IP SLAs—Analyzing IP Service Levels Using the ICMP Path Jitter Operation

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This document describes how to use the Cisco IOS IP Service Level Agreements (SLAs) ICMP Path Jitter operation to monitor hop-by-hop jitter (inter-packet delay variance).

Cisco IOS IP SLAs is an embedded feature set in Cisco IOS software that allows you to analyze IP service levels for IP applications and services, to increase productivity, to lower operational costs, and to reduce occurrences of network congestion or outages. IP SLAs uses active traffic monitoring—the generation of traffic in a continuous, reliable, and predictable manner—for measuring network performance. The accuracy of measured data is enhanced by enabling the IP SLAs responder, available in Cisco routers, on the destination device. This document also demonstrates how the data gathered using the Path Jitter operations can be displayed and analyzed using the Cisco IOS CLI.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for the IP SLAs ICMP Path Jitter Operation" section on page 11.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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Prerequisites

- To use the IP SLAs ICMP Path Jitter operation, your device must be running Cisco IOS Software Release 12.2(2)T and later, 12.0(26)S and later, 12.2(20)S and later, or a derivative release with the correct feature set.
- Before configuring the IP SLAs ICMP Path Jitter operation you should be familiar with the "Cisco IOS IP SLAs Overview" chapter of the *Cisco IOS IP SLAs Configuration Guide*, Release 12.4.

Information About the IP SLAs ICMP Path Jitter Operation

To perform the tasks required to monitor ICMP Path Jitter performance using IP SLA, you should understand the following concept:

ICMP Path Jitter Operation

The IP SLAs ICMP Path Jitter operation provides hop-by-hop jitter, packet loss, and delay measurement statistics in an IP network. The Path Jitter operation functions differently than the standard UDP Jitter operation, which provides total one-way data and total round-trip data.

The ICMP Path Jitter operation can be used a supplement to the standard UDP Jitter operation. For example, results from the UDP Jitter operation may indicate unexpected delays or high jitter values; the ICMP Path Jitter operation could then be used to troubleshoot the network path and determine if traffic is bottlenecking in a particular segment along the transmission path.

The operation first discovers the hop-by-hop IP route from the source to the destination using a traceroute utility, and then uses ICMP echoes to determine the response times, packet loss and approximate jitter values for each hop along the path. The jitter values obtained using the ICMP Path Jitter operation are approximates because ICMP only provides round trip times.

The ICMP Path Jitter operation is not supported in the RTTMON MIB; configuration and performance data can only be obtained using the CLI.

How to Configure the IP SLAs ICMP Path Jitter Operation

This section contains the following procedure:

Configuring and Scheduling a ICMP Path Jitter Operation

The ICMP Path Jitter operation functions by tracing the IP path from a source device to a specified destination device, then sending *N* number of Echo probes to each hop along the traced path, with a time interval of *T* milliseconds between each Echo probe. The operation as a whole is repeated at a frequency of once every *F* seconds. The attributes are user-configurable, as shown here:

Path Jitter Operation Parameter	Default	Configured Using:
Number of echo probes (*N*)	10 echos	**type pathJitter** command, **num-packets** option
Time between Echo probes, in milliseconds (*T*)	20 ms	**type pathJitter** command, **interval** option **Note** The operation's frequency is different than the operation's interval.
The frequency of how often the operation is repeated (*F*)	once every 60 seconds	**frequency** command

Perform one of the following procedures in this section, depending on whether you want to configure and schedule a basic ICMP Path Jitter operation or configure and schedule an ICMP Jitter Operation with additional parameters.

- Configuring and Scheduling a Basic ICMP Path Jitter Operation, page 3
- Configuring and Scheduling an ICMP Path Jitter Operation with Additional Parameters, page 5

Restrictions

- The IP SLAs ICMP Path Jitter operation is ICMP-based. ICMP-based operations can compensate for source processing delay but cannot compensate for target processing delay. For more robust monitoring and verifying, use of the IP SLAs UDP Jitter operation is recommended.
- The jitter values obtained using the ICMP Path Jitter operation are approximates because ICMP does not provide the capability to embed processing times on routers in the packet. If the target router does not place ICMP packets as the highest priority, then the router will not respond properly. ICMP performance also can be affected by the configuration of priority queueing on the router and by ping response.
- Unlike other IP SLAs operations, the ICMP Path Jitter operation is not supported in the RTTMON MIB. Path Jitter operations can only be configured using the CLI, and statistics can only be returned using CLI **show ip sla monitor** commands.

