



IP SLAs—Analyzing VoIP Service Levels Using the RTP-Based VoIP Operation

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The IP Service Level Agreements (SLAs) Real-Time Transport Protocol (RTP)-based Voice over IP (VoIP) Operation feature provides the capability to set up and schedule a test call and use Voice gateway digital signal processors (DSPs) to gather network performance-related statistics for the call. Available statistical measurements for VoIP networks include jitter, frame loss, Mean Opinion Score for Conversational Quality (MOS-CQ), and Mean Opinion Score for Listening Quality (MOS-LQ).

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 RTP-Based VoIP Operation](#)” section on page 10.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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 for the IP SLAs RTP-Based VoIP Operation

- Both the source and destination routers must be running Cisco IOS Release 12.4(4)T or later releases.
- Both the source and destination routers must be running a Cisco IOS image with the Cisco IOS IP Voice or higher grade feature package.
- The source router must have a network module with a c5510 or c549 DSP. The destination router need not have a network module with a DSP.
- The IP SLAs Responder must be enabled on the destination gateway.

Restrictions for the IP SLAs RTP-Based VoIP Operation

- The IP SLAs RTP-based VoIP operation gathers statistical information only from the DSP of the source router.
- For source-to-destination measurements, the RTP-based VoIP operation does not obtain statistical information from DSPs.
- Depending on the type of DSP, the statistics measured by the IP SLAs RTP-based VoIP operation will vary. For more information, see the [“Statistics Measured by the IP SLAs RTP-Based VoIP Operation” section on page 2](#).
- The voice port used by the IP SLAs RTP-based VoIP operation will not be available for other calls.

Information About the IP SLAs RTP-Based VoIP Operation

To configure an IP SLAs RTP-based VoIP operation, you should understand the following concepts:

- [Benefits of the IP SLAs RTP-Based VoIP Operation, page 2](#)
- [Statistics Measured by the IP SLAs RTP-Based VoIP Operation, page 2](#)

Benefits of the IP SLAs RTP-Based VoIP Operation

The IP SLAs RTP-Based VoIP Operation feature provides the following key benefits:

- End-to-end performance measurements using DSPs for determining voice quality in VoIP networks.
- Proactive threshold violation monitoring through Simple Network Management Protocol (SNMP) trap notifications and syslog messages.

Statistics Measured by the IP SLAs RTP-Based VoIP Operation

The IP SLAs RTP-based VoIP operation provides an enhanced capability to measure voice quality using DSP-based calculations to determine MOS scores. For customer scenarios where the destination gateway does not have DSP hardware, statistical information is gathered only from the DSP of the source gateway. In this case, the RTP data stream is looped back from the destination to the source gateway.

The statistics gathered by the IP SLAs RTP-based VoIP operation will vary depending on the type of DSP module (see [Table 1](#) and [Table 2](#)).

Table 1 **Statistics Gathered by the RTP-Based VoIP Operation for c549 DSPs**

Statistics	Description
Interarrival jitter (destination-to-source and source-to-destination)	Interarrival jitter is the mean deviation (smoothed absolute value) of the difference in packet spacing for a pair of packets. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement. For more information about interarrival jitter, see RFC 3550 (<i>RTP: A Transport Protocol for Real-Time Applications</i>).
Estimated R factor (destination-to-source and source-to-destination)	Estimated transmission rating factor R. This value is based on one-way transmission delay and standard default values. No values are obtained from the DSP to calculate the estimated transmission rating factor R. For more information about the estimated R factor, see International Telecommunication Union Telecommunication Standardization Sector (ITU-T) Recommendation G.107 (<i>The E-model, a computational model for use in transmission planning</i>).
MOS-CQ (destination-to-source and source-to-destination)	Mean Opinion Score for Conversational Quality. This value is obtained by conversion of the estimated R factor to Mean Opinion Score (MOS) using ITU-T Recommendation G.107 conversion tables. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement.
Round-trip time (RTT) latency	Round-trip time latency for an RTP packet to travel from the source to the destination and back to the source.
Packet loss (destination-to-source and source-to-destination)	Number of packets lost. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement.
Packets missing in action (source-to-destination)	Number of missing packets. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement.
One-way latency (destination-to-source and source-to-destination)	Average, minimum, and maximum latency values. These values are measured by sending RTP packets to IP SLAs Responder. The RTP data stream is then looped back from the destination to the source gateway.

