Configuring Proactive Threshold Monitoring for IP SLAs Operations

This document describes the proactive monitoring capabilities of IP Service Level Agreements (SLAs) using thresholds and reaction triggering.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 table.

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.

Information About Proactive Threshold Monitoring

IP SLAs Reaction Configuration

IP SLAs reactions are configured to trigger when a monitored value exceeds or falls below a specified level or when a monitored event, such as a timeout or connection loss, occurs. If IP SLAs measures too high or too low of any configured reaction, IP SLAs can generate a notification to a network management application or trigger another IP SLA operation to gather more data.

When an IP SLA operation is triggered, the (triggered) target operation starts and continues to run independently and without knowledge of the condition of the triggering operation. The target operation continues to run until its life expires, as specified by the target operation's configured lifetime value. The target operation must finish its life before it can be triggered again.

In Cisco IOS Release 15.2(3) and later releases, the (triggered) target operation runs until the condition-cleared event. After which the target operation gracefully stops and the state of the target operation changes from Active to Pending so it can be triggered again.

Supported Reactions by IP SLAs Operation

The tables below list which reactions are supported for each IP SLA operation.

Table 1: Supported Reaction Configuration, by IP SLA Operation

Reaction	ICMP Echo	Path Echo	UDP Jitter	UDP Echo	TCP Connect	DHCP	DLSW	ICMP Jitter	DNS	Frame Relay
Failure	Y	--	Y	Y	Y	Y	--	Y	Y	--
RTT	Y	Y	--	Y	Y	Y	Y	--	Y	Y
RTTAvg	--	--	Y	--	--	--	--	Y	--	--
timeout	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
connectionLoss	--	--	Y	Y	Y	--	--	--	--	
verifyError	--	--	Y	Y	--	--	--	Y	--	Y
jitterSDAvg	--	--	Y	--	--	--		Y	--	--
jitterAvg	--	--	Y	--	--	--	--	Y	--	--
packetLateArrival	--	--	Y	--	--	--	--	Y	--	--
packetOutOfSequence	--	--	Y	--	--	--	--	Y	--	--
MaxOfPositivesSD	--	--	Y	--	--	--		Y	--	--
MaxOfNegativesSD	--	--	Y	--	--	--	--	Y	--	--
MaxOfPositivesDS	--	--	Y	--	--	--	--	Y	--	--
MaxOfNegativesDS	--	--	Y	--	--	--	--	Y	--	--
MOS	--	--	Y	--	--	--		--	--	--
ICPIF	--	--	Y	--	--	--	--	--	--	--
PacketLossDS	--	--	Y	--	--	--	--	--	--	--

Reaction	ICMP Echo	Path Echo	UDP Jitter	UDP Echo	TCP Connect	DHCP	DLSW	ICMP Jitter	DNS	Frame Relay
PacketLossSD	--	--	Y	--	--	--	--	--	--	--
PacketMIA	--	--	Y	--	--	--		--	--	--
iaJitterDS	--	--	--	--	--	--	--	--	--	--
frameLossDS	--	--	--	--	--	--	--	--	--	--
mosLQDSS	--	--	--	--	--	--	--	--	--	--
mosCQDS	--	--	--	--	--	--	--	--	--	--
rfactorDS	--	--	--	--	--	--	--	--	--	--
iaJitterSD	--	--	--	--	--	--	--	--	--	--
successivePacketLoss	--	--	--	--	--	--	--	Y	--	--
MaxOfLatencyDS	--	--	--	--	--	--	--	Y	--	--
MaxOfLatencySD	--	--	--	--	--	--	--	Y	--	--
LatencyDS	--	--	--	--	--	--	--	Y	--	--
LatencySD	--	--	--	--	--	--	--	Y	--	--
packetLoss	--	--	--	--	--	--	--	Y	--	--

Table 2: Supported Reaction Configuration, by IP SLA Operation

Reaction	HTTP	SLM	RTP	FTP	Lsp Trace	Post delay	Path Jitter	LSP Ping	Gatekeeper Registration
Failure	--	--	--	--	--	--	--	--	--
RTT	Y	Y	Y	Y	Y	Y	Y	Y	Y
RTTAvg	--	--	--	--	--	--	--	--	--
timeout	Y	Y	Y	Y	--	Y	Y	Y	Y
connectionLoss	Y		Y	Y	Y	--	--	Y	--
verifyError	--	--	--	--	--	--	--	--	--
jitterSDAvg	--	--	--	--	--	--	Y	--	--