Note In contrast with other IP SLAs operations, the IP SLAs Responder does not have to be enabled on either the target device or intermediate devices for Path Jitter operations. However, the operational efficiency may improve if you enable the IP SLAs Responder; see the "Cisco IOS IP SLAs Overview" chapter of the *Cisco IOS IP SLAs Configuration Guide*, Release 12.4, for information about the IP SLAs Responder and the IP SLAs Control Protocol.

Note Before configuring any IP SLAs application, you can use the **show ip sla monitor application** command to verify that the operation type is supported on your software image.

Configuring and Scheduling a Basic ICMP Path Jitter Operation

Perform the following steps to configure and schedule an ICMP Path Jitter operation using the general default characteristics for the operation. Start in privileged EXEC mode.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla monitor** *operation-number*
4. **type pathJitter dest-ipaddr** {*destination-ip-address* | *destination-hostname*} [**source-ipaddr** {*ip-address* | *hostname*}] [**num-packets** *packet-number*] [**interval** *milliseconds*] [**targetOnly**]
5. **frequency** *seconds*
6. **exit**
7. **ip sla monitor schedule** *operation-number* [**life** {**forever** | *seconds*}] [**start-time** {*hh*:*mm*[:*ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh*:*mm*:*ss*] [**ageout** *seconds*] [**recurring**]
8. **exit**

DETAILED STEPS

	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 monitor** *operation-number* **Example:** `Router(config)# ip sla monitor 10`	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
Step 4	**type pathJitter dest-ipaddr** {*destination-ip-address* | *destination-hostname*} [**source-ipaddr** {*ip-address* | *hostname*}] [**num-packets** *packet-number*] [**interval** *milliseconds*] [**targetOnly**] **Example:** `Router(config-sla-monitor)# type PathJitter dest-ipaddr 172.31.1.129 source-ipaddr 10.2.30.1 num-packets 12 interval 22`	Defines an ICMP Path Jitter operation and enters IP SLA Monitor Path Jitter configuration mode.
Step 5	**frequency** *seconds* **Example:** `Router(config-sla-monitor-pathJitter)# frequency 30`	(Optional) Sets the rate at which a specified IP SLAs operation repeats.
Step 6	**exit** **Example:** `Router(config-sla-monitor-pathJitter)# exit`	Exits path jitter configuration submode and returns to global configuration mode.

	Command or Action	Purpose
Step 7	**ip sla monitor 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 monitor schedule 10 start-time now life forever`	Configures the scheduling parameters for an individual IP SLAs operation.
Step 8	**exit** **Example:** `Router(config)# exit`	(Optional) Exits global configuration mode and returns to privileged EXEC mode.

Examples

In the following example, the **targetOnly** keyword is used to bypass the hop-by-hop measurements. With this version of the command, echo probes will be sent to the destination only.

```
Router(config)# ip sla monitor 1
router(config-sla-monitor)# type pathJitter dest-ipaddr 172.17.246.20 num-packets 50
interval 30 targetOnly
```

What to Do Next

To view and interpret the results of an IP SLAs operation use the **show ip sla monitor statistics** command. Checking the output for fields that correspond to criteria in your service level agreement will help you determine whether the service metrics are acceptable.

Configuring and Scheduling an ICMP Path Jitter Operation with Additional Parameters

Perform the following steps to configure and schedule an ICMP Path Jitter operation with additional parameters, using any of the optional commands needed. Start in Privileged Exec mode.

Restrictions

The IP SLAs Path Jitter operation does not support the IP SLAs History feature (statistics history buckets) because of the large data volume involved with Jitter operations. This means that the following IP SLAs commands are not supported for Jitter operations: **buckets-of-history-kept**, **filter-for-history**, **lives-of-history-kept**, **samples-of-history-kept**, and **show ip sla monitor history**.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla monitor** *operation-number*
4. **type pathJitter dest-ipaddr** {*destination-ip-address* | *destination-hostname*} [**source-ipaddr** {*ip-address* | *hostname*}] [**num-packets** *packet-number*] [**interval** *milliseconds*] [**targetOnly**]
5. **frequency** *seconds*
6. **owner** *owner-id*

