency iteration** command is recommended before the execution of the **duration** command.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.

	Command or Action	Purpose
Step 4	**service-performance type ip dest-ip-addr** *dest-ip-addr* {**interface** *interface* | **interface** *interface* [**service instance** *efp-id* | **vrf** *vrf_id*} **Example:** `Device(config-ip-sla)# service-performance type ip dest-ip 194.168.1.1 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as IP and the destination IP address. Specifies the target for the SLA session. The options are: • service instance • interface • vrf
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iteration.
Step 6	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Sets the service performance duration configuration.
Step 7	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 8	**deafult** | **exit** | **no** | **outer vlan** | **packet-size** | **source-ip-addr** **Example:** `Device(config-ip-sla-service-performance-packet)# src-ip-addr 193.168.1.1`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **exit** - Exists the packet mode. • **no** - Negates a command or set its defaults. • **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64, 128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. • **source-ip-addr** - Specifies the source IP address. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session.

	Command or Action	Purpose
Step 9	**exit** **Example:** `Device(config-ip-sla)# exit`	Exists the IP SLA Service Performance packet mode.

Step 10	**profile traffic direction internal cir** *number* or **eir** *number* or **cbs** *number* or **ebs** *number* or **conform-color set-dscp-transmit** *dscp_value* or **exceed-color set-dscp-transmit** *dscp_value* or **default** or **exit** or **no** or **rate step kbps | pps** *number*
	Example:
	`Device(config-ip-sla-service-performance)# profile traffic direction internal`
	`Device(config-ip-sla-service-performance-traffic)# cir 45000`
	`Device(config-ip-sla-service-performance-traffic)# eir 45000`
	`Device(config-ip-sla-service-performance-traffic)# conform-color set-dscp-transmit af434`
	`Device(config-ip-sla-service-performance-traffic)# exceed-color set-dscp-transmit af41`
	`Device(config-ip-sla-service-performance-traffic)# rate-step kbps 1000`
		Specifies the in-line traffic profile or selection of a pre-configured traffic profile. A traffic profile defines an upper bound on the volume of the expected service frames belonging to a particular service instance. If a traffic profile is not specified, the Service Performance probe is in passive measurement mode.
		• **cir** - It is the Committed Information Rate.
		• **cbs** - It is the Committed Burst Size.
		• **conform-color** - Sets the color conform.
		• **default** - Sets a command to its defaults.
		• **drop** - Drops the packet.
		• **eir** - It is Excess Information Rate.
		• **ebs** - It is the Excess Burst Size.
		• **exceed-color** - Sets the color-exceed.
		• **exit** - Exits the traffic mode.
		• **no** - Negates a command or sets its defaults.
		• **rate step kbps** - Sets the rate step.
		• **set-dscp-transmit** *dscp_value* - Sets the IP DSCP value to a new value and sends the packet. The valid range is from 0 to 63. You also can enter nemonic name for a commonly used value.
		• **transmit** - Sends the packet without altering it. This is the default value.
		Note This command is required to configure the **rate step kbps** command.
		• **default** - Sets a command to its defaults.
		• **rate step kbps** - Specifies the transmission rate in kbps. The rate-step range is from 1 to 1000000 (1 Kbps to 1 Gbps).

	Command or Action	Purpose
		• **rate step pps** - Specifies the transmission rate in pps. The rate-step range is from 1 to 1000000 (1 pps to 1000000 pps). **Note** The **rate-step kbps | pps number** is mandatory for traffic generation.
Step 11	**measurement-type direction internal conform-color dscp** *dscp_value* **exceed-color dscp** *dscp_value* **Example:** `Device(config-ip-sla-service-performance)# measurement-type direction internal conform-color dscp af43 exceed-color dscp af41`	Specifies the direction of measurement.
Step 12	**default** | **exit** | **loss** | **no** | **throughput** | **receive** | **delay** | **jitter**	Specifies the measurement type based on which the service performance is calculated. The options are: • **default** - Sets a command to its default value. • **loss** - Specifies the measurement such as frame loss. • **throughput** - Specifies the measurement such as average rate of successful frame delivery. • **receive** - Specifies the passive measurement mode. • **delay** - Specifies the measurement that is frame delay (FTD). • **jitter** - Specifies the measurement that is frame delay variation (FDV).

Example

```
ip sla 1
 service-performance type ip dest-ip-addr 150.1.1.2 interface TenGigabitEthernet0/0/3 service
 instance 1
  frequency iteration 1 delay 1
 measurement-type direction internal conform-color dscp af11 exceed-color dscp af12
   loss
   receive
   throughput
   delay
   jitter
   profile packet
   source-ip-addr 2.2.1.2
   packet-size 512
   outer-vlan 10
  profile traffic direction internal
   cir 100000
   eir 100000
   rate-step kbps 200000
   conform-color set-dscp-transmit af11
   exceed-color set-dscp-transmit af12
  duration time 1200
```

Configuring IP Target Color-Aware IMIX Traffic Generation

Perform the following steps to configure IP target color-aware IMIX traffic generation session.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ip dest-mac-addr** *dest_ip_addr* {**interface** *interface* | **interface** *interface* [**service instance** *efp-id*] | **vrf** *vrf_id*} **Example:** `Device(config-ip-sla))#service-performance type ip dest-ip-addr 194.168.1.1 interface gigabitEthernet0/0/10 service instance 10`	Specifies the service performance type as IPt and the destination IP address. Specifies the target for the SLA session. The options are: • service instance • interface • vrf
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iterations.
Step 6	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.