Reaction	HTTP	SLM	RTP	FTP	Lsp Trace	Post delay	Path Jitter	LSP Ping	Gatekeeper Registration
jitterAvg	--	--	--	--	--	--	Y	--	--
packetLateArrival	--	--	--	--	--	--	Y	--	--
packetOutOfSequence	--	--	--	--	--	--	Y	--	--
MaxOfPositivesSD	--	--	--	--	--	--	Y	--	--
MaxOfNegativesSD	--	--	--	--	--	--	Y	--	--
MaxOfPositivesDS	--	--	--	--	--	--	Y	--	--
MaxOfNegativesDS	--	--	--	--	--	--	Y	--	--
MOS	--	--	--	--	--	--	--	--	--
ICPIF	--	--	--	--	--	--	--	--	--
PacketLossDS	--	--	Y	--	--	--	--	--	--
PacketLossSD	--	--	Y	--	--	--	--	--	--
PacketMIA	--	--	Y	--	--	--	--	--	--
iaJitterDS	--	--	Y	--	--	--	--	--	--
frameLossDS	--	--	Y	--	--	--	--	--	--
mosLQDSS	--	--	Y	--	--	--	--	--	--
mosCQDS	--	--	Y	--	--	--	--	--	--
rfactorDS	--	--	Y						
iaJitterSD	--	--	Y	--	--	--	--	--	--
successivePacketLoss	--	--	--	--	--	--	--	--	--
MaxOfLatencyDS	--	--	--	--	--	--	--	--	--
MaxOfLatencySD	--	--	--	--	--	--	--	--	--
LatencyDS	--	--	--	--	--	--	--	--	--
LatencySD	--	--	--	--	--	--	--	--	--
packetLoss	--	--	--	--	--	--	--	--	--

IP SLAs Threshold Monitoring and Notifications

IP SLAs supports proactive threshold monitoring and notifications for performance parameters such as average jitter, unidirectional latency, bidirectional round-trip time (RTT), and connectivity for most IP SLAs operations. The proactive monitoring capability also provides options for configuring reaction thresholds for important VoIP related parameters including unidirectional jitter, unidirectional packet loss, and unidirectional VoIP voice quality scoring.

Notifications for IP SLAs are configured as a triggered reaction. Packet loss, jitter, and Mean Operation Score (MOS) statistics are specific to IP SLAs jitter operations. Notifications can be generated for violations in either direction (source-to-destination and destination-to-source) or for out-of-range RTT values for packet loss and jitter. Events, such as traps, are triggered when the RTT value rises above or falls below a specified threshold.

IP SLAs can generate system logging (syslog) messages when a reaction condition occurs. System logging messages can be sent as Simple Network Management Protocol (SNMP) traps (notifications) using the CISCO-RTTMON-MIB. SNMP traps for IP SLAs are supported by the CISCO-RTTMON-MIB and CISCO-SYSLOG-MIB.

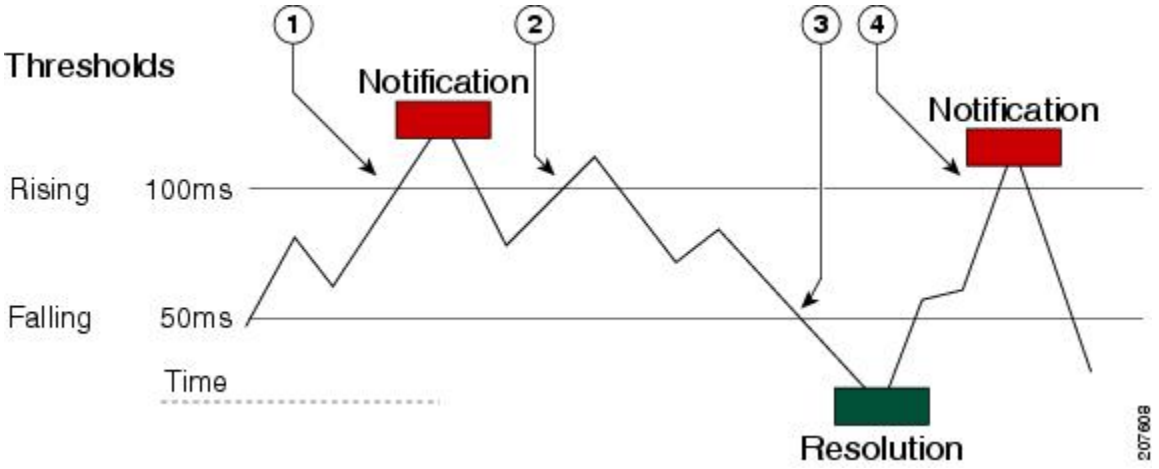
Severity levels in the CISCO-SYSLOG-MIB are defined as follows: SyslogSeverity INTEGER {emergency(1), alert(2), critical(3), error(4), warning(5), notice(6), info(7), debug(8)}

