Cisco IOS IP SLAs Commands

access-list (epl-disc)

To add a list of discovered endpoints to an auto IP Service Level Agreements (SLAs) endpoint list, use the **access-list** command in IP SLA endpoint-list auto-discovery configuration mode. To remove the list, use the **no** form of this command.

access-list {*standard-list-number* | *expanded-list-number*}

no access-list

Syntax Description

standard-list-number	Unique identifier of list. Range is from 1 to 99.
expanded-list-number	Unique identifier of list. Range is from 1300 to 1999.

Command Default   No access list is specified in the auto IP SLAs endpoint list being configured.

Command Modes   IP SLA endpoint-list auto-discovery configuration (config-epl-disc)

Command History

Release	Modification
15.1(1)T	This command was introduced.

Usage Guidelines   This command assigns a name to a list of discovered IP addresses of IP SLAs destination devices and Cisco IOS IP SLAs Responder endpoints and adds the list to the auto IP SLAs endpoint list being configured.

Before you use this command, you must use the **discover** command in IP SLA endpoint-list configuration mode to build the list of endpoints on target Cisco devices.

To apply an endpoint list to an IP SLAs auto-measure group, use the **destination** command in IP SLA auto-measure group configuration mode.

Examples   The following example shows how to configure an endpoint list using the auto discovery method:

```
Router(config)# ip sla auto discovery
Router(config)# ip sla auto endpoint-list type ip autolist
Router(config-epl)# discover port 5000
Router(config-epl-disc)# access-list 3
Router(config-epl-disc)# end
Router# show ip sla auto endpoint-list
Endpoint-list Name: autolist
    Description:
    Auto Discover Parameters
        Destination Port: 5000
        Access-list: 3
        Ageout: 3600    Measurement-retry: 3

    5 endpoints are discovered for autolist
```

Related Commands	Command	Description
	destination (am-group)	Specifies an IP SLAs endpoint list for an IP SLAs auto-measure group.
	discover (epl)	Builds a list of endpoints.
	ip sla auto discovery	Enables auto discovery in Cisco IP SLAs Engine 3.0.
	ip sla responder auto-register	Enables the Cisco device or Cisco IP SLAs Responder to automatically register with the source upon configuration
	show ip sla auto endpoint-list	Displays the configuration including default values of auto IP SLAs endpoint lists.

access-list (IP SLA)

To specify the access list to apply to a Cisco IOS IP Service Level Agreements (SLAs) label switched path (LSP) Health Monitor operation, use the **access-list** command in auto IP SLA MPLS parameters configuration mode. To remove the access list, use the **no** form of this command.

> **access-list** *access-list-number*

> **no access-list** *access-list-number*

Syntax Description	*access-list-number* Number of an access list. This value is a decimal number from 1 to 99 or from 1300 to 1999.

Command Default   No access list is specified.

Command Modes   Auto IP SLA MPLS parameters configuration (config-auto-ip-sla-mpls-params)

Command History

Release	Modification
12.2(27)SBC	This command was introduced.
12.4(6)T	This command was integrated into Cisco IOS Release 12.4(6)T.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   Standard IP access lists can be configured (using the **access-list** [IP standard] command in global configuration mode) to restrict the number of IP SLAs operations that are automatically created by the IP SLAs LSP Health Monitor. When the IP SLAs access list parameter is configured, the list of Border Gateway Protocol (BGP) next hop neighbors discovered by the LSP Health Monitor is filtered based on the conditions defined by the associated standard IP access list. In other words, the LSP Health Monitor will automatically create IP SLAs operations only for those BGP next hop neighbors with source addresses that satisfy the criteria permitted by the standard IP access list.

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all BGP next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source Provider Edge (PE) router. Standard IP access list 10 is specified to restrict the number of IP SLAs operations to be created by LSP Health Monitor operation 1.

```
!Configure standard IP access list in global configuration mode
access-list 10 permit 10.10.10.8
!
```

```
mpls discovery vpn interval 60
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
 access-list 10
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands	Command	Description
	access-list (IP standard)	Defines a standard IP access list.
	auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.

ageout

To add an ageout timer to an auto IP Service Level Agreements (SLAs) scheduler or endpoint list, use the **ageout** command in IP SLA auto-measure schedule configuration or IP SLA endpoint-list auto-discovery configuration mode. To remove the timer, use the **no** form of this command.

ageout *seconds*

no ageout

Syntax Description

seconds	Length of time to keep an entry in memory, in seconds. Range is from 0 to 2073600. Default is 0.

Command Default The entry is never saved in memory.

Command Modes IP SLA auto-measure schedule configuration (config-am-schedule)
IP SLA endpoint-list auto-discovery configuration (config-epl-disc)

Command History

Release	Modification
15.1(1)T	This command was introduced.

Usage Guidelines This command changes the length of time an entry is kept in memory when either the operation or destination is inactive from the default (0) to the specified number, after which the entry is deleted from memory.

An operation can age out before it executes. To ensure that this does not happen, the difference between the time that the IP SLA auto-measure group is configured and the time at which the operation becomes active must be less than the value of the ageout timer.

Note The total RAM required to hold the history and statistics tables is allocated when the auto IP SLAs operation is scheduled. This prevents router memory problems when the router gets heavily loaded and lowers the amount of overhead an auto IP SLAs operation causes on a router when it is active.

Examples The following example shows how to configure an auto IP SLAs scheduler that will cause an auto IP SLAs operation to actively collect data at 3:00 p.m. on April 5. The operation will age out after 12 hours of inactivity, which can be before it starts or after it has finished its life. When the operation ages out, all configuration information for the operation is removed from the running configuration in RAM.

```
Router(config)# ip sla auto schedule apr5
Router(config-am-schedule)# ageout 43200
Router(config-am-schedule)# frequency 70
Router(config-am-schedule)# life 43200
Router(config-am-schedule)# probe-interval 1500
Router(config-am-schedule)# start-time 15:00 apr 5
```

```
Router(config-am-schedule)# end
Router#
Router# show ip sla auto schedule apr5
Group sched-id: apr5
    Probe Interval (ms) : 1500
    Group operation frequency (sec): 70
    Status of entry (SNMP RowStatus): Active
    Next Scheduled Start Time: P15:00 apr 5
    Life (sec): 43200
    Entry Ageout (sec): 43200
Router#
```

Related Commandsɪ

Command	Description
frequency	Specifies how often an auto IP SLAs operation will repeat once it is started.
life	Specifies length of time that an auto IP SLAs operation will run.
probe-interval	Specifies interval for staggering the start times of auto IP SLAs operations
show ip sla auto schedule	Displays configuration including default values of auto IP SLAs schedulers.
start-time	Specifies when an auto IP SLAs operation will start running.

auto ip sla mpls-lsp-monitor

To begin configuration for an IP Service Level Agreements (SLAs) label switched path (LSP) Health Monitor operation and enter auto IP SLA MPLS configuration mode, use the **auto ip sla mpls-lsp-monitor** command in global configuration mode. To remove all configuration information for an LSP Health Monitor operation, use the **no** form of this command.

> **auto ip sla mpls-lsp-monitor** *operation-number*

> **no auto ip sla mpls-lsp-monitor** *operation-number*

Syntax Description		
operation-number	Number used for the identification of the LSP Health Monitor operation you want to configure.	

Command Default   No LSP Health Monitor operation is configured.

Command Modes   Global configuration

Command History

Release	Modification
12.4(6)T	This command was introduced.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2. This command replaces the **rtr mpls-lsp-monitor** command.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **rtr mpls-lsp-monitor** command.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   Entering this command automatically enables the **mpls discovery vpn next-hop** command.

After you configure an LSP Health Monitor operation, you must schedule the operation. To schedule an LSP Health Monitor operation, use the **auto ip sla mpls-lsp-monitor schedule** command in global configuration mode. You can also optionally set reaction configuration for the operation (see the **auto ip sla mpls-lsp-monitor reaction-configuration** command).

To display the current configuration settings of an LSP Health Monitor operation, use the **show ip sla mpls-lsp-monitor configuration** command in EXEC mode.

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source Provider Edge (PE) router.

```
mpls discovery vpn interval 60
```

```
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands	Command	Description
	auto ip sla mpls-lsp-monitor reaction-configuration	Configures certain actions to occur based on events under the control of the IP SLAs LSP Health Monitor.
	auto ip sla mpls-lsp-monitor reset	Removes all IP SLAs LSP Health Monitor configuration from the running configuration.
	auto ip sla mpls-lsp-monitor schedule	Configures the scheduling parameters for an IP SLAs LSP Health Monitor operation.
	mpls discovery vpn next-hop	Enables the MPLS VPN BGP next hop neighbor discovery process.
	show ip sla mpls-lsp-monitor configuration	Displays configuration settings for IP SLAs LSP Health Monitor operations.
	type echo (MPLS)	Configures the parameters for a Cisco IOS IP SLAs LSP ping operation using the LSP Health Monitor.
	type pathEcho (MPLS)	Configures the parameters for a Cisco IOS IP SLAs LSP traceroute operation using the LSP Health Monitor.

auto ip sla mpls-lsp-monitor reaction-configuration

To configure proactive threshold monitoring parameters for a Cisco IOS IP Service Level Agreements (SLAs) label switched path (LSP) Health Monitor operation, use the **auto ip sla mpls-lsp-monitor reaction-configuration** command in global configuration mode. To clear all threshold monitoring configuration for a specified LSP Health Monitor operation, use the **no** form of this command.