Table 2 **Statistics Gathered by the RTP-Based VoIP Operation for c5510 DSPs**

Statistics	Description
Interarrival jitter (destination-to-source and source-to-destination)	Interarrival jitter is the mean deviation (smoothed absolute value) of the difference in packet spacing for a pair of packets. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement. For more information on how this value is calculated, see RFC 1889 (<i>RTP: A Transport Protocol for Real-Time Applications</i>).
Estimated R factor (destination-to-source and source-to-destination)	Estimated transmission rating factor R. This value is based on one-way transmission delay and standard default values, as well as values obtained from the DSP. For more information about how to calculate the estimated R factor, see International Telecommunication Union Telecommunication Standardization Sector (ITU-T) Recommendation G.107 (<i>The E-model, a computational model for use in transmission planning</i>).
MOS-CQ (destination-to-source and source-to-destination)	Mean Opinion Score for Conversational Quality. This value is obtained by conversion of the estimated R factor to Mean Opinion Score (MOS) using ITU-T Recommendation G.107 conversion tables. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement.
Round-trip time (RTT) latency	Round-trip time latency for an RTP packet to travel from the source to the destination and back to the source.
Packet loss (destination-to-source and source-to-destination)	Number of packets lost. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement.
Packets missing in action (source-to-destination)	Number of missing packets. The source-to-destination value is measured by sending RTP packets to the IP SLAs Responder. No values are obtained from the DSP for this measurement.
One-way latency (destination-to-source and source-to-destination)	Average, minimum, and maximum latency values. These values are measured by sending RTP packets to IP SLAs Responder. The RTP data stream is then looped back from the destination to the source gateway.
Frame loss (destination-to-source)	Number of DSP frame loss events. A frame loss can occur due to such events as packet loss, late packets, or a jitter buffer error.
MOS-LQ (destination-to-source)	Mean Opinion Score for Listening Quality.

How to Configure an IP SLAs RTP-Based VoIP Operation

This section contains the following task:

- [Configuring an IP SLAs RTP-Based VoIP Operation, page 5](#)

Configuring an IP SLAs RTP-Based VoIP Operation

Perform this task to configure and schedule an IP SLAs RTP-based VoIP operation.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla** *operation-number*
4. **voip rtp** {*destination-ip-address* | *destination-hostname*} **source-ip** {*ip-address* | *hostname*}
source-voice-port {*slot* [*subunit*/*port:ds0-group-number*]} [**codec** *codec-type*] [**duration** *seconds*]
[**advantage-factor** *value*]
5. **frequency** *seconds*
6. **history** *history-parameter*
7. **owner** *text*
8. **tag** *text*
9. **threshold** *milliseconds*
10. **timeout** *milliseconds*
11. **exit**
12. **ip sla reaction-configuration** *operation-number* **react** *monitored-element* [**action-type** *option*]
[**threshold-type** {**average** [*number-of-measurements*] | **consecutive** [*occurrences*] | **immediate** |
never | **xofy** [*x-value* *y-value*]}] [**threshold-value** *upper-threshold* *lower-threshold*]
13. **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**]
14. **exit**
15. **show ip sla monitor 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 operation-number Example: Router(config)# ip sla 1	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
Step 4	voip rtp {destination-ip-address destination-hostname} source-ip {ip-address hostname} source-voice-port {slot [/subunit/port:ds0-group-number]} [codec codec-type] [duration seconds] [advantage-factor value] Example: Router(config-ip-sla)# voip rtp 10.2.3.4 source-ip 10.5.6.7 source-voice-port 1/0:1 codec g711alaw duration 30 advantage-factor 5	Enters IP SLAs VoIP RTP configuration mode and configures the IP SLAs operation as an RTP-based VoIP operation.
Step 5	frequency seconds Example: Router(config-ip-sla-voip-rtp)# frequency 90	(Optional) Sets the rate at which a specified IP SLAs operation repeats. The default frequency value is 60 seconds.
Step 6	history history-parameter Example: Router(config-ip-sla-voip-rtp)# history buckets-kept 25	(Optional) Specifies the parameters used for gathering statistical history information for an IP SLAs operation.
Step 7	owner text Example: Router(config-ip-sla-voip-rtp)# owner 10.16.1.1 cwb.cisco.com John Doe RTP 555-1212	(Optional) Configures the SNMP owner of an IP SLAs operation.
Step 8	tag text Example: Router(config-ip-sla-voip-rtp)# tag testoperation	(Optional) Creates a user-specified identifier for an IP SLAs operation.

