IP SLAs—Analyzing IP Service Levels Using the UDP Jitter Operation

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This document describes how to use the Cisco IOS IP Service Level Agreements (SLAs) UDP jitter operation to analyze round-trip delay, one-way delay, one-way jitter, one-way packet loss, and connectivity in networks that carry UDP traffic in IPv4 or IPv6 networks.

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 module also demonstrates how the data gathered using the UDP jitter operation can be displayed and analyzed using the Cisco IOS command-line interface (CLI).

Note A VoIP-specific implementation of the UDP jitter operation is available to measure performance by simulating specific voice codecs and returned voice quality scores. For more information, see the "IP SLAs—Analyzing VoIP Service Levels Using the UDP Jitter Operation" chapter of the *Cisco IOS IP SLAs Configuration Guide*.

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 UDP Jitter Operation" section on page 13.

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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Contents

Information About the IP SLAs UDP Jitter Operation

To perform the tasks required to verify service levels using the IP SLAs UDP jitter operation, you should understand the following concept:

IP SLAs UDP Jitter Operation

The IP SLAs UDP jitter operation was primarily designed to diagnose network suitability for real-time traffic applications such as voice over IP (VoIP), video over IP, or real-time conferencing.

Jitter means inter-packet delay variance. When multiple packets are sent consecutively from source to destination, for example, 10 ms apart, and if the network is behaving ideally, the destination should be receiving them 10 ms apart. But if there are delays in the network (like queuing, arriving through alternate routes, and so on) the arrival delay between packets might be greater than or less than 10 ms. Using this example, a positive jitter value indicates that the packets arrived greater than 10 ms apart. If the packets arrive 12 ms apart, then positive jitter is 2 ms; if the packets arrive 8 ms apart, then negative jitter is 2 ms. For delay-sensitive networks like VoIP, positive jitter values are undesirable, and a jitter value of 0 is ideal.

However, the IP SLAs UDP jitter operation does more than just monitor jitter. As the UDP jitter operation includes the data returned by the IP SLAs UDP operation, the UDP jitter operation can be used as a multipurpose data gathering operation. The packets IP SLAs generates carry packet sending sequence and receiving sequence information, and sending and receiving time stamps from the source and the operational target. Based on these, UDP jitter operations are capable of measuring the following:

- Per-direction jitter (source to destination and destination to source)
- Per-direction packet-loss
- Per-direction delay (one-way delay)
- Round-trip delay (average round-trip time)

As the paths for the sending and receiving of data may be different (asymmetric), the per-direction data allow you to more readily identify where congestion or other problems are occurring in the network.

The UDP jitter operation functions by generating synthetic (simulated) UDP traffic. The UDP jitter operation sends N UDP packets, each of size S, sent T milliseconds apart, from a source router to a target router, at a given frequency of F. By default, ten packet-frames (N), each with a payload size of 10 bytes (S) are generated every 10 ms (T), and the operation is repeated every 60 seconds (F). Each of these parameters are user-configurable, so as to best simulate the IP service you are providing, or want to provide.

How to Configure the IP SLAs UDP Jitter Operation

This section contains the following procedures:

- Configuring the IP SLAs Responder on the Destination Device, page 3 (required)
- Configuring and Scheduling a UDP Jitter Operation on the Source Device, page 3 (required)

Configuring the IP SLAs Responder on the Destination Device

Before configuring a UDP jitter operation on the source device, the IP SLAs Responder must be enabled on the target device (the operational target). The IP SLAs Responder is available only on Cisco IOS software-based devices.

Perform this task to enable the IP SLAs Responder.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla responder**
4. **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 responder** **Example:** `Router(config)# ip sla responder`	Enables the IP SLAs Responder.
Step 4	**exit** **Example:** `Router(config)# exit`	(Optional) Exits global configuration mode and returns to privileged EXEC mode.

Configuring and Scheduling a UDP Jitter Operation on the Source Device

Perform one of the following tasks in this section, depending on whether you want to configure a basic UDP jitter operation or configure a UDP jitter operation with additional characteristics:

The IP SLAs operations function by generating synthetic (simulated) network traffic. A single IP SLAs operation (for example, IP SLAs operation 10) will repeat at a given frequency for the lifetime of the operation.