	Command or Action	Purpose
Step 7	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.
Step 8	**default** | **exit** | **no** | **packet-size imix** | **source-ip-addr** **Example:** `Device(config-ip-sla-service-performance-packet)#packet-size imix`	Specifies the packet type. The options are: • **default** - Sets a command to its defaults. • **exit** - Exists the packet mode. • **no** - Negates a command or set its default. • **packet-size** - Specifies the packet size in bytes; the default size is 64. The supported packet sizes are 64,128, 256, 512, 1024, 1280, 1518, 9216 bytes, and IMIX. **Note** For IMIX, the packet-size should be explicitly mentioned as IMIX. • **source-ip-addr** - Specifies the source IP address. **Note** Ensure that the value of the configured packet profile matches the target configuration of the session.
Step 9	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the profile packet mode.

Step 10	**profile packet direction internal cir** *number* or **eir** *number* or **cbs** *number* or **ebs** *number* or **conform-color set-dscp-transmit** *dscp_value* or **exceed-color set-dscp-transmit** *dscp_value* or **default** or **exit** or **no** or **rate step kbps**
	Example:
	`Device(config-ip-sla-service-performance)#profile traffic direction internal`
	`Device(config-ip-sla-service-performance-traffic)# cir 45000`
	`Device(config-ip-sla-service-performance-traffic)# eir 45000`
	`Device(config-ip-sla-service-performance-traffic)# conform-color set-dscp-transmit af43`
	`Device(config-ip-sla-service-performance-traffi`
		Specifies the in-line traffic profile or enables the selection of a pre-configured traffic profile. A traffic profile defines an upper limit on the volume of the expected service frames belonging to a particular service instance. If a traffic profile is not specified, the Service Performance probe is in passive measurement mode.
		• **cir** - It is the Committed Information Rate.
		• **cbs** - It is the Committed Burst Size.
		• **conform-color** - Sets the conform color.
		• **default** - Sets a command to its defaults.

	Command or Action	Purpose

	`c)# exceed-color set-dscp-transmit af41`
	`Device(config-ip-sla-service-performance-traffic)#`
	`rate-step kbps 1000`
		• **drop** - Drops the packet.
		• **eir** - It is the Excess Information rate.
		• **ebs** - It is the Excess Burst Size.
		• **exceed-color** - Sets the exceed color.
		• **exit** - Exits the traffic mode.
		• **no** - Negates a command or sets its defaults.
		• **rate step kbps** - Sets the rate step.
		• **set-cos-transmit** *cos_value* - Sets the CoS value to a new value, and sends the packet. The valid range is from 0 to 7.
		• **transmit** - Sends the packet without altering it. This is the default value.
		Note This command is required to configure the rate step kbps command.
		• **default** - Sets a command to its defaults.

Step 11	**default** or **exit** or **no** or **rate step kbps**	Specifies the traffic type. The options are: • **default**: Set a command to its default value. • **rate step kbps**: Specifies the transmission rate in kbps. The rate-step range is from 1-1000000 (1 Kbps to 1Gbps).

Example

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 vrf 2
frequency iteration 1 delay 1
duration time 50
profile packet
source-ip-addr 193.168.1.1
packet-size imix
profile traffic direction internal
cir 45000
eir 45000
cbs 45000
ebs 45000
rate-step kbps 50000 90000
conform-color set-dscp-transmit af43
exceed-color set-dscp-transmit af41
```

Configuration Examples for Configuring Y.1564 t o Generate and Measure IP Traffic

This section shows sample configurations for IP traffic generation and measurement.

Example: Passive Color-Aware Measurement Session

The following is a sample configuration for passive color-aware measurement session.

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 interface TenGigabitEthernet0/0/3
service instance 1
frequency iteration 1 delay 1
duration time 50
measurement-type direction internal
conform-color dscp af43
exceed-color dscp af41
receive
profile packet
source-ip-addr 193.168.1.1
packet-size 512
```

Example: Color-Aware IMIX — Traffic Generation

The following is a sample configuration for color-aware IMIX — traffic generation session.

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 interface TenGigabitEthernet0/0/3
service instance 1
frequency iteration 1 delay 1
duration time 50
profile packet
source-ip-addr 193.168.1.1
packet-size imix
profile traffic direction internal
cir 45000
eir 45000
cbs 45000
ebs 45000
rate-step kbps 50000 90000
conform-color set-dscp-transmit af43
exceed-color set-dscp-transmit af41
```

Example: Color-Aware — Traffic Generation

The following is a sample configuration for color-aware — traffic generation session.

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 interface TenGigabitEthernet0/0/3
frequency iteration 1 delay 1
duration time 50
profile packet
source-ip-addr 193.168.1.1
packet-size 512
```

```
profile traffic direction internal
cir 45000
eir 45000
cbs 45000
ebs 45000
rate-step kbps 50000 90000
conform-color set-dscp-transmit af43
exceed-color set-dscp-transmit af41
```

Example: Color Blind — Traffic Generation

The following is a sample configuration for a color blind — traffic generation session.