The values for severity levels are defined differently for the system logging process in software. Severity levels for the system logging process in Cisco software are defined as follows: {emergency (0), alert (1), critical (2), error (3), warning (4), notice (5), informational (6), debugging (7)}.

IP SLAs Threshold violations are logged as level 6 (informational) within the Cisco system logging process but are sent as level 7 (info) traps from the CISCO-SYSLOG-MIB.

Notifications are not issued for every occurrence of a threshold violation. The figure below illustrates the sequence for a triggered reaction that occurs when the monitored element exceeds the upper threshold. An event is sent and a notification is issued when the rising threshold is exceeded for the first time. Subsequent threshold-exceeded notifications are issued only after the monitored value falls below the falling threshold before exceeding the rising threshold ag ain .

Figure 1: IP SLAs Triggered Reaction Condition and Notifications for Threshold Exceeded



1	An event is sent and a threshold-exceeded notification is issued when the rising threshold is exceeded for the first time.
2	Consecutive over-rising threshold violations occur without issuing additional notifications.
3	The monitored value goes below the falling threshold.
4	Another threshold-exceeded notification is issued when the rising threshold is exceeded only after the monitored value first fell below the falling threshold.

Note A lower-threshold notification is also issued the first time that the monitored element falls below the falling threshold (3). As described, subsequent notifications for lower-threshold violations will be issued only after the rising threshold is exceeded before the monitored value falls below the falling threshold again.

RTT Reactions for Jitter Operations

RTT reactions for jitter operations are triggered only at the end of the operation and use the latest value for the return-trip time (LatestRTT), which matches the value of the average return-trip time (RTTAvg).

SNMP traps for RTT for jitter operations are based on the value of the average return-trip time (RTTAvg) for the whole operation and do not include RTT values for each individual packet sent during the operation. For example, if the average is below the threshold, up to half of the packets can actually be above threshold but this detail is not included in the notification because the value is for the whole operation only.

Only syslog messages are supported for RTTAvg threshold violations. Syslog nmessages are sent from the CISCO-RTTMON-MIB.

How to Configure Proactive Threshold Monitoring

Configuring Proactive Threshold Monitoring

Perform this task to configure thresholds and reactive triggering for generating traps or starting another operation.

Before You Begin

- IP SLAs operations to be started when violation conditions are met must be configured.

Note

- RTT reactions for jitter operations are triggered only at the end of the operation and use the latest value for the return-trip time (LatestRTT).
- SNMP traps for RTT for jitter operations are based on the average value for the return-trip time (RTTAvg) for the whole operation only and do not include return-trip time values for individual packets sent during the operation. Only syslog messages are supported for RTTAvg threshold violations.
- Only syslog messages are supported for RTT violations during Jitter operations.
- Only SNMP traps are supported for RTT violations during non-Jitter operations.
- Only syslog messages are supported for non-RTT violations other than timeout, connectionLoss, or verifyError.
- Both SNMP traps and syslog messages are supported for timeout, connectionLoss, or verifyError violations only.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **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*]
4. **ip sla reaction-trigger** *operation-number target-operation*
5. **ip sla logging traps**
6. Do one of the following:
   - **snmp-server enable traps rtr**
   - **snmp-server enable traps syslog**
7. **snmp-server host** {*hostname* | *ip-address*} [**vrf** *vrf-name*] [**traps** | **informs**] [**version** {**1** | **2c** | **3** [**auth** | **noauth** | **priv**]}] *community-string* [**udp-port** *port*] [*notification-type*]
8. **exit**
9. **show ip sla reaction- configuration** [*operation-number*]
10. **show ip sla reaction- trigger** [*operation-number*]