LSP Health Monitor Without LSP Discovery

> auto ip sla mpls-lsp-monitor reaction-configuration *operation-number* **react** {**connectionLoss** | **timeout**} [**action-type** *option*] [**threshold-type** {**consecutive** [*occurrences*] | **immediate** | **never**}]

> no auto ip sla mpls-lsp-monitor reaction-configuration *operation-number*

LSP Health Monitor with LSP Discovery

> auto ip sla mpls-lsp-monitor reaction-configuration *operation-number* **react lpd** {**lpd-group** [**retry** *number*] | **tree-trace**} [**action-type trapOnly**]

> no auto ip sla mpls-lsp-monitor reaction-configuration *operation-number*

Syntax Description

operation-number	Number of the LSP Health Monitor operation for which reactions are to be configured.
react connectionLoss	Enables monitoring of one-way connection loss events.
react timeout	Enables monitoring of one-way timeout events.
action-type *option*	(Optional) Specifies what action is performed when threshold events occur. If the **threshold-type never** keywords are defined, the **action-type** keyword is disabled. The *option* argument can be one of the following keywords: • **none**—No action is taken. This option is the default value. • **trapOnly**—SNMP trap notification is sent.
threshold-type consecutive [*occurrences*]	(Optional) When a threshold violation for the monitored element (such as a timeout) are met consecutively for a specified number of times, perform the action defined by the **action-type** keyword. The default number of 5 consecutive occurrences can be changed using the *occurrences* argument. The range is from 1 to 16.
threshold-type immediate	(Optional) When a threshold violation for the monitored element (such as a timeout) are met, immediately perform the action defined by the **action-type** keyword.
threshold-type never	(Optional) Do not calculate threshold violations. This option is the default threshold type.
lpd	(Optional) Specifies the LSP discovery option.
lpd-group	(Optional) Enables monitoring of LSP discovery group status changes.

retry *number*	(Optional) Specifies the number of times the equal-cost multipaths belonging to an LSP discovery group are retested when a failure is detected. After the specified number of retests have been completed, an SNMP trap notification may be sent depending on the current status of the LSP discovery group. See the "Usage Guidelines" section for more information. The value of the *number* argument is zero by default.
	Use the **secondary frequency** command to increase the frequency at which failed paths belonging to an LSP discovery group are retested. This command is not applicable if the retry value is set to zero.
tree-trace	(Optional) Enables monitoring of situations where LSP discovery to a Border Gateway Protocol (BGP) next hop neighbor fails.
action-type trapOnly	(Optional) Enables SNMP trap notifications.

Command Default   IP SLAs proactive threshold monitoring is disabled.

Command Modes   Global configuration

Command History

Release	Modification
12.4(6)T	This command was introduced.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2. This command replaces the **rtr mpls-lsp-monitor reaction-configuration** command.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **rtr mpls-lsp-monitor reaction-configuration** command.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   You can configure the **auto ip sla mpls-lsp-monitor reaction-configuration** command multiple times to enable proactive threshold monitoring for multiple elements for the same operation. However, disabling of individual monitored elements is not supported. In other words, the **no auto ip sla mpls-lsp-monitor reaction-configuration** command will disable all proactive threshold monitoring configuration for the specified IP SLAs operation.

SNMP traps for IP SLAs are supported by the CISCO-RTTMON-MIB and CISCO-SYSLOG-MIB. Depending on the Cisco IOS software release that you are running, use the **ip sla logging traps** or **ip sla monitor logging traps** command to enable the generation of SNMP system logging messages specific to IP SLAs trap notifications. Use the **snmp-server enable traps rtr** command to enable the sending of IP SLAs SNMP trap notifications.

To display the current threshold monitoring configuration settings for an LSP Health Monitor operation, use the **show ip sla mpls-lsp-monitor configuration** command.

Examples

The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source Provider Edge (PE) router. As specified by the proactive threshold monitoring configuration, when three consecutive connection loss or timeout events occur, an SNMP trap notification is sent.

```
mpls discovery vpn interval 60
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps

auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands

Command	Description
auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.
ip sla logging traps	Enables the generation of SNMP system logging messages specific to IP SLAs trap notifications.
ip sla monitor logging traps	Enables the generation of SNMP system logging messages specific to IP SLAs trap notifications.
show ip sla mpls-lsp-monitor configuration	Displays configuration settings for IP SLAs LSP Health Monitor operations.
snmp-server enable traps rtr	Enables the sending of IP SLAs SNMP trap notifications.

auto ip sla mpls-lsp-monitor reset

To remove all IP Service Level Agreements (SLAs) label switched path (LSP) Health Monitor configuration from the running configuration, use the **auto ip sla mpls-lsp-monitor reset** command in global configuration mode.

> **auto ip sla mpls-lsp-monitor reset** [**lpd** *group-number*]

Syntax Description

lpd *group-number*	(Optional) Specifies the number used to identify the LSP discovery group you want to configure.

Command Default   None

Command Modes   Global configuration

Command History

Release	Modification
12.4(6)T	This command was introduced.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2. The **lpd** keyword and *lpd-group* argument was added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   Use the **auto ip sla mpls-lsp-monitor reset lpd** *group-number* command to remove all the stored network connectivity statistics for the specified LSP discovery group from the LSP discovery group database. The non-statistical LSP discovery group data will be set to default values or zero. However, the IP address of the associated Border Gateway Protocol (BGP) next hop neighbor, the list of LSP discovery group IP SLAs operations, and the list of LSP selector IP addresses will be preserved. After the **auto ip sla mpls-lsp-monitor reset lpd** *group-number* command is entered, statistical data for the group will start aggregating again with new data only.

To clear IP SLAs configuration information (not including IP SLAs LSP Health Monitor configuration) from the running configuration, use the **ip sla reset** command in global configuration mode.

Examples   The following example shows how to remove all the LSP Health Monitor configurations from the running configuration:

```
auto ip sla mpls-lsp-monitor reset
```

Related Commands

Command	Description
ip sla reset	Stops all IP SLAs operations, clears IP SLAs configuration information, and returns the IP SLAs feature to the startup condition.

auto ip sla mpls-lsp-monitor schedule

To configure the scheduling parameters for an IP Service Level Agreements (SLAs) label switched path (LSP) Health Monitor operation, use the **auto ip sla mpls-lsp-monitor schedule** command in global configuration mode. To stop the operation and place it in the default state (pending), use the **no** form of this command.

> **auto ip sla mpls-lsp-monitor schedule** *operation-number* **schedule-period** *seconds* [**frequency** [*seconds*]] [**start-time** {**after** *hh*:*mm*:*ss* | *hh*:*mm*[:*ss*] [*month day* | *day month*] | **now** | **pending**}]

> **no auto ip sla mpls-lsp-monitor schedule** *operation-number*

Syntax Description

operation-number	Number of the LSP Health Monitor operation to be scheduled.
schedule-period *seconds*	Specifies the amount of time (in seconds) for which the LSP Health Monitor is scheduled.
frequency *seconds*	(Optional) Specifies the number of seconds after which each IP SLAs operation is restarted. The default frequency is the value specified for the schedule period.
start-time	(Optional) Time when the operation starts collecting information. If the start time is not specified, no information is collected.
after *hh*:*mm*:*ss*	(Optional) Indicates that the operation should start *hh* hours, *mm* minutes, and *ss* seconds after this command was entered.
hh:*mm*[:*ss*]	(Optional) Specifies an absolute start time using hours, minutes, and seconds. Use the 24-hour clock notation. For example, **start-time 01:02** means "start at 1:02 a.m.," and **start-time 13:01:30** means "start at 1:01 p.m. and 30 seconds." The current day is implied unless you specify a month and day.
month	(Optional) Name of the month in which to start the operation. If a month is not specified, the current month is used. Use of this argument requires that a day be specified. You can specify the month by using either the full English name or the first three letters of the month.
day	(Optional) Number of the day (in the range 1 to 31) on which to start the operation. If a day is not specified, the current day is used. Use of this argument requires that a month be specified.
now	(Optional) Indicates that the operation should start immediately.
pending	(Optional) No information is collected. This option is the default value.

Command Default   The LSP Health Monitor operation is placed in a pending state (that is, the operation is enabled but is not actively collecting information).

Command Modes   Global configuration

Command History	Release	Modification
	12.4(6)T	This command was introduced.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
	12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2. This command replaces the **rtr mpls-lsp-monitor schedule** command.
	12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **rtr mpls-lsp-monitor schedule** command.
	12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   After you schedule an LSP Health Monitor operation with the **auto ip sla mpls-lsp-monitor schedule** command, you cannot change the configuration of the operation. To change the configuration of the operation, use the **no auto ip sla mpls-lsp-monitor** *operation-number* command in global configuration mode and then enter the new configuration information.

To display the current configuration settings of an LSP Health Monitor operation, use the **show ip sla mpls-lsp-monitor configuration** command in user EXEC or privileged EXEC mode.

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source Provider Edge (PE) router. The schedule period for LSP Health Monitor operation 1 is set to 60 seconds and the operation is scheduled to start immediately.

```
mpls discovery vpn interval 60
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands	Command	Description
	auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.
	show ip sla mpls-lsp-monitor configuration	Displays configuration settings for IP SLAs LSP Health Monitor operations.

buckets-of-history-kept

Note Effective with Cisco IOS Release 12.4(4)T, 12.2(33)SRB, 12.2(33)SB, and 12.2(33)SXI, the **buckets-of-history-kept** command is replaced by the **history buckets-kept** command. See the **history buckets-kept** command for more information.