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 bridge-domain 100
frequency iteration 1 delay 1
duration time 50
profile packet
source-ip-addr 193.168.1.1
packet-size 512
profile traffic direction internal
rate-step kbps 50000 90000
```

Example: Color Blind — Passive Measurement

The following is a sample configuration for a color blind — passive measurement session.

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 vrf 2
frequency iteration 1 delay 1
duration time 50
measurement-type direction internal
receive
profile packet
source-ip-addr 193.168.1.1
packet-size 512
```

Example: Color-Aware — Two Way

The following is a sample configuration for a color-aware — two way session.

```
ip sla 1
 service-performance type ip dest-ip-addr 150.1.1.2 interface TenGigabitEthernet0/0/3 service
 instance 1
  frequency iteration 1 delay 1
 measurement-type direction internal conform-color dscp af11 exceed-color dscp af12
   loss
   receive
   throughput
   delay
   jitter
   profile packet
   source-ip-addr 2.2.1.2
   packet-size 512
   outer-vlan 10
  profile traffic direction internal
   cir 100000
   eir 100000
   rate-step kbps 200000
   conform-color set-dscp-transmit af11
   exceed-color set-dscp-transmit af12
  duration time 100
```

Example: Color Blind — Two Way

The following is a sample configuration for a color blind — two way session.

```
ip sla 1
 service-performance type ip dest-ip-addr 150.1.1.2 interface TenGigabitEthernet0/0/3 service
 instance 1
  frequency iteration 1 delay 1
 measurement-type direction internal
   loss
   receive
   throughput
   delay
   jitter
   profile packet
   source-ip-addr 2.2.1.2
   packet-size 512
   outer-vlan 10
  profile traffic direction internal
   rate-step kbps 200000
  duration time 100
```

How to Configure IP (Layer 3) Loopback on Responder

This section shows how to configure IP (Layer 3) loopback on responder.

Enabling IP SLA Loopback on Responder

Perform the following steps to configure ethernet target traffic generation.

Note For layer 3 Loopback, the parameters **dest-ip-addr** and **src-ip-addr** are mandatory, otherwise the configuration fails. **Outer-vlan** is mandatory only for Trunk EFP and optional for other interface types.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**ip sla** *sla_id* **Example:** `Device(config)# ip sla 100`	Specifies the SLA ID to start the IP SLA session.
Step 4	**service-performance type ip dest-ip-addr** *dest-ip-addr* **interface** *interface* **Example:** `Device(config-ip-sla))#service-performance type ip dest-ip-addr 194.168.1.1 interface gigabitEthernet0/0/1`	Specifies the service performance type as IP and the destination IP address. Specifies the target for the SLA session. The options are: • service instance • interface • vrf • bridge-domain
Step 5	**frequency iteration** *number* **delay** *number* **Example:** `Device(config-ip-sla)# frequency iteration 1 delay 2`	Specifies the number of interactions and delay between the iteration.

Step 6	**loopback direction** {*internal*}
	Example:
	`Device(config-ip-sla)# loopback direction internal`
		Configures loopback direction.

Step 7	**duration time** *seconds* **Example:** `Device(config-ip-sla)# duration time 30`	Specifies the time period to send packets.
Step 8	**profile packet** **Example:** `Device(config-ip-sla-service-performance)# profile packet`	Specifies the packet profile. A packet profile defines the packets to be generated.

Step 9	**source-ip-addr** *ip-address* | **outer-vlan** *vlan-id*
	Example:
	`Device(config-ip-sla-service-performance-packet)# source-ip-addr 51.1.1.1`
	`Device(config-ip-sla-service-performance-packet)# outer-vlan 301`
		Specifies the packet type. The options are:
		• **default** - Sets a command to its defaults.
		• **exit** - Exists the packet mode.
		• **no** - Negates a command or set its defaults.
		• **source-ip-addr** - Specifies the source IP address.
		• **outer-vlan** - Specifies the VLAN ID that is populated in the outer VLAN tag of the packet.

	Command or Action	Purpose
		Note Ensure that the value of the configured packet profile matches the target configuration of the session.
Step 10	**exit** **Example:** `Device(config-ip-sla-service-performance-packet)#exit`	Exits the profile packet mode.

Example

```
ip sla 1
service-performance type ip dest-ip-addr 194.168.1.1 interface gi0/0/0 service instance 1
frequency iteration 1 delay 1
loopback direction internal
profile packet
source-ip-addr 193.168.1.1
outer-vlan 301
duration time 30000
```

SADT Overhead Accounting

FPGA measures the following parameters for SADT:

- Throughput
- Frame Loss
- Jitter
- Delay

FPGA has the capability to generate and measure only 1Gbps traffic rate and hence maximum throughput cannot be achieved.

The following table shows the packet size and the maximum rate that can be achieved.

Packet Size (Bytes)	1G Maximum Rate (kbps)
64	469848
128	638061
256	775123
512	867758
1024	922728
1280	934554

Packet Size (Bytes)	1G Maximum Rate (kbps)
1518	942124
9216	977675
IMIX	788000

To overcome this limitation, use the **platform y1564 shadow-session-enable** command to replicate the packets 10 times in FPGA.