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**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*] **Example:** `Device(config)# ip sla reaction-configuration 10 react jitterAvg threshold-type immediate threshold-value 5000 3000 action-type trapAndTrigger`	Configures the action (SNMP trap or IP SLAs trigger) that is to occur based on violations of specified thresholds.
Step 4	**ip sla reaction-trigger** *operation-number target-operation* **Example:** `Device(config)# ip sla reaction-trigger 10 2`	(Optional) Starts another IP SLAs operation when the violation conditions are met. • Required only if the **ip sla reaction-configuration** command is configured with either the **trapAndTrigger**or **triggerOnly**keyword.
Step 5	**ip sla logging traps** **Example:** `Device(config)# ip sla logging traps`	(Optional) Enables IP SLAs syslog messages from CISCO-RTTMON-MIB.

Step 6	Do one of the following:
	• **snmp-server enable traps rtr**
	• **snmp-server enable traps syslog**
	
	Example:
	`Device(config)# snmp-server enable traps rtr`
	
	Example:
	`Device(config)# snmp-server enable traps syslog`
		• (Optional) The first example shows how to enable the system to generate CISCO-RTTMON-MIB traps.
		• (Optional) The second example shows how to enable the system to generate CISCO-SYSLOG-MIB traps.

Step 7	**snmp-server host** {*hostname* | *ip-address*} [**vrf** *vrf-name*] [**traps** | **informs**] [**version** {**1** | **2c** | **3** [**auth** | **noauth** | **priv**]}] *community-string* [**udp-port** *port*] [*notification-type*]	(Optional) Sends traps to a remote host. • Required if the **snmp-server enable traps** command is configured.

	Command or Action	Purpose
	Example: `Device(config)# snmp-server host 10.1.1.1 public syslog`	
Step 8	**exit** **Example:** `Device(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 9	**show ip sla reaction- configuration** [*operation-number*] **Example:** `Device# show ip sla reaction-configuration 10`	(Optional) Displays the configuration of proactive threshold monitoring.
Step 10	**show ip sla reaction- trigger** [*operation-number*] **Example:** `Device# show ip sla reaction-trigger 2`	(Optional) Displays the configuration status and operational state of target operations to be triggered.

Configuration Examples for Proactive Threshold Monitoring

Example Configuring an IP SLAs Reaction Configuration

In the following example, IP SLAs operation 10 is configured to send an SNMP logging trap when the MOS value either exceeds 4.9 (best quality) or falls below 2.5 (poor quality):

```
Device(config)# ip sla reaction-configuration 10 react mos threshold-type immediate
threshold-value 490 250 action-type trapOnly
```

The following example shows the default configuration for the **ip sla reaction-configuration** command:

```
Device# show ip sla reaction-configuration 1
Entry number: 1
Reaction Configuration not configured
Device# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Device(config)# ip sla reaction-configuration 1
Device(config)# do show ip sla reaction-configuration 1
Entry number: 1
Reaction: rtt
Threshold Type: Never
Rising (milliseconds): 5000
Falling (milliseconds): 3000
Threshold Count: 5
```

```
Threshold Count2: 5
Action Type: None
```

Example Verifying an IP SLAs Reaction Configuration

The following example shows that multiple monitored elements are configured for the IP SLAs operation (1), as indicated by the values of Reaction: in the output:

```
Device# show ip sla reaction-configuration

Entry Number: 1
Reaction: RTT
Threshold type: Never
Rising (milliseconds): 5000
Falling (milliseconds): 3000
Threshold Count: 5
Threshold Count2: 5
Action Type: None
Reaction: jitterDSAvg
Threshold type: average
Rising (milliseconds): 5
Falling (milliseconds): 3
Threshold Count: 5
Threshold Count2: 5
Action Type: triggerOnly
Reaction: jitterDSAvg
Threshold type:  immediate
Rising (milliseconds): 5
Falling (milliseconds): 3
Threshold Count: 5
Threshold Count2: 5
Action Type: trapOnly
Reaction: PacketLossSD
Threshold type:  immediate
Rising (milliseconds): 5
Threshold Falling (milliseconds): 3
Threshold Count: 5
Threshold Count2: 5
Action Type: trapOnly
```