To set the number of history buckets that are kept during the lifetime of a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **buckets-of-history-kept** command in the appropriate submode of IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

buckets-of-history-kept *size*

no buckets-of-history-kept

Syntax Description		
size	Number of history buckets kept during the lifetime of the operation. The default is 50.

Defaults 50 buckets

Command Modes DHCP configuration (config-sla-monitor-dhcp)
DLSw configuration (config-sla-monitor-dlsw)
DNS configuration (config-sla-monitor-dns)
FTP configuration (config-sla-monitor-ftp)
HTTP configuration (config-sla-monitor-http)
ICMP echo configuration (config-sla-monitor-echo)
ICMP path echo configuration (config-sla-monitor-pathEcho)
ICMP path jitter configuration (config-sla-monitor-pathJitter)
TCP connect configuration (config-sla-monitor-tcp)
UDP echo configuration (config-sla-monitor-udp)
VoIP configuration (config-sla-monitor-voip)

Command History

Release	Modification
11.2	This command was introduced.
12.4(4)T	This command was replaced by the **history buckets-kept** command.
12.2(33)SRB	This command was replaced by the **history buckets-kept** command.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
12.2(33)SB	This command was replaced by the **history buckets-kept** command.
12.2(33)SXI	This command was replaced by the **history buckets-kept** command.

Usage Guidelines   Each time IP SLAs starts an operation, a new bucket is created until the number of history buckets matches the specified size or the operation's lifetime expires. History buckets do not wrap (that is, the oldest information is not replaced by newer information). The operation's lifetime is defined by the **ip sla monitor schedule** global configuration command.

> **Note**   The **buckets-of-history-kept** command does not support the IP SLAs User Datagram Protocol (UDP) jitter operation.

An IP SLAs operation can collect history and capture statistics. By default, the history for an IP SLAs operation is not collected. If history is collected, each history bucket contains one or more history entries from the operation. When the operation type is ICMP path echo, an entry is created for each hop along the path that the operation takes to reach its destination. The type of entry stored in the history table is controlled by the **filter-for-history** command. The total number of entries stored in the history table is controlled by the combination of the **samples-of-history-kept**, **buckets-of-history-kept**, and **lives-of-history-kept** commands.

> **Note**   Collecting history increases the RAM usage. Collect history only when you think there is a problem in the network.

> **Note**   You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

Examples   The following example shows how to configure IP SLAs ICMP echo operation 1 to keep 25 history buckets during the operation lifetime.

```
ip sla monitor 1
 type echo protocol ipIcmpEcho 172.16.161.21
 buckets-of-history-kept 25
 lives-of-history-kept 1
!
ip sla monitor schedule 1 start-time now life forever
```

Related Commands

Command	Description
filter-for-history	Defines the type of information kept in the history table for the IP SLAs operation.
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
lives-of-history-kept	Sets the number of lives maintained in the history table for the IP SLAs operation.
samples-of-history-kept	Sets the number of entries kept in the history table per bucket for the IP SLAs operation.

clock-tolerance ntp oneway

To set the acceptable Network Time Protocol (NTP) clock synchronization tolerance for a one-way Cisco IOS IP Service Level Agreements (SLAs) operation measurement, use the **clock-tolerance ntp oneway** command in the UDP jitter submode of IP SLA configuration, IP SLA monitor configuration, or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

> **clock-tolerance ntp oneway** {**absolute** *value* | **percent** *value*}

> **no clock-tolerance ntp oneway**

Syntax Description

absolute *value*	Sets the NTP synchronization tolerance value to an absolute number, in microseconds. The range is from 0 to 100000.
percent *value*	Sets the NTP synchronization tolerance value as a percentage of the one-way IP SLAs operation delay measurement. The range is from 0 to 100. The NTP clock synchronization tolerance is set to 0 percent by default.

Command Default   The NTP clock synchronization tolerance is set to 0 percent.

Command Modes   **IP SLA Configuration**

UDP jitter configuration (config-ip-sla-jitter)

IP SLA Monitor Configuration

UDP jitter configuration (config-sla-monitor-jitter)

IP SLA Template Parameters Configuration

UDP jitter configuration (config-udp-jtr-params)

> **Note**   The configuration mode varies depending on the Cisco IOS release you are running and the operation type configured. See the "Usage Guidelines" section for more information.

Command History

Release	Modification
12.3(14)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI.
15.1(1)T	This command was modified. The IP SLA template parameters configuration mode was added.

Usage Guidelines   The **precision microseconds** command must be configured before the **clock-tolerance ntp oneway** command is used.

> **Note**   This command is supported by the IP SLAs User Datagram Protocol (UDP) jitter operation only.

If the NTP running state is true and the total offset (sum of the offset for the sender and responder) is within the specified tolerance value (defined using the **clock-tolerance ntp oneway** command) of a one-way IP SLAs operation measurement for all the packets in a stream, the NTP synchronization status is determined to be synchronized. If these conditions are not met, the status is determined to be not synchronized.

The following guidelines apply to the displayed output:

- If the NTP synchronization status is determined to be synchronized, the one-way IP SLAs delay measurement values will be displayed.

- If the NTP synchronization status is determined to be not synchronized, the one-way values will be zero.

- The total number of operational packets that are not synchronized will be tracked during the collection period and reported.

IP SLAs Operation Configuration Dependence on Cisco IOS Release

The Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 1). You must configure the type of IP SLAs operation (such as User Datagram Protocol (UDP) jitter or Internet Control Message Protocol (ICMP) echo before you can configure any of the other parameters of the operation.

The configuration mode for the **clock-tolerance ntp oneway** command varies depending on the Cisco IOS release you are running (see Table 1) and the operation type configured.

If you are using auto IP SLAs in Cisco IOS IP SLAs Engine 3.0, you must enter the **parameters** command in IP SLA template configuration mode before you can use the **clock-tolerance ntp oneway** command.

Table 1   Command Used to Begin Configuration of an IP SLAs Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(4)T, 12.0(32)SY, 12.2(33)SRB, 12.2(33)SB, or later releases	**ip sla**	IP SLA configuration
12.3(14)T, 12.4, 12.4(2)T, 12.2(31)SB2, or 12.2(33)SXH	**ip sla monitor**	IP SLA monitor configuration
15.1(1)T	**ip sla auto template**	IP SLA template configuration

Examples   The following examples show how to enable microsecond precision, configure the NTP synchronization offset tolerance to 10 percent, and set the packet priority to high for IP SLAs UDP jitter operation 1. Note that the Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 1).

IP SLA Configuration

```
ip sla 1
 udp-jitter 205.199.199.2 dest-port 9006
 precision microseconds
 clock-tolerance ntp oneway percent 10
 probe-packet priority high
 frequency 300
!
ip sla schedule 1 life forever start-time after 00:00:06
```