Restrictions

- If two SADT sessions are run in parallel with the same source and destination MAC address by fault, then subsequent SADT session must be started only after modifying the source and destination MAC addresses in the SLA profile to overcome loss.
- The platform y1564 **shadow-session-enable** command does not work in HA setup.
- While using platform y1564 **shadow-session-enable** command, SADT session uses a shadow session with the given MAC + 1 (for example, 0011.1111.2222 to 0011.1111.2223). Hence source MAC and destination MAC must not be in consecutive numbers.
- Use external Ethernet data plane loopback (ELB) for this feature as 1G internal loopback is not supported.
- 1G internal SADT only supports EFP cross connect EFP.
- 1G SADT is *not* supported on local connect and layer 2 VFI.
- Color-aware configurations are *not* supported on 1G SADT.
- 1G SADT can *only* be configured in two-way mode.
- 1G SADT target type is *only* supported on access EFP.
- A combination of 1G and 10G SADT sessions cannot be performed in parallel. Also, two 10G SADT sessions cannot be performed in parallel.
- SADT statistics can *only* be validated after SADT operation is complete.
- Layer 3 packets are *not* supported when SADT overhead accounting is enabled.
- You should configure the parameters that are *only* related to layer 2 for a packet profile.
- Overall throughput value slightly differs the rate step value.
- Multiple rate steps of a single command should be added in an incremental order.
- While QoS egress shaper policy is applied on the same SAT interface with 1G SADT, SAT traffic generation is affected based on the shaper value. There is no effect on the traffic when inbound policer-based policy is applied on the same SAT interface.
- Broadcast and multicast destination MAC are *not* supported.
- You should define the rate-steps upper limits of SADT to provide bandwidth to BFD and avoid the OSPF flaps.

- Online Insertion and Removal (OIR) and Stateful Switchover (SSO) are *not* supported. SLA session must be stopped and re-started manually after these triggers are generated.
- SADT SLA session and ELB on the same service instance of an interface are *not* supported.
- 1G SADT on encapsulation default does not work when untagged encapsulation is configured on the interface.
- 1G SADT is *not* supported on VRF and Port-Channel interfaces.

Configuring SADT Overhead Accounting

To configure SADT Overhead Accounting:

```
enable
configure terminal
platform y1564 shadow-session-enable
```

To remove the configuration:

```
enable
configure terminal
no platform y1564 shadow-session-enable
```

Verifying SADT Overhead Accounting Configuration

Use **show run | sec platform y1564** command to verify SADT overhead accounting configuration as follows:

```
Router#show run | sec platform y1564platform y1564 shadow-session-enable


Router#sh ip sla statistics
IPSLAs Latest Operation Statistics

IPSLA operation id: 102
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 500000
Test duration: 30 seconds

Latest measurement:  15:22:35.807 IST Thu Nov 7 2019
Latest return code:  OK

Overall Throughput: 499871 kbps

Step 1 (500000 kbps):
Stats:
IR(kbps)  FL          FLR      Avail    FTD Min/Avg/Max      FDV Min/Avg/Max
499871    0           0.00%    100.00%  59.44us/98.93us/102.56us  800ns/3.54us/42.48us
Tx Packets: 28401828  Tx Bytes: 1874520648
Rx Packets: 28401828  Rx Bytes: 1874520648
Step Duration: 30 seconds
```

Configurable User-Defined and EMIX Packet Size

Table 17: Feature History

Feature Name	Release	Description
Configurable Y.1564 Service Activation Frame Sizes and EMIX Support	Cisco IOS XE Amsterdam 17.3.1	Starting with Cisco IOS XE Amsterdam 17.3.1 release, EMIX packet size is supported. For EMIX traffic, packet sizes of 64, 128, 256, 1024 and 1518 bytes are supported. These packet sizes are forwarded in ratio of 1:1:1:1:1.
SAT based support for configurable EMIX traffic pattern in FPGA	Cisco IOS XE Bengaluru 17.4.1	The support for EMIX packet size is enhanced. For EMIX traffic, packet sizes of 64, 128, 256, 512, 1024, 1280, 1518, Maximum Transmission Unit (MTU) and user-defined patterns are supported. These packet sizes are forwarded in ratio of 1:1:1:1:1.
EMIX Sequence Enhancement	Cisco IOS XE Bengaluru 17.4.1	This feature enables SAT based support for configurable EMIX traffic pattern in FPGA-based SAT.
Configurable User-Defined and EMIX Packet Size	Cisco IOS XE Bengaluru 17.4.1	This feature allows you to configure user-defined and Enterprise traffic (EMIX) packet sizes. Use the following commands to configure user-defined and EMIX packet sizes: • **packet-size user-defined** *packet size* • **packet-size emix sequence** *emix-sequence* [**u-value** *u-value value*]

EMIX patterns are to be specified by the size designator for each frame in the repeating pattern. The following table is an example of the EMIX test profile.

Starting with Cisco IOS XE Release 16.12.4, EMIX packet size (default abceg pattern) is supported. For EMIX traffic, ITU-T Rec. Y.1564 packet sizes of 64, 128, 256, 1024, and 1518 bytes are supported.