A single UDP jitter operation consists of *N* UDP packets, each of size *S*, sent *T* milliseconds apart, from a source router to a target router, at a given frequency of *F*. By default, ten packets (*N*), each with an RTP payload size of 32 bytes (*S*), are generated every 20 ms (*T*), and the operation is repeated every 60 seconds (*F*). Each of these parameters are user-configurable, as shown in Table 1.

Table 1 UDP Jitter Operation Parameters

UDP Jitter Operation Parameter	Default	Configured Using:
Number of packets (N)	10 packets	**udp-jitter** command, **num-packets** option
Payload size per packet (S)	32 bytes	**request-data-size** command
Time between packets, in milliseconds (T)	20 ms	**udp-jitter** command, **interval** option
Elapsed time before the operation repeats, in seconds (F)	60 seconds	**frequency** (IP SLA) command

Prerequisites

Use of the UDP jitter operation requires that the IP SLAs Responder be enabled on the target Cisco device. To enable the Responder, perform the task in the "Configuring the IP SLAs Responder on the Destination Device" section on page 3.

Time synchronization, such as that provided by NTP, is required between the source and the target device in order to provide accurate one-way delay (latency) measurements. To configure NTP on the source and target devices, perform the tasks in the "Performing Basic System Management" chapter of the *Cisco IOS Network Manageent Configuration Guide*. Time synchronization is not required for the one-way jitter and packet loss measurements, however. If the time is not synchronized between the source and target devices, one-way jitter and packet loss data will be returned, but values of "0" will be returned for the one-way delay measurements provided by the UDP jitter operation.

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.

Restrictions

The responder should not configure a permanent port for the same sender. If the responder configures the permanent port for the same sender, even if the packets are successfully sent (no timeout or packet loss issues), the jitter values will be zero.

Configuring and Scheduling a Basic UDP Jitter Operation on the Source Device

Perform this task to configure and schedule a basic UDP jitter operation.

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **ip sla** *operation-number*
4. **udp-jitter** {*destination-ip-address* | *destination-hostname*} *destination-port* [**source-ip** {*ip-address* | *hostname*}] [**source-port** *port-number*] [**control** {**enable** | **disable**}] [**num-packets** *number-of-packets*] [**interval** *interpacket-interval*]
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**
9. **show ip sla 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** *operation-number* **Example:** `Router(config)# ip sla 10`	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
Step 4	**udp-jitter** {*destination-ip-address* | *destination-hostname*} *destination-port* [**source-ip** {*ip-address* | *hostname*}] [**source-port** *port-number*] [**control** {**enable** | **disable**}] [**num-packets** *number-of-packets*] [**interval** *interpacket-interval*] **Example:** `Router(config-ip-sla)# udp-jitter 172.29.139.134 5000`	Configures the IP SLAs operation as a UDP jitter operation and enters UDP jitter configuration submode. After entering this command, the command-line interface (CLI) enters IP SLA jitter configuration mode to allow you to specify optional characteristics for the operation.
Step 5	**frequency** *seconds* **Example:** `Router(config-ip-sla-jitter)# frequency 30`	(Optional) Sets the rate at which a specified IP SLAs operation repeats.
Step 6	**exit** **Example:** `Router(config-ip-sla-jitter)# exit`	Exits UDP jitter configuration submode and returns to global configuration mode.

	Command or Action	Purpose
Step 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**] **Example:** `Router(config)# ip sla schedule 5 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.
Step 9	**show ip sla configuration** [*operation-number*] **Example:** `Router# show ip sla configuration 10`	(Optional) Displays configuration values including all defaults for all IP SLAs operations or a specified operation.

Troubleshooting Tips

- If the IP SLAs operation is not running and generating statistics, add the **verify-data** command to the configuration of the operation (while configuring in IP SLA configuration mode) to enable data verification. When enabled, each operation response is checked for corruption. Use the **verify-data** command with caution during normal operations because it generates unnecessary overhead.
- 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.

If you with configure and schedule a UDP jitter operation with additional characteristics, perform the task in the "Configuring and Scheduling a UDP Jitter Operation with Additional Characteristics" section on page 6.

Configuring and Scheduling a UDP Jitter Operation with Additional Characteristics

Perform this task to configure and schedule a UDP jitter operation with additional parameters.