IP SLA Monitor Configuration

```
ip sla monitor 1
 type jitter dest-ipaddr 205.199.199.2 dest-port 9006
 precision microseconds
 clock-tolerance ntp oneway percent 10
 probe-packet priority high
 frequency 300
!
ip sla monitor schedule 1 life forever start-time after 00:00:06
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip udp-jitter 1
Router(config-udp-jtr-tplt)# parameters
Router(config-udp-jtr-params)# precision microseconds
Router(config-udp-jtr-params)# clock-tolerance ntp oneway percent 10
Router(config-udp-jtr-params)# operation-packet high
Router(config-udp-jtr-params)# end
Router#
Router# show ip sla auto template type ip udp-jitter
IP SLAs Auto Template: 1
Measure Type: udp-jitter (control enabled)
    Description:
    IP options:
        Source IP: 0.0.0.0      Source Port: 0
        VRF:     TOS: 0x0
    Operation Parameters:
        Request Data Size: 32   Verify Data: false
        Number of Packets: 10   Inter packet interval: 20
        Timeout: 5000           Threshold: 5000
        Granularity: usec       Operation packet priority: high
        NTP Sync Tolerance: 10 percent
    Statistics Aggregation option:
        Hours of statistics kept: 2
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
ip sla auto template	Begins configuration for an IP SLAs operation template and enters IP SLA template configuration mode.
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.

codec (tplt)

To configure codec in an auto IP Service Level Agreements (SLAs) operation template for a User Datagram Protocol (UDP) jitter operation that returns VoIP scores, use the **codec** command in UDP jitter submode of the IP SLA template configuration mode.

codec *codec-type* [**advantage-factor** *value*] [**codec-numpackets** *number-of-packets*]
[**codec-interval** *milliseconds*] [**codec-size** *number-of-bytes*]

Syntax Description

codec-type	The following codec-type keywords are valid: • **g711alaw**—The G.711 a-law codec (64 kbps transmission) • **g711ulaw**—The G.711 mu-law codec (64 kbps transmission) • **g729a**—The G.729A codec (8 kbps transmission)
advantage-factor	(Optional) Specifies expectation factor to be used for ICPIF calculations.
value	Range is from 0 to 20. Default is 0. For recommended values, see Table 3.
codec-numpackets	(Optional) Specifies number of packets to be transmitted per operation.
number-of-packets	Range is from 1 to 60000. Default is 1000.
codec-interval	(Optional) Specifies interval between packets in operation.
milliseconds	Length of interval, in milliseconds (ms). Range is from 1 to 60000. Default is 20.
codec-size	(Optional) Specifies number of bytes in each packet transmitted.
number-of-bytes	Range is from 16 to 1500. Default varies by codec. For default values, see Table 2.

Defaults A codec is not configured in the auto IP SLAs operation template being configured.

Command Modes IP SLA UDP jitter template configuration (config-tplt-udp-jtr)

Command History

Release	Modification
15.1(1)T	This command was introduced.

Usage Guidelines This command configures the codec in an auto IP SLAs operation template for a UDP jitter operation and generates ICPIF and MOS scores, based on the specified codec type.

The specified *codec-type* should match the encoding algorithm being used for VoIP transmissions.

You must configure the type of auto IP SLAs operation, such as User Datagram Protocol (UDP) jitter or Internet Control Message Protocol (ICMP) echo, before you can configure any of the other parameters of the operation.

A UDP jitter operation computes statistics by sending n UDP packets, each of size s, sent t msec apart, from a given source router to a given target router, at a given frequency f. Based on the type of codec you configure for the operation, the number of packets (n), the size of each payload (s), the interpacket time interval (t), and the operational frequency (f) are auto-configured with default values or you can manually configure these parameters using the keyword and argument combinations in this command.

Note You should not specify values for the interval, size, and number of packet options unless you have a specific reason to override the defaults; for example, to approximate a different codec.

Table 2 lists the default values for each parameter by codec.

Table 2   *Default UDP Jitter Operation Parameters by Codec*

Codec	Default Number of Packets (n); [codec-numpackets]	Packet Payload (s) [codec-size][1]	Default Interval Between Packets (t) [codec-interval]	Frequency of Operations (f)
G.711 mu-law (g711ulaw)	1000	160 bytes	20 ms	Once every 60 seconds
G.711 a-law (g711alaw)	1000	160 bytes	20 ms	Once every 60 seconds
G.729A (g729a)	1000	20 bytes	20 ms	Once every 60 seconds

1. The actual data size of each request packet will contain an additional 12 bytes of Real-Time Transport Protocol (RTP) header data in order to simulate the RTP/UDP/IP/Layer 2 protocol stack.

The **advantage-factor** *value* keyword and argument allow you to specify an access Advantage Factor, also known as the Expectation Factor. Table 3, adapted from ITU-T Rec. G.113, defines a set of provisional maximum values for Advantage Factors in terms of the service provided.

Table 3   *Advantage Factor Recommended Maximum Values*

Communication Service	Maximum Value of Advantage/Expectation Factor (A):
Conventional wire line (land line)	0
Mobility (cellular connections) within a building	5
Mobility within a geographical area or moving within a vehicle	10
Access to hard-to-reach location; for example, via multihop satellite connections	20

These values are only suggestions. To be meaningful, the Advantage/Expectation factor (A) and its selected value in a specific application should be used consistently in any planning model you adopt. However, the values in Table 3 should be considered as the absolute upper limits for A. The default Advantage/Expectation factor for UDP jitter operations is always zero.

Examples

In the following example, an auto IP SLAs operation template for a UDP jitter (codec) operation is configured to use the default characteristics of the G.711 a-law codec, which means the operation will consist of 1000 packets, each of 172 bytes (160 plus 12 header bytes), sent 20 ms apart. The default value for the Advantage Factor and operations frequency is used.

```
Router(config)# ip slas auto template type ip udp-jitter voip
Router(config-tplt)# codec g711alaw
Router(config-tplt)# end
Router# show ip sla auto template type ip udp-jitter voip
IP SLAs Auto Template: voip
    Measure Type: udp-jitter (control enabled)
    Description:
    IP options:
        Source IP: 0.0.0.0      Source Port: 0
        VRF:    TOS: 0x0
    Operation Parameters:
        Verify Data: false
        Timeout: 5000          Threshold: 5000
        Codec: g711alaw Number of packets: 1000
        Interval: 20    Payload size: 16        Advantage factor: 0
        Granularity: msec      Operation packet priority: normal
    Statistics Aggregation option:
        Hours of statistics kept: 2
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

Related Commands

Command	Description
ip sla auto template	Enters IP SLA template configuration mode for defining an auto IP SLAs operation template.
show ip sla auto template	Displays configuration including default values of auto IP SLAs operation templates.

control

To enable or disable control messages in an auto IP Service Level Agreements (SLAs) operation template, use the **control** command in the appropriate submode of the IP SLA template configuration mode. To return to the default value, use the **no** form of this command.

> **control** {**enable** | **disable**}

> **no control**

Syntax Description

enable	Sends IP SLAs control messages to the IP SLAs Responder. This is the default.
disable	Does not send IP SLAs control messages between the source and the IP SLAs Responder.

Command Default   IP SLAs control messaging is enabled.

Command Modes   **IP SLA Template Configuration**

TCP connect template configuration (config-tplt-tcp-conn)
UDP echo template configuration (config-tplt-udp-ech)
UDP jitter template configuration (config-tplt-udp-jtr)

Command HistoryTC

Release	Modification
15.1(1)T	This command was introduced.

Usage Guidelines   This command disables or enables control messages for an auto IP SLAs operation. Prior to sending an operation packet to the destination router, IP SLAs sends a control message to the IP SLAs Responder to enable the destination port. Control protocol is required when the target device is a Cisco router that does not natively provide the UDP or TCP Connect service.

If you disable control, you must define the IP address of the source for the Cisco IOS IP SLAs Responder by using the **ip sla responder tcp-connect ipaddress** or **ip sla responder udp-echo ipaddress** command on the destination device.

The **no** form of this command returns the configuration to the default (enabled). If control is already enabled (default), the **no** form of this command has no affect.

You must configure the type of IP SLAs operation, such as User Datagram Protocol (UDP) jitter or Internet Control Message Protocol (ICMP) echo, before you can configure any of the other parameters of the operation.

■ control

Examples   The following example shows how to configure an auto IP SLA operation template for a TCP connect operation from Router 2 (10.1.1.1) to host device1. In this example, the control protocol is disabled. Auto IP SLAs uses the control protocol to notify the IP SLAs Responder to enable the target port temporarily. This action allows the Responder to reply to the TCP Connect operation. Because the control is disabled, you must configure the IP address of the source for the endpoint.

Router (Destination)

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Roter1(config)# ip sla responder ipaddress 10.1.1.1 port 23
Router(config)# exit
Router# show running-config
.
.
.
!
ip sla responder
 ip sla responder ipaddress 10.1.1.1 port 23
```

Router (Source)

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# ip sla auto template type ip tcp-connect 6
Router(config-tplt-tcp-conn)# control disable
Router(config-tplt-tcp-conn)# tos 128
Router(config-tplt-tcp-conn)# exit
Router# show running-config
.
.
.
ip sla auto template type ip tcp-connect 6
 control disable
 tos 128
```

Related Commands

Command	Description
ip sla auto template	Enters IP SLA template configuration mode for defining an auto IP SLAs operation template.
ip sla responder tcp-connect ipaddress	Defines the IP address of the source for the Cisco IOS IP SLAs Responder for TCP connect operations.
ip sla responder udp-echo ipaddress	Defines the IP address of the source for the Cisco IOS IP SLAs Responder for UDP echo or jitter operations.
show ip sla auto template	Display configuration including default values of auto IP SLAs operation templates.

cos

To set the class of service (CoS) for a Cisco IOS IP Service Level Agreements (SLAs) Ethernet operation, use the **cos** command in the appropriate submode of IP SLA configuration or IP SLA Ethernet monitor configuration mode. To return to the default value, use the **no** form of this command.

> **cos** *cos-value*

> **no cos**

Syntax Description

cos-value	Class of service value. The range is from 0 to 7. The default is 0.

Command Default   The class of service value for the IP SLAs Ethernet operation is set to 0.

Command Modes   **IP SLA configuration**

Ethernet echo configuration (config-ip-sla-ethernet-echo)
Ethernet jitter configuration (config-ip-sla-ethernet-jitter)

IP SLA Ethernet monitor configuration

Ethernet parameters configuration (config-ip-sla-ethernet-params)

Note   The configuration mode varies depending on the operation type configured. See the "Usage Guidelines" section for more information.

Command History

Release	Modification
12.2(33)SRB	This command was introduced.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB.
12.4(20)T	This command was integrated into Cisco IOS Release 12.4(20)T.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI.

Usage Guidelines   You must configure the type of IP SLAs operation (such as Ethernet ping) before you can configure any of the other parameters of the operation.

The configuration mode for the **cos** command varies depending on the operation type configured. For example, if you are running Cisco IOS Release 12.2(33)SRB and the Ethernet ping operation type is configured using the **ethernet echo mpid** command in IP SLA configuration mode, you would enter the **cos** command in Ethernet echo configuration mode (config-ip-sla-ethernet-echo).

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using an IP SLAs auto Ethernet operation. In this example, operation 10 is configured to automatically create IP SLAs Ethernet ping operations for all the discovered maintenance

endpoints in the domain named testdomain and VLAN identification number 34. The class of service for each Ethernet ping operation is set to 3. As specified by the proactive threshold monitoring configuration, when three consecutive connection loss events occur, a Simple Network Management Protocol (SNMP) trap notification should be sent. The schedule period for operation 10 is 60 seconds, and the operation is scheduled to start immediately.

```
ip sla ethernet-monitor 10
 type echo domain testdomain vlan 34
 cos 3
!
ip sla ethernet-monitor reaction-configuration 10 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
!
ip sla ethernet-monitor schedule 10 schedule-period 60 start-time now
```

Related Commands	Command	Description
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla ethernet-monitor	Begins configuration for an IP SLAs auto Ethernet operation and enters IP SLA Ethernet monitor configuration mode.

data-pattern

To specify the data pattern in a Cisco IOS IP Service Level Agreements (SLAs) operation to test for data corruption, use the **data pattern** command in the appropriate submode of IP SLA configuration or IP SLA monitor configuration mode. To remove the data pattern specification, use the **no** form of this command.

data-pattern *hex-pattern*

no data-pattern *hex-pattern*

Syntax Description	*hex-pattern*	Hexadecimal string to use for monitoring the specified operation.