The following table shows the configurable packet size patterns. You must specify the EMIX patterns using the size designator for each frame in the repeating pattern. For example, in the above table, you can specify an eight-frame repeating pattern as follows:

Table 18: Configuring EMIX Frame Size

EMIX Definition	a	b	c	d	e	f	g	h	(u) User Defined
EMIX size (in bytes)	64	128	256	512	1024	1280	1518	Service MTU	Range is from 64-9216

Note SAT traffic is not transmitted as per the configured emix sequence order on the Cisco NCS 4202 router.

- Starting with Cisco IOS XE Amsterdam 17.3.1 release, EMIX packet size (default abceg pattern) is supported on both, RSP2 and RSP3 modules. On the Cisco RSP3 module, it is supported in FPGA-based SADT. For EMIX traffic, ITU-T Rec. Y.1564 packet sizes of 64, 128, 256, 1024, and 1518 bytes are supported.
- The IP SLA packets are generated and forwarded in ratio of 1:1:1:1:1 from UNI or NNI port based on your configuration.
- Starting from Cisco IOS XE Bengaluru 17.4.1 release, EMIX packet size of 62, 128, 256, 512, 1024, 1280, 1518, MTU and *user-defined* bytes are supported. You can configure the SLA using Maximum Transmission Unit (MTU) of Ethernet interface.

  A maximum of eight characters in the **packet-size emix sequence abcdefgh** command is supported. In case you want to use **u**, then you must include **u-value** in the command.
- You can specify the packet size according to Y1564 and assign the user-specified MTU using a hex pattern (**abcdefghu**).
  - EMIX – **abcdefghu** = 64, 128, 256, 512, 1024, 1280, 1518, MTU, *user-defined*

    EMIX – **aabbccuu** = 64, 64, 128, 128, 256, 256, *user-defined*, *user-defined*
- The EMIX pattern must be configurable for the service test.
- Data loss equal to the egress MTU drop is observed when Y1564 is used to configure BDI and h in EMIX sequence.
- EMIX sequence is supported with platform **platform y1564 shadow-session enable** command.
- When the **platform y1564 shadow-session enable** command is enabled, you cannot configure two parallel sessions for 1G interface.

Configuration Example: Configurable User-Defined and EMIX Packet Size

The following example shows the configuration of user-defined packet size:

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip sla 1
Router(config-ip-sla)#service-performance type ethernet dest-mac-addr aaa.ccc.aaa interface
 Gi0/1
Router(config-ip-sla-service-performance)#profile packet
Router(config-sla-service-performance-packet)#packet-size ?
```

```
  1024          1024 byte
  128           128 byte
  1280          1280 byte
  1518          1518 byte
  256           256 byte
  512           512 byte
  64            64 byte
  9216          9216 byte
  emix          Emix packet size
  imix          Imix packet size
  user-defined  User defined Packet Size
Router(config-sla-service-performance-packet)#packet-size user-defined 2955
Router(config-sla-service-performance-packet)#end
```

The following example shows the configuration of EMIX packet size:

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip sla 1
Router(config-ip-sla)#service-performance type ethernet dest-mac-addr aaa.ccc.aaa interface
 Gi0/1
Router(config-ip-sla-service-performance)#profile packet
Router(config-sla-service-performance-packet)#packet-size ?
  1024  1024 byte
  128   128 byte
  1280  1280 byte
  1518  1518 byte
  256   256 byte
  512   512 byte
  64    64 byte
  9216  9216 byte
  emix  Emix packet size
  imix  Imix packet size

Router(config-sla-service-performance-packet)#packet-size em
Router(config-sla-service-performance-packet)#packet-size emix ?
  sequence  Specify the EMIX sequence
  <cr>      <cr>

Router(config-sla-service-performance-packet)#packet-size emix sequence ?
  WORD  EMIX Sequence

Router(config-sla-service-performance-packet)#packet-size emix sequence aaabbcc ?
 u-value  Specify the user-defined value
  <cr>     <cr>

Router(config-sla-service-performance-packet)#packet-size emix sequence aaabbbccu u-value
?
  <64-10236>  Specify user-defined packet size value

Router(config-sla-service-performance-packet)#packet-size emix sequence aaabbbccu u-value
128 ?
  <cr>  <cr>
```

Verification of User-Defined and EMIX Packet Size Configuration

Use **show run | sec sla** command to verify user-defined packet size configuration.

```
Router# show run | sec sla
ip sla 100
service-performance type ethernet dest-mac-addr aaaa.bbbb.cccc interface GigabitEthernet0/1
```

```
  profile packet
   packet-size user-defined 2955
```

Use **show run | sec sla** command to verify EMIX packet size configuration.

```
Router#show run | section sla
ip sla 1
service-performance type ethernet dest-mac-addr 0aaa.0ccc.0aaa interface GigabitEthernet0/1

  profile packet
   packet-size emix sequence aabbccu u-value 128
```

Additional References for IP SLA - Service Performance Testing

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference

Standards and RFCs

Standard/RFC	Title
ITU-T Y.1564	*Ethernet service activation test methodology*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

CHAPTER 11

IP SLA v2 UDP Jitter Probe

The IP SLA V2 UDP feature performs link monitoring by actively injecting traffic, and measuring metrics such as traffic packet loss and delay. The software crafts probe packets and injects them to the data plane. The responses are punted back to the CPU for statistics. The IP SLA packets carry sender or responder sequence numbers to infer the packet loss statistics per direction (sender to responder or vice versa), and the timestamps required for delay measurements.

