



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

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the “[Feature Information for the IP SLAs ICMP Path Jitter Operation](#)” section on page 11.

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

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Prerequisites

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*.

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, page 2](#)

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, page 3](#) (required)

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	path-jitter command, num-packets option
Time between Echo probes, in milliseconds (T)	20 ms	path-jitter 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 4](#)
- [Configuring and Scheduling an ICMP Path Jitter Operation with Additional Parameters, page 6](#)

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** 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*, 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 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 operation-number**
4. **path-jitter** {*destination-ip-address* | *destination-hostname*} [**source-ip** {*ip-address* | *hostname*}] [**num-packets** *packet-number*] [**interval** *milliseconds*] [**targetOnly**]
5. **frequency** *seconds*
6. **exit**
7. **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**]
8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none">• 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 10	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
Step 4	path-jitter { <i>destination-ip-address</i> <i>destination-hostname</i> } [source-ip { <i>ip-address</i> <i>hostname</i> }] [num-packets <i>packet-number</i>] [interval <i>milliseconds</i>] [targetOnly] Example: Router(config-ip-sla)# path-jitter 172.31.1.129 source-ip 10.2.30.1 num-packets 12 interval 22	Defines an ICMP Path Jitter operation and enters IP SLA Path Jitter configuration mode.
Step 5	frequency <i>seconds</i> Example: Router(config-ip-sla-pathJitter)# frequency 30	(Optional) Sets the rate at which a specified IP SLAs operation repeats.
Step 6	exit Example: Router(config-ip-sla-pathJitter)# exit	Exits path jitter configuration submode and returns to global configuration mode.

	Command or Action	Purpose
Step 7	<pre>ip sla schedule <i>operation-number</i> [life {forever <i>seconds</i>}] [start-time {<i>hh:mm[:ss]</i> [<i>month day</i> <i>day month</i>] pending now after <i>hh:mm:ss</i>] [ageout <i>seconds</i>] [recurring]</pre> <p>Example: Router(config)# ip sla schedule 10 start-time now life forever</p>	Configures the scheduling parameters for an individual IP SLAs operation.
Step 8	<pre>exit</pre> <p>Example: Router(config)# exit</p>	(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 1
Router(config-ip-sla)# path-jitter 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 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: **history buckets-kept**, **history filter**, **history lives-kept**, **samples-of-history-kept**, and **show ip sla history**.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla** *operation-number*
4. **path-jitter** {*destination-ip-address* | *destination-hostname*} [**source-ip** {*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 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 configuration** [*operation-number*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none">Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	ip sla <i>operation-number</i> Example: Router(config)# ip sla 10	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
Step 4	path-jitter { <i>destination-ip-address</i> <i>destination-hostname</i> } [source-ip { <i>ip-address</i> <i>hostname</i> }] [num-packets <i>packet-number</i>] [interval <i>milliseconds</i>] [targetOnly] Example: Router(config-ip-sla)# path-jitter 172.31.1.129 source-ip 10.2.30.1 num-packets 12 interval 22	Defines an ICMP Path Jitter operation and enters IP SLA Path Jitter configuration mode.
Step 5	frequency <i>seconds</i> Example: Router(config-ip-sla-pathJitter)# frequency 30	(Optional) Sets the rate at which a specified IP SLAs operation repeats.
Step 6	owner <i>owner-id</i> Example: Router(config-ip-sla-pathJitter)# owner admin	(Optional) Configures the Simple Network Management Protocol (SNMP) owner of an IP SLAs operation.
Step 7	request-data-size <i>bytes</i> Example: Router(config-ip-sla-pathJitter)# request-data-size 64	(Optional) Sets the protocol data size in the payload of an IP SLAs operation's request packet.

How to Configure the IP SLAs ICMP Path Jitter Operation

	Command or Action	Purpose
Step 8	tag <i>text</i> Example: Router(config-ip-sla-pathJitter)# tag TelnetPollServer1	(Optional) Creates a user-specified identifier for an IP SLAs operation.
Step 9	timeout <i>milliseconds</i> Example: Router(config-ip-sla-pathJitter)# timeout 10000	(Optional) Sets the amount of time an IP SLAs operation waits for a response from its request packet.
Step 10	vrf <i>vrf-name</i> Example: Router(config-ip-sla-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-ip-sla-pathJitter)# exit	Exits Path Jitter configuration submode and returns to global configuration mode.
Step 12	ip sla schedule <i>operation-number</i> [life { forever <i>seconds</i> }] [start-time { <i>hh:mm[:ss]</i> [<i>month day</i> <i>day month</i>] pending now after <i>hh:mm:ss</i> }] [ageout <i>seconds</i>] [recurring] Example: Router(config)# ip sla 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 configuration [<i>operation-number</i>] Example: Router# show ip sla 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:

- **history buckets-kept**
- **history distributions-of-statistics-kept**
- **history enhanced**
- **history filter**
- **history hours-of-statistics-kept**
- **history lives-kept**
- **lsr-path**
- **samples-of-history-kept**

- **history 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 7
Router(config-ip-sla)# path-jitter 10.3.30.130
Router(config-ip-sla-pathJitter)# vrf red
Router(config-ip-sla-pathJitter)# exit
Router(config)# ip sla 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 1
router(config-ip-sla)# path-jitter 172.17.246.20 num-packets 50 interval 30 targetOnly
```

Troubleshooting Tips

Use the `debug ip sla trace` and `debug ip sla 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 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 15011
Router(config-sla-monitor)# path-jitter 10.222.1.100 source-ip 10.222.3.100 num-packets 20
Router(config-sla-monitor-pathJitter)# frequency 30
Router(config-sla-monitor-pathJitter)# exit
Router(config)# ip sla schedule 15011 life forever start-time now
```

```

Router(config)# exit
Router# show ip sla 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 statistics** command for the path jitter operation will only show the statistics for the first hop.

Where to Go Next

For information about other types of IP SLAs operations and IP SLAs features, see the [Cisco IOS IP SLAs Features Roadmap](#).

Additional References

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

Related Documents

Related Topic	Document Title
Cisco IOS IP SLAs command-line interface enhancements	Cisco IOS IP Service Level Agreements Command Line Interface , Cisco white paper
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference

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	<i>RTP: A Transport Protocol for Real-Time Applications</i> ; 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 release history for this feature.

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

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

**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, 12.2(31)SB2, 12.2(33)SRB1, 12.2(33)SXH, Cisco IOS XE Release 2.1	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).

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