Defaults
The default *hex-pattern* is ABCD.

Command Modes

IP SLA Configuration

UDP echo configuration (config-ip-sla-udp)

IP SLA Monitor Configuration

UDP echo configuration (config-sla-monitor-udp)

Note
The configuration mode varies depending on the Cisco IOS release you are running and the operation type configured. See the "Usage Guidelines" section for more information.

Command History

Release	Modification
12.1(1)T	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines
The **data-pattern** command allows users to specify an alphanumeric character string to verify that operation payload does not get corrupted in either direction (source-to-destination [SD] or destination-to-source [DS]).

Note
The **data-pattern** command is supported by the IP SLAs User Datagram Protocol (UDP) echo operation only.

This command is supported in IPv4 networks and in IPv6 networks.

IP SLAs Operation Configuration Dependence on Cisco IOS Release

The Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 4). You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

The configuration mode for the **data-pattern** command varies depending on the Cisco IOS release you are running (see Table 4) and the operation type configured. For example, if you are running Cisco IOS Release 12.4 and the UDP echo operation type is configured, you would enter the **data-pattern** command in UDP echo configuration mode (config-sla-monitor-udp) within IP SLA monitor configuration mode.

Table 4   Command Used to Begin Configuration of an IP SLAs Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(4)T, 12.0(32)SY, 12.2(33)SRB, 12.2(33)SB, 12.2(33)SXI or later releases	**ip sla**	IP SLA configuration
12.3(14)T, 12.4, 12.4(2)T, 12.2(31)SB2, or 12.2(33)SXH	**ip sla monitor**	IP SLA monitor configuration

Examples   The following examples show how to specify 1234ABCD5678 as the data pattern. Note that the Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 4).

The examples show the **data-pattern** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla 1
 udp-echo 10.0.54.205 dest-port 101
 data-pattern 1234ABCD5678
!
ip sla schedule 1 life forever start-time now
```

IP SLA Monitor Configuration

```
ip sla monitor 1
 type udpEcho dest-ipaddr 10.0.54.205 dest-port 101
 data-pattern 1234ABCD5678
!
ip sla monitor schedule 1 life forever start-time now
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.

delete-scan-factor

To specify the number of times the IP Service Level Agreements (SLAs) label switched path (LSP) Health Monitor should check the scan queue before automatically deleting IP SLAs operations for Border Gateway Protocol (BGP) next hop neighbors that are no longer valid, use the **delete-scan-factor** command in auto IP SLA MPLS parameters configuration mode. To return to the default value, use the **no** form of this command.

delete-scan-factor *factor*

no delete-scan-factor

Syntax Description		
factor	Number of times the LSP Health Monitor should check the scan queue before automatically deleting IP SLAs operations for BGP next hop neighbors that are no longer valid.	

Command Default   The default scan factor is 1. In other words, each time the LSP Health Monitor checks the scan queue for updates, it deletes IP SLAs operations for BGP next hop neighbors that are no longer valid.

Command Modes   Auto IP SLA MPLS parameters configuration (config-auto-ip-sla-mpls-params)

Command History	Release	Modification
	12.2(27)SBC	This command was introduced.
	12.4(6)T	This command was integrated into Cisco IOS Release 12.4(6)T.
	12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
	12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2.
	12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   This command must be used with the **scan-interval** command. Use the **scan-interval** command to specify the time interval at which the LSP Health Monitor checks the scan queue for BGP next hop neighbor updates.

Note   If the scan factor is set to 0, IP SLAs operations will not be automatically deleted by the LSP Health Monitor. This configuration is not recommended.

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with

the source Provider Edge (PE) router. The delete scan factor is set to 2. In other words, every other time the LSP Health Monitor checks the scan queue for updates, it deletes IP SLAs operations for BGP next hop neighbors that are no longer valid.

```
mpls discovery vpn interval 60
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
 delete-scan-factor 2
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands	Command	Description
	auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.
	scan-interval	Specifies the time interval (in minutes) at which the LSP Health Monitor checks the scan queue for BGP next hop neighbor updates.
	show ip sla mpls-lsp-monitor scan-queue	Displays information about adding or deleting BGP next hop neighbors from a particular MPLS VPN of an IP SLAs LSP Health Monitor operation.

description (IP SLA)

To add a description to the configuration of an IP Service Level Agreements (SLAs) auto-measure group, auto IP SLAs operation template, or auto IP SLAs endpoint list, use the **description** command in IP SLA auto-measure group configuration, IP SLA endpoint-list configuration, or appropriate submode of IP SLA template configuration mode. To remove the description, use the **no** form of this command.

> **description** *description*
>
> **no description**

Syntax Description	*description* String of 1 to 64 ASCII characters.

Command Default No description is added to configuration.

Command Modes

IP SLA Configuration

IP SLA auto-measure group (config-am-group)
IP SLA endpoint-list (config-epl)

IP SLA Template Configuration

ICMP echo configuration (config-tplt-icmp-ech)
ICMP jitter configuration (config-tplt-icmp-jtr)
TCP connect configuration (config-tplt-tcp-conn)
UDP echo configuration (config-tplt-udp-ech)
UDP jitter configuration (config-tplt-udp-jtr)

Command History

Release	Modification
15.1(1)T	This command was introduced.

Usage Guidelines This command adds descriptive text to the configuration of an IP SLAs auto-measure group, auto IP SLAs operation template, or auto IP SLAs endpoint list. The description appears in the **show** command output and does not affect the operation of the template.

Examples The following example shows how to configure this command for an auto IP SLAs operation template:

```
Router(config)# ip sla auto template type ip icmp-jitter 1
Router(config-tplt-icmp-jtr)# description default oper temp for icmp jitter
Router# end
Router# show ip sla auto template type ip icmp-jitter
IP SLAs Auto Template: 1
    Measure Type: icmp-jitter
    Description: default oper temp for icmp jitter
    IP options:
        Source IP: 0.0.0.0
        VRF:    TOS: 0x0
```

```
Operation Parameters:
    Number of Packets: 10   Inter packet interval: 20
    Timeout: 5000           Threshold: 5000
Statistics Aggregation option:
    Hours of statistics kept: 2
Statistics Distributions options:
    Distributions characteristics: RTT
    Distributions bucket size: 20
    Max number of distributions buckets: 1
Reaction Configuration: None
```

Related Commands	Command	Description
	show ip sla auto group	Displays configuration including default values of IP SLAs auto-measure groups.
	show ip sla auto endpoint-list	Displays configuration including default values of auto IP SLAs endpoint lists.
	show ip sla auto schedule	Displays configuration including default values of auto IP SLAs schedulers.
	show ip sla auto template	Displays configuration including default values of auto IP SLAs operation templates.

destination (am-group)

To add an auto IP Service Level Agreements (SLAs) endpoint list to the configuration of an IP SLAs auto-measure group, use the **destination** command in IP SLA auto-measure group configuration mode. To remove the endpoint list from the group configuration, use the **no** form of this command.

>**destination** *template-name*

>**no destination**

Syntax Description

template-name	Name of an already-configured endpoint list.

Command Default   No endpoints are defined for the IP SLAs auto-measure group being configured.

Command Modes   IP SLA auto-measure group configuration (config-am-grp)

Command History

Release	Modification
15.1(1)T	This command was introduced.

Usage Guidelines   This command specifies an auto IP SLAs endpoint list as a reference for the IP SLAs auto-measure group being configured. An endpoint list contains IP addresses for IP SLAs endpoints.

Only one auto IP SLAs endpoint list can be specified for each IP SLAs auto-measure group. Each endpoint list can be referenced by more than one group.

To change the auto IP SLAs endpoint list in the configuration of an existing auto-measure group, first use the **no** form of this command to remove the endpoint list from the group configuration and then reconfigure the group with a different endpoint list.

To create an auto IP SLAs endpoint list, use the **ip sla auto endpoint-list** command.

Examples   The following example shows how to add an auto IP SLAs endpoint list to the configuration of an IP SLAs auto-measure group:

```
Router(config)# ip sla auto group type ip 1
Router(config-am-grp)# destination 1
Router(config-am-grp)# schedule 1
Router(config-am-grp)# end
Router#
Router# show ip sla auto group
Group Name: 1
    Description:
    Activation Trigger: Immediate
    Destination: 1
    Schedule: 1

IP SLAs Auto Template: default
    Measure Type: icmp-jitter
```

```
                    Description:
                    IP options:
                        Source IP: 0.0.0.0
                        VRF:    TOS: 0x0
                    Operation Parameters:
                        Number of Packets: 10    Inter packet interval: 20
                        Timeout: 5000           Threshold: 5000
                    Statistics Aggregation option:
                        Hours of statistics kept: 2
                    Statistics Distributions options:
                        Distributions characteristics: RTT
                        Distributions bucket size: 20
                        Max number of distributions buckets: 1
                    Reaction Configuration: None