The IP SLA v2 UDP Jitter Probe feature provides link monitoring with UDP packets carrying timestamp information, called probe. The RX / TX timestamp information provides monitoring of better UDP statistics and accuracy.

The IP SLA UDP jitter probe configuration has 3 packet formats, referred to as versions v1/v2/v3.

- v2—Precision microsecond
- v3—Optimize timestamp

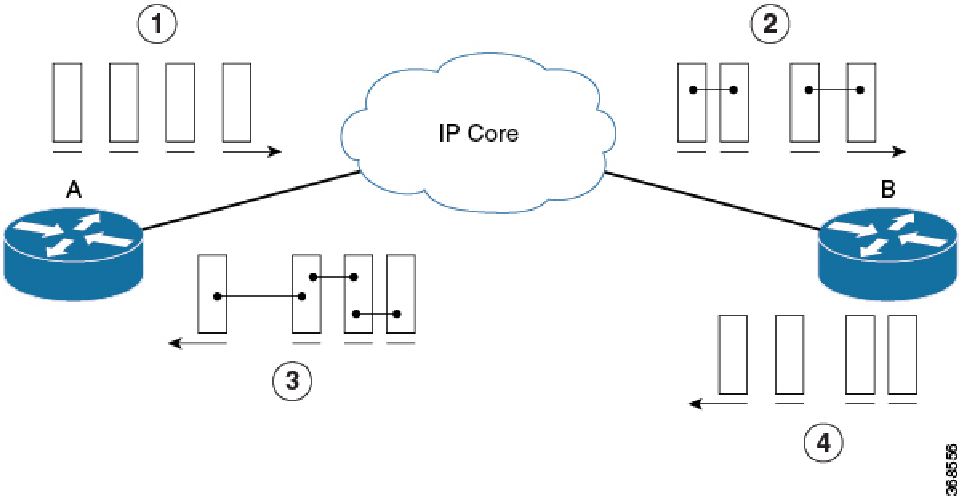
Note RSP3 module does not support IP SLA v3.

Note IP SLA v1 is the default configuration.

Benefits of Using IP SLA UDP Probe

- Monitors network performance and health of the system.
- Ability to test and troubleshoot network problems.
- Ability to measure network metrics such as:
    - Network delay
    - Packet loss
    - Network delay variation (jitter)
    - Connectivity

The example explains the Jitter operation where, A is the IP SLA source, and B is the Responder. The IP Core connects A and B.

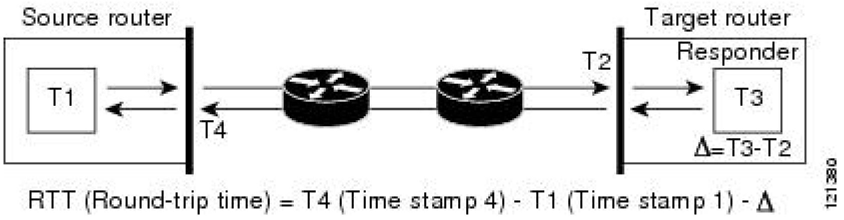


1	Displays the train of packets that are sent at a constant interval.	3	Displays the train of packets that are received at an interval that is impacted by network.
2	Indicates the per-direction (SD or DS) inter-packet delay (Jitter) Indicates the per-direction (SD or DS) packet loss.	4	Indicates the timestamp. Increments Rx count delta time.

- Calculating the UDP-Based Probe Round Trip Time, on page 162
- Restrictions for IP SLA V2, on page 163
- Configuring IP SLA V2 , on page 163

Calculating the UDP-Based Probe Round Trip Time

The router uses the Patented Control Protocol for UDP operation. It requires a responder for accurate results. The source and the destination routers subtract the processed delays.


Source router
Target router
Responder
T1
T2
T3
T4
Δ=T3-T2
RTT (Round-trip time) = T4 (Time stamp 4) - T1 (Time stamp 1) - Δ
121380

One-way latency is T2-T1.

The Round Trip Time (RTT) is [T4-T1]-[T3-T2].

Restrictions for IP SLA V2

- RSP3 module only supports IP SLA v2.
- IP SLA v2 does not support hardware time stamping.
- IP SLA v2 supports MD5 authentication.
- One-way latency values are not displayed in the **show ip sla statistics** command.

Configuring IP SLA V2

```
Router(config)# ip sla 15
Router(config-ip-sla)#udp-jitter 190.168.1.2 2080 num-packets 1200 interval 50
Router(config-ip-sla-jitter)#precision microseconds
Router(config-ip-sla-jitter)#frequency 250
Router(config-ip-sla-jitter)#verify-data
Router(config-ip-sla-jitter)#tos 48
DUT2(config)#ip sla responder
Router(config)#ip sla schedule 15 start-time now
```

Configuring IP SLA V2 on the NTP Server

NTP configuration is mandatory to get accurate results [T1, T2, T3, T4].