Example Triggering SNMP Notifications

The following example shows how to configure proactive threshold monitoring so that CISCO-SYSLOG-MIB traps are sent to the remote host at 10.1.1.1 if the threshold values for RTT or VoIP MOS are violated:

```
! Configure the operation on source.
Device(config)# ip sla 1

Device(config-ip-sla)# udp-jitter 10.1.1.1 3000 codec g711alaw
Device(config-ip-sla-jitter)# exit

Device(config)# ip sla schedule 1 start now life forever

! Configure thresholds and reactions.
Device(config)# ip sla reaction-configuration 1 react rtt threshold-type immediate
threshold-value 3000 2000 action-type trapOnly

Device(config)# ip sla reaction-configuration 1 react MOS threshold-type consecutive 4
threshold-value 390 220 action-type trapOnly

Device(config)# ip sla logging traps

! The following command sends traps to the specified remote host.
```

```
Device(config)# snmp-server host 10.1.1.1 version 2c public syslog

! The following command is needed for the system to generate CISCO-SYSLOG-MIB traps.
Device(config)# snmp-server enable traps syslog
```

The following sample system logging messages shows that IP SLAs threshold violation notifications are generated as level 6 (informational) in the Cisco system logging process:

```
3d18h:%RTT-6-SAATHRESHOLD:RTR(11):Threshold exceeded for MOS
```

This following sample SNMP notification from the CISCO-SYSLOG-MIB for the same violation is a level 7 (info) notification:

```
3d18h:SNMP:V2 Trap, reqid 2, errstat 0, erridx 0
 sysUpTime.0 = 32613038
 snmpTrapOID.0 = ciscoSyslogMIB.2.0.1
 clogHistoryEntry.2.71 = RTT
 clogHistoryEntry.3.71 = 7
 clogHistoryEntry.4.71 = SAATHRESHOLD
 clogHistoryEntry.5.71 = RTR(11):Threshold exceeded for MOS
 clogHistoryEntry.6.71 = 32613037
```

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

MIBs

MIBs	MIBs Link
• CISCO-RTTMON-MIB • CISCO-SYSLOG-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

Feature Information for IP SLAs Proactive Threshold Monitoring

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 . An account on Cisco.com is not required.

Table 3: Feature Information for IP SLAs Proactive Threshold Monitoring

Feature Name	Releases	Feature Information
IP SLAs - Reaction Threshold	Cisco IOS XE Release 3.2SE	Cisco IOS IP SLAs proactive threshold monitoring capability allows you to configure an IP SLAs operation to react to certain measured network conditions. In Cisco IOS XE Release 3.2SE, this feature was supported on the following platforms: • Catalyst 3650 Series Switches • Catalyst 3850 Series Switches • Cisco 5760 Wireless LAN Controller

Feature Name	Releases	Feature Information
IP SLAs - VoIP Traps	Cisco IOS XE Release 3.2SE	The IP SLA - VoIP Traps feature includes new capabilities for configuring reaction thresholds for important VoIP related parameters such as unidirectional jitter, unidirectional packet loss, and unidirectional VoIP voice quality scoring (MOS scores). In Cisco IOS XE Release 3.2SE, this feature was supported on the following platforms: • Catalyst 3650 Series Switches • Catalyst 3850 Series Switches • Cisco 5760 Wireless LAN Controller
IP SLAs Additional Threshold Traps	Cisco IOS XE Release 3.2SE	This enhancement for IP SLAs reaction threshold monitoring includes per direction average jitter, per direction packet loss, maximum positive and negative jitter, and Mean Opinion Score (MOS) traps. The feature also enables one-way latency jitter, packet loss and latency traps within IP SLAs and includes traps for packet loss due to missing in action and late arrivals. In Cisco IOS XE Release 3.2SE, this feature was supported on the following platforms: • Catalyst 3650 Series Switches • Catalyst 3850 Series Switches • Cisco 5760 Wireless LAN Controller