Restrictions

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

The MIB used by IP SLAs (CISCO-RTTMON-MIB) limits the hours-of-statistics kept for the UDP jitter operation to two hours. Configuring a larger value using the **history hours-of-statistics** *hours* global configuration change will not increase the value beyond two hours.

However, the Data Collection MIB can be used to collect historical data for the operation. See the CISCO-DATA-COLLECTION-MIB (available from http://www.cisco.com/go/mibs).

Note The **tos** command defines the type of service (ToS) byte in the IPv4 header of an IP SLAs operation and is valid only in IPv4 networks. The **traffic-class** command defines the traffic class byte in the IPv6 header for a supported IP SLAs operation.

The **flow-label** command defines the value in the flow label field in the IPv6 header for a supported IP SLAs operation and is valid only in IPv6 networks.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla** *operation-number*
4. **udp-jitter** {*destination-ip-address* | *destination-hostname*} *destination-port* [**source-ip** {*ip-address* | *hostname*}] [**source-port** *port-number*] [**control** {**enable** | **disable**}] [**num-packets** *number-of-packets*] [**interval** *interpacket-interval*]
5. **history distributions-of-statistics-kept** *size*
6. **history enhanced** [**interval** *seconds*] [**buckets** *number-of-buckets*]
7. **frequency** *seconds*
8. **history hours-of-statistics-kept** *hours*
9. **owner** *owner-id*
10. **request-data-size** *bytes*
11. **history statistics-distribution-interval** *milliseconds*
12. **tag** *text*
13. **threshold** *milliseconds*
14. **timeout** *milliseconds*
15. **tos** *number*
    or
    traffic-class *number*
16. **flow-label** *number*
17. **verify-data**
18. **vrf** *vrf-name*
19. **exit**
20. **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**]
21. **exit**
22. **show ip sla 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** *operation-number* **Example:** `Router(config)# ip sla 10`	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
Step 4	**udp-jitter** {*destination-ip-address* | *destination-hostname*} *destination-port* [**source-ip** {*ip-address* | *hostname*}] [**source-port** *port-number*] [**control** {**enable** | **disable**}] [**num-packets** *number-of-packets*] [**interval** *interpacket-interval*] **Example:** `Router(config-ip-sla)# udp-jitter 172.29.139.134 5000`	Configures the IP SLAs operation as a UDP jitter operation and enters UDP jitter configuration submode. • The default number of packets (**num-packets**) sent is 10. • The default **interval** between packets is 20 milliseconds. • The **control disable** keyword combination should only be used if you are disabling the IP SLAs control protocol on both the source and target routers. The IP SLAs control protocol is enabled by default. • After entering this command, the command-line interface (CLI) enters IP SLA jitter configuration mode to allow you to specify optional characteristics for the operation.
Step 5	**history distributions-of-statistics-kept** *size* **Example:** `Router(config-ip-sla-jitter)# history distributions-of-statistics-kept 5`	(Optional) Sets the number of statistics distributions kept per hop during an IP SLAs operation.
Step 6	**history enhanced** [**interval** *seconds*] [**buckets** *number-of-buckets*] **Example:** `Router(config-ip-sla-jitter)# history enhanced interval 900 buckets 100`	(Optional) Enables enhanced history gathering for an IP SLAs operation.
Step 7	**frequency** *seconds* **Example:** `Router(config-ip-sla-jitter)# frequency 30`	(Optional) Sets the rate at which a specified IP SLAs operation repeats.

	Command or Action	Purpose
Step 8	**history hours-of-statistics-kept** *hours* **Example:** `Router(config-ip-sla-jitter)# history hours-of-statistics-kept 4`	(Optional) Sets the number of hours for which statistics are maintained for an IP SLAs operation.
Step 9	**owner** *owner-id* **Example:** `Router(config-ip-sla-jitter)# owner admin`	(Optional) Configures the Simple Network Management Protocol (SNMP) owner of an IP SLAs operation.
Step 10	**request-data-size** *bytes* **Example:** `Router(config-ip-sla-jitter)# request-data-size 64`	(Optional) Sets the protocol data size in the payload of an IP SLAs operation's request packet.
Step 11	**history statistics-distribution-interval** *milliseconds* **Example:** `Router(config-ip-sla-jitter)# history statistics-distribution-interval 10`	(Optional) Sets the time interval for each statistics distribution kept for an IP SLAs operation.
Step 12	**tag** *text* **Example:** `Router(config-ip-sla-jitter)# tag TelnetPollServer1`	(Optional) Creates a user-specified identifier for an IP SLAs operation.
Step 13	**threshold** *milliseconds* **Example:** `Router(config-ip-sla-jitter)# threshold 10000`	(Optional) Sets the upper threshold value for calculating network monitoring statistics created by an IP SLAs operation.
Step 14	**timeout** *milliseconds* **Example:** `Router(config-ip-sla-jitter)# timeout 10000`	(Optional) Sets the amount of time an IP SLAs operation waits for a response from its request packet.