7. **request-data-size** *bytes*
8. **tag** *text*
9. **timeout** *milliseconds*
10. **vrf** *vrf-name*
11. **exit**
12. **ip sla monitor schedule** *operation-number* [**life** {**forever** | *seconds*}] [**start-time** {*hh*:*mm*[:*ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh*:*mm*:*ss*] [**ageout** *seconds*] [**recurring**]
13. **exit**
14. **show ip sla monitor configuration** [*operation-number*]

DETAILED STEPS

	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 monitor** *operation-number* **Example:** `Router(config)# ip sla monitor 10`	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
Step 4	**type pathJitter dest-ipaddr** {*destination-ip-address* | *destination-hostname*} [**source-ipaddr** {*ip-address* | *hostname*}] [**num-packets** *packet-number*] [**interval** *milliseconds*] [**targetOnly**] **Example:** `Router(config-sla-monitor)# type PathJitter dest-ipaddr 172.31.1.129 source-ipaddr 10.2.30.1 num-packets 12 interval 22`	Defines an ICMP Path Jitter operation and enters IP SLA Monitor Path Jitter configuration mode.
Step 5	**frequency** *seconds* **Example:** `Router(config-sla-monitor-pathJitter)# frequency 30`	(Optional) Sets the rate at which a specified IP SLAs operation repeats.
Step 6	**owner** *owner-id* **Example:** `Router(config-sla-monitor-pathJitter)# owner admin`	(Optional) Configures the Simple Network Management Protocol (SNMP) owner of an IP SLAs operation.

	Command or Action	Purpose
Step 7	**request-data-size** *bytes* **Example:** `Router(config-sla-monitor-pathJitter)# request-data-size 64`	(Optional) Sets the protocol data size in the payload of an IP SLAs operation's request packet.
Step 8	**tag** *text* **Example:** `Router(config-sla-monitor-pathJitter)# tag TelnetPollServer1`	(Optional) Creates a user-specified identifier for an IP SLAs operation.
Step 9	**timeout** *milliseconds* **Example:** `Router(config-sla-monitor-pathJitter)# timeout 10000`	(Optional) Sets the amount of time an IP SLAs operation waits for a response from its request packet.
Step 10	**vrf** *vrf-name* **Example:** `Router(config-sla-monitor-pathJitter)# vrf vpn-A`	(Optional) Allows monitoring within Multiprotocol Label Switching (MPLS) Virtual Private Networks (VPNs) using IP SLAs operations.
Step 11	**exit** **Example:** `Router(config-sla-monitor-pathJitter)# exit`	Exits Path Jitter configuration submode and returns to global configuration mode.
Step 12	**ip sla monitor 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 monitor schedule 10 start-time now life forever`	Configures the scheduling parameters for an individual IP SLAs operation.
Step 13	**exit** **Example:** `Router(config)# exit`	(Optional) Exits global configuration mode and returns to privileged EXEC mode.
Step 14	**show ip sla monitor configuration** [*operation-number*] **Example:** `Router# show ip sla monitor configuration 10`	(Optional) Displays configuration values including all defaults for all IP SLAs operations or a specified operation.

The following commands, available in Path Jitter configuration mode, do not apply to Path Jitter operations:

- **buckets-of-history-kept**
- **distributions-of-statistics-kept**

- **enhanced-history**
- **filter-for-history**
- **hours-of-statistics-kept**
- **lives-of-history-kept**
- **lsr-path**
- **samples-of-history-kept**
- **statistics-distribution-interval**
- **tos**
- **threshold**
- **verify-data**

Examples

In the following example, a Path Jitter operation is configured to run over a VPN using the VRF "red" to the CE at 10.3.30.130:

```
Router# configure terminal
Enter configuration commands, one per line.  End with the end command.
Router(config)# ip sla monitor 7
Router(config-sla-monitor)# type pathJitter dest-ipaddr 10.3.30.130
Router(config-sla-monitor-pathJitter)# vrf red
Router(config-sla-monitor-pathJitter)# exit
Router(config)# ip sla monitor schedule 7 start-time now life forever
```

In the following example, the targetOnly keyword is used to bypass the hop-by-hop measurements. With this version of the command, echo probes will be sent to the destination only.

```
Router(config)# ip sla monitor 1
router(config-sla-monitor)# type pathJitter dest-ipaddr 172.17.246.20 num-packets 50
interval 30 targetOnly
```

Troubleshooting Tips

Use the **debug ip sla monitor trace** and **debug ip sla monitor error** commands to help troubleshoot issues with an IP SLAs operation.