            IP SLAs auto-generated operations of group 1
                    no operation created
```

Related Commands	Command	Description
	ip sla auto endpoint-list	Enters IP SLA endpoint-list configuration mode for creating an auto IP SLAs endpoint list.

dhcp (IP SLA)

To configure a Cisco IOS IP Service Level Agreements (SLAs) Dynamic Host Configuration Protocol (DHCP) operation, use the **dhcp** command in IP SLA configuration mode.

> **dhcp** {*destination-ip-address* | *destination-hostname*} [**source-ip** {*ip-address* | *hostname*}]
> [**option-82** [**circuit-id** *circuit-id*] [**remote-id** *remote-id*] [**subnet-mask** *subnet-mask*]]

Syntax Description

destination-ip-address | *destination-hostname*	Destination IP address or hostname.
source-ip {*ip-address* | *hostname*}	(Optional) Specifies the source IP address or hostname. When a source IP address or hostname is not specified, IP SLAs chooses the IP address nearest to the destination.
option-82	(Optional) Specifies DHCP option 82 for the destination DHCP server.
circuit-id *circuit-id*	(Optional) Specifies the circuit ID in hexadecimal.
remote-id *remote-id*	(Optional) Specifies the remote ID in hexadecimal.
subnet-mask *subnet-mask*	(Optional) Specifies the subnet mask IP address. The default subnet mask is 255.255.255.0.

Defaults   No IP SLAs operation type is configured for the operation being configured.

Command Modes   IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **type dhcp** command.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **type dhcp** command.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **type dhcp** command.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **type dhcp** command.

Usage Guidelines   If the source IP address is configured, then packets will be sent with that source address.

You may configure the **ip dhcp-server** global configuration command to identify the DHCP server that the DHCP operation will measure. If the target IP address is configured, then only that device will be measured. If the **ip dhcp-server** command is not configured and the target IP address is not configured, then DHCP discover packets will be sent on every available IP interface.

Option 82 is called the Relay Agent Information option and is inserted by the DHCP relay agent when client-originated DHCP packets are forwarded to a DHCP server. Servers recognizing the Relay Agent Information option may use the information to implement IP address or other parameter assignment policies. The DHCP server echoes the option back verbatim to the relay agent in server-to-client replies, and the relay agent strips the option before forwarding the reply to the client.

The Relay Agent Information option is organized as a single DHCP option that contains one or more suboptions that convey information known by the relay agent. The initial suboptions are defined for a relay agent that is colocated in a public circuit access unit. These suboptions are as follows: a circuit ID for the incoming circuit, a remote ID that provides a trusted identifier for the remote high-speed modem, and a subnet mask designation for the logical IP subnet from which the relay agent received the client DHCP packet.

Note If an odd number of characters are specified for the circuit ID, a zero will be added to the end of the string.

You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples In the following example, IP SLAs operation number 4 is configured as a DHCP operation enabled for DHCP server 172.16.20.3:

```
ip sla 4
 dhcp option-82 circuit-id 10005A6F1234
ip dhcp-server 172.16.20.3
!
ip sla schedule 4 start-time now
```

Related Commands

Command	Description
ip dhcp-server	Specifies which DHCP servers to use on a network, and specifies the IP address of one or more DHCP servers available on the network.
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

discover (epl)

To enter IP SLA endpoint-list auto-discovery configuration mode for building a list of destination IP addresses for Cisco routing devices or Cisco IP Service Level Agreements (SLAs) Responders, use the **discover** command in IP SLA endpoint-list configuration mode. To remove the list, use the **no** form of this command.

discover [**port** *port*]

no discover [**port** *port*]

Syntax Description		
port	(Optional) Specifies port on source IP SLAs device.	
port	Port number. Range is from 1 to 65535. Default is 5000.	

Command Default No destination IP addresses are identified.

Command Modes IP SLA endpoint-list configuration (config-epl)

Command History	Release	Modification
	15.1(1)T	This command was introduced.

Usage Guidelines This command discovers and builds a list of destination IP addresses to be added to an endpoint list for IP SLAs auto-measure groups.

Before using this command, use the **ip sla auto discovery** command to enable auto-discovery.

Before using this command, use the **ip sla responder auto-register** command on the destination Cisco device to enable endpoints to register with source upon configuration.

Destination IP addresses can either be automatically discovered by using this command or manually configured using the **ip-address** command. If you use this command to build an endpoint list, you cannot use the **ip-address** command to manually add or remove IP addresses in an endpoint list.

To add the discovered list of destination IP addresses to the endpoint list being configured, use the **access-list** command in IP SLA endpoint-list auto-discovery configuration mode.

Examples The following example shows how to configure an endpoint list using the auto discovery method:

Destination Router
```
Router(config)# ip sla responder auto-register 10.1.1.25
Router(config)#
```

Source Router
```
Router(config)# ip sla auto discovery
Router(config)# ip sla auto endpoint-list type ip autolist
```

```
Router(config-epl)# discover port 5000
Router(config-epl-disc)# access-list 3
Router(config-epl-disc)# end
Router# show ip sla auto endpoint-list
Endpoint-list Name: autolist
    Description:
    Auto Discover Parameters
        Destination Port: 5000
        Access-list: 3
        Ageout: 3600    Measurement-retry: 3
.
.
.
```

Related Commands	Command	Description
	access-list	Adds a list of discovered endpoints to an auto IP SLAs endpoint list.
	ip sla auto discovery	Enables IP SLAs auto discovery for auto IP SLAs in Cisco IOS IP SLAs Engine 3.0.
	ip sla responder auto-register	Configures a Cisco IP SLAs Responder to automatically register with the source.
	show ip sla auto discovery	Displays the status of IP SLAs auto discovery and the configuration of auto IP SLAs endpoint lists configured using auto discovery.
	show ip sla auto endpoint-list	Displays the configuration including default values of auto IP SLAs endpoint lists.

distributions-of-statistics-kept

✎

Note Effective with Cisco IOS Release 12.4(4)T, 12.2(33)SRB, 12.2(33)SB, and 12.2(33)SXI, the **distributions-of-statistics-kept** command is replaced by the **history distributions-of-statistics-kept** command. See the **history distributions-of-statistics-kept** command for more information.

To set the number of statistics distributions kept per hop during a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **distributions-of-statistics-kept** command in the appropriate submode of IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

> **distributions-of-statistics-kept** *size*

> **no distributions-of-statistics-kept**

Syntax Description

size	Number of statistics distributions kept per hop. The default is 1 distribution.

Defaults   1 distribution

Command Modes   DHCP configuration (config-sla-monitor-dhcp)
DLSw configuration (config-sla-monitor-dlsw)
DNS configuration (config-sla-monitor-dns)
FTP configuration (config-sla-monitor-ftp)
HTTP configuration (config-sla-monitor-http)
ICMP echo configuration (config-sla-monitor-echo)
ICMP path echo configuration (config-sla-monitor-pathEcho)
ICMP path jitter configuration (config-sla-monitor-pathJitter)
TCP connect configuration (config-sla-monitor-tcp)
UDP echo configuration (config-sla-monitor-udp)
UDP jitter configuration (config-sla-monitor-jitter)
VoIP configuration (config-sla-monitor-voip)

Command History

Release	Modification
11.2	This command was introduced.
12.4(4)T	This command was replaced by the **history distributions-of-statistics-kept** command.
12.2(33)SRB	This command was replaced by the **history distributions-of-statistics-kept** command.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Release	Modification
12.2(33)SB	This command was replaced by the **history distributions-of-statistics-kept** command.
12.2(33)SXI	This command was replaced by the **history distributions-of-statistics-kept** command.

Usage Guidelines

In most situations, you do not need to change the number of statistics distributions kept or the time interval for each distribution. Only change these parameters when distributions are needed, for example, when performing statistical modeling of your network. To set the statistics distributions interval, use the **statistics-distribution-interval** command.

When the number of distributions reaches the size specified, no further distribution-based information is stored.

For the IP SLAs Internet Control Message Protocol (ICMP) path echo operation, the amount of router memory required to maintain the distribution statistics table is based on multiplying all of the values set by the following four commands:

- **distributions-of-statistics-kept**
- **hops-of-statistics-kept**
- **paths-of-statistics-kept**
- **hours-of-statistics-kept**

The general equation used to calculate the memory requirement to maintain the distribution statistics table for an ICMP path echo operation is as follows:
Memory allocation = (160 bytes) * (**distributions-of-statistics-kept** *size*) * (**hops-of-statistics-kept** *size*) * (**paths-of-statistics-kept** *size*) * (**hours-of-statistics-kept** *hours*)

> **Note** To avoid significant impact on router memory, careful consideration should be used when configuring the **distributions-of-statistics-kept**, **hops-of-statistics-kept**, **paths-of-statistics-kept**, and **hours-of-statistics-kept** commands.

> **Note** You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

Examples

The following example shows how to set the statistics distribution to 5 and the distribution interval to 10 ms for IP SLAs ICMP echo operation 1. Consequently, the first distribution will contain statistics from 0 to 9 ms, the second distribution will contain statistics from 10 to 19 ms, the third distribution will contain statistics from 20 to 29 ms, the fourth distribution will contain statistics from 30 to 39 ms, and the fifth distribution will contain statistics from 40 ms to infinity.