	Command or Action	Purpose
Step 9	<p>threshold <i>milliseconds</i></p> <p>Example: Router(config-ip-sla-voip-rtp)# threshold 10000</p>	(Optional) Sets the upper threshold value for calculating network monitoring statistics created by an IP SLAs operation.
Step 10	<p>timeout <i>milliseconds</i></p> <p>Example: Router(config-ip-sla-voip-rtp)# timeout 10000</p>	(Optional) Sets the amount of time an IP SLAs operation waits for a response from its request packet.
Step 11	<p>exit</p> <p>Example: Router(config-ip-sla-voip-rtp)# exit</p>	Exits IP SLAs VoIP RTP configuration submode and returns to global configuration mode.
Step 12	<p>ip sla reaction-configuration <i>operation-number</i> react <i>monitored-element</i> [action-type <i>option</i>] [threshold-type {average [<i>number-of-measurements</i>] consecutive [<i>occurrences</i>] immediate never xofy [<i>x-value</i> <i>y-value</i>]}] [threshold-value <i>upper-threshold</i> <i>lower-threshold</i>]</p> <p>Example: Router(config)# ip sla reaction-configuration 1 react frameLossDS action-type traponly threshold-type consecutive 3</p>	(Optional) Configures certain actions to occur based on events under the control of Cisco IOS IP SLAs.
Step 13	<p>ip sla schedule <i>operation-number</i> [life {forever <i>seconds</i>}] [start-time {<i>hh:mm[:ss]</i> [<i>month</i> <i>day</i> <i>day</i> <i>month</i>] pending now after <i>hh:mm:ss</i>}] [ageout <i>seconds</i>] [recurring]</p> <p>Example: Router(config)# ip sla schedule 1 start-time now life forever</p>	Specifies the scheduling parameters for an IP SLAs operation.
Step 14	<p>exit</p> <p>Example: Router(config)# exit</p>	(Optional) Exits global configuration mode and returns to privileged EXEC mode.
Step 15	<p>show ip sla configuration [<i>operation-number</i>]</p> <p>Example: Router# show ip sla configuration 10</p>	(Optional) Displays configuration values including all defaults for all IP SLAs operations or a specified operation.

Troubleshooting Tips

Use the `show ip sla configuration` and `show ip sla statistics` 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` and `show ip sla summary` commands. 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 RTP-Based VoIP Operation

This section provides the following configuration example:

- [Configuring an IP SLAs RTP-Based VoIP Operation: Example, page 8](#)

Configuring an IP SLAs RTP-Based VoIP Operation: Example

The following example shows how to configure an IP SLAs RTP-based VoIP operation:

```
ip sla 1
  voip rtp 10.2.3.4 source-ip 10.5.6.7 source-voice-port 1/0:1 codec g711alaw duration 30
  advantage-factor 5
  !
ip sla reaction-configuration 1 react FrameLossDS action-type traonly threshold-type
consecutive 3
  !
ip sla schedule 1 start-time now life forever
```

Use the `show ip sla statistics` command in privileged EXEC mode to display the current operational status and statistics for an IP SLAs operation. Use the `show ip sla summary` command in privileged EXEC mode to display the aggregated hourly status and statistics for an IP SLAs operation.

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 the IP SLAs RTP-Based VoIP Operation feature.

Related Documents

Related Topic	Document Title
Cisco IOS IP SLAs UDP-based VoIP operations for VoIP networks	“IP SLAs—Analyzing VoIP Service Levels Using the UDP Jitter Operation” chapter of the <i>Cisco IOS IP SLAs Configuration Guide</i>
Cisco IOS IP SLAs command-line interface enhancements	<i>Cisco IOS IP Service Level Agreements Command Line Interface</i> , Cisco white paper
Cisco IOS IP SLAs commands	<i>Cisco IOS IP SLAs Command Reference</i>

Standards

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

MIBs

MIB	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

RFC	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 Technical Support & Documentation website contains thousands of 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/techsupport

Feature Information for the IP SLAs RTP-Based VoIP Operation

Table 3 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.

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Note

Table 3 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 3 Feature Information for the IP SLAs RTP-Based VoIP Operation

Feature Name	Releases	Feature Information
IP SLAs RTP-Based VoIP Operation	12.4(4)T	The Cisco IOS IP Service Level Agreements (SLAs) Internet Control Message Protocol (ICMP) jitter operation provides the capability to generate a stream of ICMP packets to gather network performance-related statistics. Available statistical measurements for the IP SLAs ICMP jitter operation include latency, round-trip time, jitter (interpacket delay variance), and packet loss between a Cisco device (source) and any other IP device (destination).
IP SLAs RTP-Based VoIP Operation Enhancements	12.4(6)T	New statistical measurement options for the source-to-destination data path were added.

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