Note Ensure that NTP configuration is in sync state on all the devices.

```
Router(config)# ntp logging
Router(config)#ntp source Loopback0
Router(config)# ntp server 192.168.2.1
```

Verifying IP SLA V2

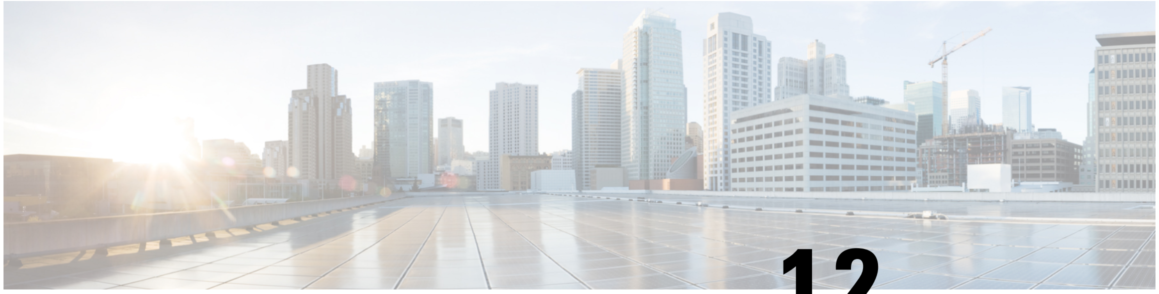
The **show ip sla statistics** command displays the jitter operation statistics

```
Router# show ip sla statistics
IPSLAs Latest Operation Statistics
IPSLA operation id: 10
Type of operation: udp-jitter
Latest RTT: 582 microseconds
 Latest operation start time: 10:18:51 IST Sat Feb 9 2019
Latest operation return code: OK
Latest operation NTP sync state: SYNC
RTT Values:
Number Of RTT: 10 RTT Min/Avg/Max: 494/582/718 microseconds
 Latency one-way time:
Number of Latency one-way Samples: 0
Source to Destination Latency one way Min/Avg/Max: 0/0/0 microseconds Destination to Source
 Latency one way Min/Avg/Max: 0/0/0 microseconds
Jitter Time:
Number of SD Jitter Samples: 9
 Number of DS Jitter Samples: 9
```

```
Source to Destination Jitter Min/Avg/Max: 2/69/110 microseconds
 Destination to Source Jitter Min/Avg/Max: 5/32/78 microseconds
 Over Threshold: Number Of RTT Over Threshold: 0 (0%)
 Packet Loss Values: Loss Source to Destination: 0
Source to Destination Loss Periods Number: 0
Source to Destination Loss Period Length Min/Max: 0/0
 Source to Destination Inter Loss Period Length Min/Max: 0/0
 Loss Destination to Source: 0
Destination to Source Loss Periods Number: 0
Destination to Source Loss Period Length Min/Max: 0/0
Destination to Source Inter Loss Period Length Min/Max: 0/0 Out Of Sequence: 0
Tail Drop: 0 Packet Late Arrival: 0 Packet Skipped: 0 Voice Score Values: Calculated Planning
 Impairment Factor (ICPIF): 0 Mean Opinion Score (MOS): 0
Number of successes: 3
Number of failures: 0
 Operation time to live: Forever
```

The **show ip sla configuration** command displays IP SLA configuration.

```
Router# show ip sla configuration
IP SLAs Infrastructure Engine-III
Entry number: 10
Owner:
Tag:
Operation timeout (milliseconds): 5000
Type of operation to perform: udp-jitter
Target address/Source address: 10.0.0.2/0.0.0.0
Target port/Source port: 3028/0
Type Of Service parameter: 0xC
Request size (ARR data portion): 64
Packet Interval (milliseconds)/Number of packets: 40/200
Verify data: Yes
Operation Stats Precision : microseconds
Timestamp Location Optimization: disabled
Operation Packet Priority : normal
Vrf Name:
Control Packets: enabled
Schedule:
   Operation frequency (seconds): 15  (not considered if randomly scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): Forever
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): Active
Threshold (milliseconds): 5000
Distribution Statistics:
   Number of statistic hours kept: 2
   Number of statistic distribution buckets kept: 1
   Statistic distribution interval (microseconds): 20000
Enhanced History:
Percentile:
```



CHAPTER 12

IP SLA VCCV Operation

The IP SLA supports Virtual Circuit Connectivity Verification (VCCV) for pseudowire Emulation Edge-to-Edge (PWE3) services across MPLS networks. The IP SLAs VCCV operation type is based on the **ping mpls pseudowire** command, which checks MPLS LSP connectivity across an Any Transport over MPLS (AToM) virtual circuit (VC) by sending a series of pseudowire ping operations to the specified destination PE router.

MPLS LSP connectivity checking is performed using an IP SLAs VCCV operation (rather than through the **ping mpls** command with the **pseudowire** keyword). The VCCV operation provides IP SLA proactive threshold monitoring and multioperation scheduling capabilities.

Note IP SLA VCCV operation does not support LSP discovery.

Configuring and Scheduling an IP SLA VCCV Operation

Procedure

Step 1 **enable**

Example:

```
Router> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Router# configure terminal
```

Enters global configuration mode.

Step 3 **ip sla** *operation-number*

Example:

```
Router(config)# ip sla 777
```

Begins configuring an IP SLA VCCV operation and enters IP SLA configuration mode.

Step 4 **mpls lsp ping pseudowire** *peer-ipaddr vc-id* [**source-ipaddr** *source-ipaddr*]

Example:

```
Router(config-ip-sla)# mpls lsp ping
pseudowire 192.168.1.103 123 source-ipaddr 192.168.1.102
```

Configures the IP SLA VCCV operation as an LSP pseudowire ping and enters VCCV configuration mode.