```
ip sla monitor 1
 type echo protocol ipIcmpEcho 172.16.161.21
 distributions-of-statistics-kept 5
 statistics-distribution-interval 10
!
ip sla monitor schedule 1 life forever start-time now
```

Related Commands	Command	Description
	hops-of-statistics-kept	Sets the number of hops for which statistics are maintained per path for the IP SLAs operation.
	hours-of-statistics-kept	Sets the number of hours for which statistics are maintained for the IP SLAs operation.
	ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
	paths-of-statistics-kept	Sets the number of paths for which statistics are maintained per hour for the IP SLAs operation.
	statistics-distribution-interval	Sets the time interval for each statistics distribution kept for the IP SLAs operation.

dlsw peer-ipaddr

To configure a Cisco IOS IP Service Level Agreements (SLAs) Data Link Switching Plus (DLSw+) operation, use the **dlsw peer-ipaddr** command in IP SLA configuration mode.

dlsw peer-ipaddr *ip-address*

Syntax Description		
ip-address	IP address of the peer destination.	

Defaults No IP SLAs operation type is configured for the operation being configured.

Command Modes IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **type dlsw peer-ipaddr** command.

Usage Guidelines To configure an IP SLAs DLSw+ operation, the DLSw+ feature must be configured on the local and target routers.

For DLSw+ operations, the default request packet data size is 0 bytes (use the **request-data-size** command to modify this value) and the default amount of time the operation waits for a response from the request packet is 30 seconds (use the **timeout** command to modify this value).

You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples In the following example, IP SLAs operation number 10 is configured as a DLSw+ operation enabled for remote peer IP address 172.21.27.11. The data size is 15 bytes:

```
ip sla 10
 dlsw peer-ipaddr 172.21.27.11
 request-data-size 15
!
ip sla schedule 4 start-time now
```

Related Commands	Command	Description
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	request-data-size	Sets the protocol data size in the payload of the IP SLAs operation's request packet.
	show dlsw peers	Displays DLSw peer information.

dns (IP SLA)

To configure a Cisco IOS IP Service Level Agreements (SLAs) Domain Name System (DNS) operation, use the **dns** command in IP SLA configuration mode.

> **dns** {*destination-ip-address* | *destination-hostname*} **name-server** *ip-address* [**source-ip**
> {*ip-address* | *hostname*} **source-port** *port-number*]

Syntax Description

destination-ip-address | *destination-hostname*	Destination IP address or hostname.
name-server *ip-address*	Specifies the IP address of the DNS server.
source-ip {*ip-address* | *hostname*}	(Optional) Specifies the source IP address or hostname. When a source IP address or hostname is not specified, IP SLAs chooses the IP address nearest to the destination.
source-port *port-number*	(Optional) Specifies the source port number. When a port number is not specified, IP SLAs chooses an available port.

Defaults

No IP SLAs operation type is configured for the operation being configured.

Command Modes

IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **type dns target-addr** command.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **type dns target-addr** command.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **type dns target-addr** command.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **type dns target-addr** command.

Usage Guidelines

You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples

In the following example, IP SLAs operation 7 is configured as a DNS operation using the target IP address 172.20.2.132:

```
ip sla 7
```

```
 dns host1 name-server 172.20.2.132
!
ip sla schedule 7 start-time now
```

Related Commands	Command	Description
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

enhanced-history

> ✎
>
> **Note**   Effective with Cisco IOS Release 12.4(4)T, 12.2(33)SRB, 12.2(33)SB, and 12.2(33)SXI, the **enhanced-history** command is replaced by the **history enhanced** command. See the **history enhanced** command for more information.

To enable enhanced history gathering for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **enhanced-history** command in the appropriate submode of IP SLA monitor configuration mode.

enhanced-history [**interval** *seconds*] [**buckets** *number-of-buckets*]

Syntax Description	**interval** *seconds*	(Optional) Number of seconds that enhanced history should be gathered in each bucket. When this time expires, enhanced history statistics are gathered in a new bucket. The default is 900 (15 minutes).
	buckets *number-of-buckets*	(Optional) Number of history buckets that should be retained in system memory. When this number is reached, statistic gathering for the operation ends. The default is 100.

Defaults   900 seconds and 100 buckets

Command Modes   DHCP configuration (config-sla-monitor-dhcp)
DLSw configuration (config-sla-monitor-dlsw)
DNS configuration (config-sla-monitor-dns)
FTP configuration (config-sla-monitor-ftp)
HTTP configuration (config-sla-monitor-http)
ICMP echo configuration (config-sla-monitor-echo)
ICMP path echo configuration (config-sla-monitor-pathEcho)
ICMP path jitter configuration (config-sla-monitor-pathJitter)
TCP connect configuration (config-sla-monitor-tcp)
UDP echo configuration (config-sla-monitor-udp)
UDP jitter configuration (config-sla-monitor-jitter)
VoIP configuration (config-sla-monitor-voip)

Command History	Release	Modification
	12.2(11)T	This command was introduced.
	12.2(25)S	This command was integrated into Cisco IOS Release 12.2(25)S.
	12.2(27)SBC	This command was integrated into Cisco IOS Release 12.2(27)SBC.
	12.4(4)T	This command was replaced by the **history enhanced** command.
	12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
	12.2(33)SRB	This command was replaced by the **history enhanced** command.

Release	Modification
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
12.2(33)SB	This command was replaced by the **history enhanced** command.
12.2(33)SXI	This command was replaced by the **history enhanced** command.

Usage Guidelines

Performance statistics are stored in "buckets" that separate the accumulated data. Each bucket consists of data accumulated over the specified time interval.

Note   You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

Examples

In the following example, Internet Control Message Protocol (ICMP) echo operation 3 is configured with the standard enhanced history characteristics.

```
ip sla monitor 3
 type echo protocol ipIcmpEcho 172.16.1.175
 enhanced-history interval 900 buckets 100
!
ip sla monitor schedule 3 start-time now life forever
```

Related Commands

Command	Description
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
show ip sla monitor enhanced-history collection-statistics	Displays data for all collected history buckets for the specified IP SLAs operation, with data for each bucket shown individually.
show ip sla monitor enhanced-history distribution-statistics	Displays enhanced history data for all collected buckets in a summary table.

ethernet echo mpid

To manually configure an individual Cisco IOS IP Service Level Agreements (SLAs) Ethernet ping operation, use the **ethernet echo mpid** command in IP SLA configuration mode.

ethernet echo mpid *mp-id* **domain** *domain-name* {**evc** *evc-id* | **port** | **vlan** *vlan-id*}

Syntax Description

mp-id	Maintenance endpoint identification number.
domain *domain-name*	Specifies the name of the Ethernet Connectivity Fault Management (CFM) maintenance domain.
evc *evc-id*	Specifies the Ethernet Virtual Circuit (EVC) identification name.
port	Enables port level statistical measurements for two directly connected maintenance endpoints (MEPs).
vlan *vlan-id*	Specifies the VLAN identification number.

Command Default No IP SLAs Ethernet ping operation is configured.

Command Modes IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.2(33)SRB	This command was introduced.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB.
12.4(20)T	This command was integrated into Cisco IOS Release 12.4(20)T.
12.2(33)SRD	The **evc** *evc-id* keyword and argument were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI.
12.2(33)SRE	This command was modified. The **port** keyword was added.

Usage Guidelines Unlike the EVC and VLAN statistical measurements, the port level measurement is performed at the physical layer level and does not cross a bridge boundary.

You must configure the type of IP SLAs operation (such as Ethernet ping) before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples The following example shows how to configure an IP SLAs Ethernet ping operation. In this example, the maintenance endpoint identification number is 23, the maintenance domain name is testdomain, and the VLAN identification number is 34. Operation 1 is scheduled to start immediately.

```
ip sla 1
 ethernet echo mpid 23 domain testdomain vlan 34
!
```

```
ip sla schedule 1 start-time now
```

	Command	Description
Related Commands	**ip sla**	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

ethernet jitter mpid

To manually configure an individual Cisco IOS IP Service Level Agreements (SLAs) Ethernet jitter operation, use the **ethernet jitter mpid** command in IP SLA configuration mode.

> **ethernet jitter mpid** *mp-id* **domain** *domain-name* {**evc** *evc-id* | **port** | **vlan** *vlan-id*} [**interval** *interframe-interval*] [**num-frames** *frames-number*]

Syntax Description	

mp-id	Maintenance endpoint identification number.
domain *domain-name*	Specifies the name of the Ethernet Connectivity Fault Management (CFM) maintenance domain.
evc *evc-id*	Specifies the Ethernet Virtual Circuit (EVC) identification name.
vlan *vlan-id*	Specifies the VLAN identification number.
interval *interframe-interval*	(Optional) Specifies the interframe interval (in milliseconds). The default is 20.
num-frames *frames-number*	(Optional) Specifies the number of frames to be sent. The default is 10.

Command Default   No IP SLAs Ethernet jitter operation is configured.

Command Modes   IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.2(33)SRB	This command was introduced.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB.
12.4(20)T	This command was integrated into Cisco IOS Release 12.4(20)T.
12.2(33)SRD	The **evc** *evc-id* keyword and argument were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI.
12.2(33)SRE	This command was modified. The **port** keyword was added.

Usage Guidelines   Unlike the EVC and VLAN statistical measurements, the port level measurement is performed at the physical layer level and does not cross a bridge boundary.

You must configure the type of IP SLAs operation (such as Ethernet jitter) before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples The following example shows how to configure an IP SLAs Ethernet jitter operation. In this example, the maintenance endpoint identification number is 23, the maintenance domain name is testdomain, the VLAN identification number is 34, the interframe interval is 20 ms, and the number of frames to be sent is 30. Operation 2 is scheduled to start immediately.