Step 15	**tos** *number*
	or
	traffic-class *number*
	
	Example:
	`Router(config-ip-sla-jitter)# tos 160`
	or
	
	Example:
	`Router(config-ip-sla-jitter)# traffic-class 160`
		(Optional) In an IPv4 network only, defines the ToS byte in the IPv4 header of an IP SLAs operation.
		or
		(Optional) In an IPv6 network only, defines the traffic class byte in the IPv6 header for a supported IP SLAs operation.

	Command or Action	Purpose
Step 16	**flow-label** *number* **Example:** `Router(config-ip-sla-jitter)# flow-label 112233`	(Optional) In an IPv6 network only, defines the flow label field in the IPv6 header for a supported IP SLAs operation.
Step 17	**verify-data** **Example:** `Router(config-ip-sla-jitter)# verify-data`	(Optional) Causes an IP SLAs operation to check each reply packet for data corruption.
Step 18	**vrf** *vrf-name* **Example:** `Router(config-ip-sla-jitter)# vrf vpn-A`	(Optional) Allows monitoring within Multiprotocol Label Switching (MPLS) Virtual Private Networks (VPNs) using IP SLAs operations.
Step 19	**exit** **Example:** `Router(config-ip-sla-jitter)# exit`	Exits UDP jitter configuration submode and returns to global configuration mode.
Step 20	**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 5 start-time now life forever`	Configures the scheduling parameters for an individual IP SLAs operation.
Step 21	**exit** **Example:** `Router(config)# exit`	(Optional) Exits global configuration mode and returns to privileged EXEC mode.
Step 22	**show ip sla configuration** [*operation-number*] **Example:** `Router# show ip sla configuration 10`	(Optional) Displays configuration values including all defaults for all IP SLAs operations or a specified operation.

Troubleshooting Tips

- If the IP SLAs operation is not running and generating statistics, add the **verify-data** command to the configuration of the operation (while configuring in IP SLA configuration mode) to enable data verification. When enabled, each operation response is checked for corruption. Use the **verify-data** command with caution during normal operations because it generates unnecessary overhead.
- 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 UDP Jitter Operation

This section provides the following configuration example:

Configuring a UDP Jitter Operation: Example

In the following example, two operations are configured as UDP jitter operations, with operation 2 starting five seconds after the first operation. Both operations will run indefinitely.

```
ip sla 1
 udp-jitter 20.0.10.3 65051 num-packets 20
 request-data-size 160
 tos 128
 frequency 30
ip sla schedule 1 start-time after 00:05:00
ip sla 2
 udp-jitter 20.0.10.3 65052 num-packets 20 interval 10
 request-data-size 20
 tos 64
 frequency 30
ip sla schedule 2 start-time after 00:05:05
```

On the target (destination) device:

```
ip sla responder
```

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 configuring IP SLAs UDP Jitter operations.

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
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 specific RFCs are supported by the features in this document.	—

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for the IP SLAs UDP Jitter Operation

Table 2 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 2 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 2 Feature Information for the IP SLAs UDP Jitter Operation

Feature Name	Releases	Feature Information
IP SLAs UDP Jitter Operation	12.3(14)T, 12.2(31)SB2, 12.2(33)SRB1, 12.2(33)SXH	The Cisco IOS IP SLAs User Datagram Protocol (UDP) jitter operation allows you to measure round-trip delay, one-way delay, one-way jitter, one-way packet loss, and connectivity in networks that carry UDP traffic.
IP SLAs for IPv6 (UDP Jitter, UDP Echo, ICMP Echo, TCP Connect)	12.2(33)SRC, 12.2(33)SB, 12.4(20)T	Support was added for operability in IPv6 networks.