Step 5 **exp** *exp-bits*

Example:

```
Router(config-sla-vccv)# exp 5
```

(Optional) Specifies the experimental field value in the header for an echo request packet of an IP SLA VCCV operation.

Step 6 **frequency** *seconds*

Example:

```
Router(config-sla-vccv)# frequency 120
```

(Optional) Specifies the rate at which a specified IP SLA VCCV operation repeats.

Step 7 **request-data-size** *bytes*

Example:

```
Router(config-sla-vccv)# request-data-size 200
```

(Optional) Specifies the protocol data size for a request packet of an IP SLA VCCV operation.

Step 8 **secondary-frequency** {**both** | **connection-loss** | **timeout**} *frequency*

Example:

```
Router(config-sla-vccv)# secondary-frequency connection-loss 10
```

(Optional) Sets the measurement frequency (secondary frequency) to which an IP SLA VCCV operation should change when a reaction condition occurs.

Step 9 **tag** *text*

Example:

```
Router(config-sla-vccv)# tag testgroup
```

(Optional) Creates a user-specified identifier for an IP SLA VCCV operation.

Step 10 **threshold** *milliseconds*

Example:

```
Router(config-sla-vccv)# threshold 6000
```

(Optional) Sets the upper threshold value for calculating network monitoring statistics created by an IP SLA VCCV operation.

Step 11 **timeout** *milliseconds*

Example:

```
Router(config-sla-vccv)# timeout 7000
```

(Optional) Specifies the amount of time the IP SLA VCCV operation waits for a response from its request packet.

Step 12 **exit**

Example:

```
Router(config-sla-vccv)# exit
```

Exits VCCV configuration mode and returns to global configuration mode.

Step 13 **ip sla reaction-configuration** *operation-number* [**react** *monitored-element*] [**threshold-type** {**never** | **immediate** | **consecutive** [*consecutive-occurrences*] | **xofy** [*x-value y-value*] | **average** [*number-of-probes*]}] [**threshold-value** *upper-threshold lower-threshold*] [**action-type** {**none** | **trapOnly** | **triggerOnly** | **trapAndTrigger**}]

Example:

```
Router(config)# ip sla reaction-configuration 777 react connectionLoss threshold-type
consecutive 3 action-type traponly
```

(Optional) Configures certain actions to occur based on events under the control of Cisco IOS IP SLA VCCV Operation.

Step 14 **ip sla logging traps**

Example:

```
Router(config)# ip sla logging traps
```

(Optional) Enables the generation of SNMP system logging messages specific to IP SLA trap notifications.

Step 15 **ip sla schedule** *operation-number* [**life** {**forever** | *seconds*}] [**start-time** {*hh* **:** *mm*[**:** *ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh* **:** *mm* **:** *ss*}] [**ageout** *seconds*] [**recurring**]

Example:

```
Router(config)# ip sla schedule 777 life forever start-time now
```

Configures the scheduling parameters for an IP SLA VCCV operation.

Step 16 **exit**

Example:

```
Router(config)# exit
```

Exits global configuration submode and returns to privileged EXEC mode.

Example for Configuring an IP SLA VCCV Operation

The following example shows how to configure an IP SLA VCCV operation with the proactive threshold monitoring and multioperation scheduling capabilities of the LSP Health Monitor.

In this example, a VC with the identifier 123 has already been established between the PE device and its peer at IP address 192.168.1.103.

IP SLA VCCV operation 777 is configured with operation parameters and reaction conditions, and it is scheduled to begin immediately and run indefinitely.

```
ip sla 777
 mpls lsp ping pseudowire 192.168.1.103 123
  exp 5
  frequency 120
  secondary-frequency timeout 30
  tag testgroup
  threshold 6000
  timeout 7000
  exit
!
 ip sla reaction-configuration 777 react rtt threshold-value 6000 3000 threshold-type
immediate 3 action-type traponly
 ip sla reaction-configuration 777 react connectionLoss threshold-type immediate action-type
 traponly
 ip sla reaction-configuration 777 react timeout threshold-type consecutive 3 action-type
traponly
 ip sla logging traps
!
 ip sla schedule 777 life forever start-time now
 exit
```

RTT Thresholds

The **threshold** command configures 6000 milliseconds as the amount of time for a rising threshold to be declared on the monitored pseudowire. The first **ip sla reaction-configuration** command specifies that an SNMP logging trap is to be sent immediately if the round-trip time violates the upper threshold of 6000 milliseconds or the lower threshold of 3000 milliseconds.

Connection Loss

The second **ip sla reaction-configuration** command specifies that an SNMP logging trap is to be sent immediately if a connection loss occurs for the monitored pseudowire.

Response Timeout

The **timeout** command configures 7000 seconds as the amount of time that VCCV operation 777 waits for a response from its request packet before a timeout is declared. The **secondary-frequency** command specifies that, if a timeout occurs, the measurement frequency of the operation repeats is to be increased from 120 seconds (the initial measurement frequency that is specified using the **frequency** command) to a faster rate of 30 seconds. The third **ip sla reaction-configuration** command specifies that an SNMP logging trap is to be sent if three consecutive timeouts occur.