What to Do Next

To view and interpret the results of an IP SLAs operation use the **show ip sla monitor statistics** command. Checking the output for fields that correspond to criteria in your service level agreement will help you determine whether the service metrics are acceptable.

Configuration Examples for the IP SLAs ICMP Path Jitter Operation

This section provides the following configuration example:

- Configuring a Path Jitter Operation: Example, page 9

Configuring a Path Jitter Operation: Example

The following example shows the output when the ICMP Path Jitter operation is configured:

```
Router# configure terminal
Router(config)# ip sla monitor 15011
Router(config-sla-monitor)# type path-jitter dest-ipaddr 10.222.1.100 source-ipaddr
10.222.3.100 num-packets 20
Router(config-sla-monitor-pathJitter)# frequency 30
Router(config-sla-monitor-pathJitter)# exit
Router(config)# ip sla monitor schedule 15011 life forever start-time now
Router(config)# exit
Router# show ip sla monitor statistics 15011

Round Trip Time (RTT) for       Index 15011
        Latest RTT: 1 milliseconds
Latest operation start time: 15:37:35.443 EDT Mon Jun 16 2008
Latest operation return code: OK

---- Path Jitter Statistics ----

Hop IP 10.222.3.252:
Round Trip Time milliseconds:
        Latest RTT: 1 ms
        Number of RTT: 20
        RTT Min/Avg/Max: 1/1/3 ms
Jitter time milliseconds:
        Number of jitter: 2
        Jitter Min/Avg/Max: 2/2/2 ms
Packet Values:
        Packet Loss (Timeouts): 0
        Out of Sequence: 0
        Discarded Samples: 0
Operation time to live: Forever
```

Note The path jitter operation does not support hourly statistics and hop information. The output for the **show ip sla monitor statistics** command for the path jitter operation will only show the statistics for the first hop.

Where to Go Next

- If you want to configure multiple Cisco IOS IP SLAs operations at once, see the "IP SLAs—Multiple Operation Scheduling" chapter of the *Cisco IOS IP SLAs Configuration Guide*, Release 12.4.
- If you want to configure threshold parameters for an IP SLAs operation, see the "IP SLAs—Proactive Threshold Monitoring" chapter of the *Cisco IOS IP SLAs Configuration Guide*, Release 12.4.
- If you want to configure other types of IP SLAs operations, see the "Where to Go Next" section of the "Cisco IOS IP SLAs Overview" chapter of the *Cisco IOS IP SLAs Configuration Guide*, Release 12.4.

Additional References

The following sections provide references related to monitoring UDP echo operations using IP SLA.

Related Documents

Related Topic	Document Title
Overview of Cisco IOS IP SLAs	"Cisco IOS IP SLAs Overview" chapter of the *Cisco IOS IP SLAs Configuration Guide*, Release 12.4
Cisco IOS IP SLAs commands: complete command syntax, defaults, command mode, command history, usage guidelines, and examples	*Cisco IOS IP SLAs Command Reference*, Release 12.4

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by features in this document.	—

MIBs

MIBs	MIBs Link
MIB support for the Path Jitter operation is not provided.	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
RFC 1889[1]	*RTP: A Transport Protocol for Real-Time Applications*; see the section "Estimating the Interarrival Jitter"

1. Support for the listed RFC is not claimed; listed as a reference only.

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

Feature Information for the IP SLAs ICMP Path Jitter Operation

Table 1 lists the features in this module and provides links to specific configuration information. Only features that were introduced or modified in Cisco IOS Release 12.3(14)T or a later release appear in the table. *Not all features may be supported in your Cisco IOS software release*.

For information on a feature in this technology that is not documented here, see the "Cisco IOS IP SLAs Features Roadmap."

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Cisco IOS software images are specific to a Cisco IOS software release, a feature set, and a platform. Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Note Table 1 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 1 Feature Information for the IP SLAs ICMP Path Jitter Operation

Feature Name	Releases	Feature Information
IP SLAs Path Jitter Operation	12.3(14)T	The Cisco IOS IP SLAs Internet Control Message Protocol (ICMP) path jitter operation allows you to measure hop-by-hop jitter (inter-packet delay variance).