```
ip sla 2
 ethernet jitter mpid 23 domain testdomain vlan 34 interval 20 num-frames 30
!
ip sla schedule 2 start-time now
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

exp (IP SLA)

To specify the experimental field value in the header for an echo request packet of a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **exp** command in the appropriate submode of auto IP SLA MPLS configuration, IP SLA configuration, or IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

exp *exp-bits*

no exp

Syntax Description	*exp-bits*	Specifies the experimental field value in the header for an echo request packet. The range is from 0 to 7. The default is 0.

Command Default   The experimental field value is set to 0.

Command Modes   **Auto IP SLA MPLS Configuration**

MPLS parameters configuration (config-auto-ip-sla-mpls-params)

IP SLA Configuration and IP SLA Monitor Configuration

LSP ping configuration (config-sla-monitor-lspPing)
LSP trace configuration (config-sla-monitor-lspTrace)
VCCV configuration (config-sla-vccv)

Note   The configuration mode varies depending on the Cisco IOS release you are running and the operation type configured. See the "Usage Guidelines" section for more information.

Command History	Release	Modification
	12.2(27)SBC	This command was introduced.
	12.4(6)T	This command was integrated into Cisco IOS Release 12.4(6)T.
	12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
	12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2.
	12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.
	12.2(33)SRC	Support for MPLS Pseudo-Wire Emulation Edge-to-Edge (PWE3) services via Virtual Circuit Connectivity Verification (VCCV) was added.
	12.2(33)SB	Support for MPLS Pseudo-Wire Emulation Edge-to-Edge (PWE3) services via Virtual Circuit Connectivity Verification (VCCV) was added.

Usage Guidelines

IP SLAs Operation Configuration Dependence on Cisco IOS Release

The Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 5). Note that if you are configuring an IP SLAs label switched path (LSP) Health Monitor operation, see Table 6 for information on Cisco IOS release dependencies. You must configure the type of IP SLAs operation (such as LSP ping) before you can configure any of the other parameters of the operation.

The configuration mode for the **exp** (IP SLA) command varies depending on the Cisco IOS release you are running and the operation type configured. For example, if you are running Cisco IOS Release 12.4(6)T and the LSP ping operation type is configured (without using the LSP Health Monitor), you would enter the **exp** (IP SLA) command in LSP ping configuration mode (config-sla-monitor-lspPing) within IP SLA configuration mode.

Table 5   Command Used to Begin Configuration of an IP SLAs Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(4)T, 12.0(32)SY, 12.2(33)SRB, 12.2(33)SB, or later releases	**ip sla**	IP SLA configuration
12.3(14)T, 12.4, 12.4(2)T, 12.2(31)SB2, or 12.2(33)SXH	**ip sla monitor**	IP SLA monitor configuration

Table 6   Command Used to Begin Configuration of an IP SLAs LSP Health Monitor Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(6)T, 12.0(32)SY, 12.2(31)SB2, 12.2(33)SRB, 12.2(33)SXH, or later releases	**auto ip sla mpls-lsp-monitor**	Auto IP SLA MPLS configuration

Examples

The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source Provider Edge (PE) router. The experimental field value for each IP SLAs operations created by LSP Health Monitor operation 1 is set to 5.

```
mpls discovery vpn interval 60
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
 delete-scan-factor 2
 exp 5
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
```

```
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands	Command	Description
	auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.

filter-for-history

> ✎
>
> **Note** Effective with Cisco IOS Release 12.4(4)T, 12.2(33)SRB, 12.2(33)SB, and 12.2(33)SXI, the **filter-for-history** command is replaced by the **history filter** command. See the **history filter** command for more information.

To define the type of information kept in the history table for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **filter-for-history** command in the appropriate submode of IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

filter-for-history {**none** | **all** | **overThreshold** | **failures**}

no filter-for-history {**none** | **all** | **overThreshold** | **failures**}

Syntax Description

none	No history kept. This is the default.
all	All operations attempted are kept in the history table.
overThreshold	Only packets that are over the threshold are kept in the history table.
failures	Only packets that fail for any reason are kept in the history table.

Defaults No IP SLAs history is kept for an operation.

Command Modes DHCP configuration (config-sla-monitor-dhcp)
DLSw configuration (config-sla-monitor-dlsw)
DNS configuration (config-sla-monitor-dns)
FTP configuration (config-sla-monitor-ftp)
HTTP configuration (config-sla-monitor-http)
ICMP echo configuration (config-sla-monitor-echo)
ICMP path echo configuration (config-sla-monitor-pathEcho)
ICMP path jitter configuration (config-sla-monitor-pathJitter)
TCP connect configuration (config-sla-monitor-tcp)
UDP echo configuration (config-sla-monitor-udp)
VoIP configuration (config-sla-monitor-voip)

Command History

Release	Modification
11.2	This command was introduced.
12.4(4)T	This command was replaced by the **history filter** command.
12.2(33)SRB	This command was replaced by the **history filter** command.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
12.2(33)SB	This command was replaced by the **history filter** command.
12.2(33)SXI	This command was replaced by the **history filter** command.

Usage Guidelines   Use the **filter-for-history** command to control what gets stored in the history table for an IP SLAs operation. To control how much history gets saved in the history table, use the **lives-of-history-kept**, **buckets-of-history-kept**, and the **samples-of-history-kept** commands.

> **Note**   The **filter-for-history** command does not support the IP SLAs User Datagram Protocol (UDP) jitter operation.

An IP SLAs operation can collect history and capture statistics. By default, the history for an IP SLAs operation is not collected. If history is collected, each history bucket contains one or more history entries from the operation. When the operation type is ICMP path echo, an entry is created for each hop along the path that the operation takes to reach its destination. The type of entry stored in the history table is controlled by the **filter-for-history** command. The total number of entries stored in the history table is controlled by the combination of the **samples-of-history-kept**, **buckets-of-history-kept**, and **lives-of-history-kept** commands.

> **Note**   Collecting history increases the RAM usage. Collect history only when you think there is a problem in the network.

> **Note**   You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

Examples   In the following example, only operation packets that fail are kept in the history table.

```
ip sla monitor 1
 type echo protocol ipIcmpEcho 172.16.161.21
 lives-of-history-kept 1
 filter-for-history failures
!
ip sla monitor schedule 1 life forever start-time now
```

Related Commands

Command	Description
buckets-of-history-kept	Sets the number of history buckets that are kept during the lifetime of the IP SLAs operation.
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
lives-of-history-kept	Sets the number of lives maintained in the history table for the IP SLAs operation.
samples-of-history-kept	Sets the number of entries kept in the history table per bucket for the IP SLAs operation.

flow-label (IP SLA)

To define the flow label field in the IPv6 header of a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **flow-label** (IP SLA) command in the appropriate submode of IP SLA configuration or IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

flow-label *number*

no flow-label

Syntax Description

number	Value in the flow label field of the IPv6 header. The range is from 0 to 1048575 (or FFFFF hexadecimal). This value can be preceded by "0x" to indicate hexadecimal notation. The default value is 0.

Defaults

The default flow label value is 0.

Command Modes

ICMP echo configuration (config-ip-sla-echo)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
UDP jitter configuration (config-ip-sla-jitter)

Note The configuration mode varies depending on the operation type configured.

Command History

Release	Modification
12.2(33)SRC	This command was introduced.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB.
12.4(20)T	This command was integrated into Cisco IOS Release 12.4(20)T.

Usage Guidelines

The flow label value is stored in a a 20-bit field in the IPv6 packet header and is used by a source to label packets of a flow.

A flow label value of zero is used to indicate packets that are not part of any flow.

When the flow label is defined for an operation, the IP SLAs Responder will reflect the flow-label value it receives.

Note This command is applicable only to IPv6 networks.

To display the flow label value for all Cisco IOS IP SLAs operations or a specified operation, use the **show ip sla configuration** command.

Examples

In the following example, IP SLAs operation 1 is configured as an Internet Control Message Protocol (ICMP) echo operation with destination IPv6 address 2001:DB8:100::1. The value in the flow label field of the IPv6 header is set to 0x1B669.

```
ip sla 1
 icmp-echo 2001:DB8:100::1
 flow-label 0x1B669
!
ip sla schedule 1 start-time now
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
show ip sla configuration	Displays configuration values including all defaults for all Cisco IOS IP SLAs operations or a specified operation.

force-explicit-null

To add an explicit null label to all echo request packets of a Cisco IOS IP Service Level Agreements (SLAs) LSP Health Monitor operation, use the **force-explicit-null** command in the appropriate submode of auto IP SLA MPLS configuration mode. To return to the default value, use the **no** form of this command.

> **force-explicit-null**

> **no force-explicit-null**

Syntax Description   This command has no arguments or keywords.

Command Default   An explicit null label is not added.

Command Modes   **Auto IP SLA MPLS Configuration**

MPLS parameters configuration (config-auto-ip-sla-mpls-params)
LSP discovery parameters configuration (config-auto-ip-sla-mpls-lpd-params)

Command History

Release	Modification
12.4(6)T	This command was introduced.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(31)SB2	This command was integrated into Cisco IOS Release 12.2(31)SB2. Support for this command in MPLS label switched path (LSP) discovery parameters configuration mode was added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines   You must configure the type of LSP Health Monitor operation (such as LSP ping) before you can configure any of the other parameters of the operation.

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, LSP Health Monitor operation 1 is configured to automatically create IP SLAs LSP ping operations for all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source PE router. In this example, an explicit null label will be added to all the echo request packets of IP SLAs operations created by LSP Health Monitor operation 1.

```
mpls discovery vpn interval 60
mpls discovery vpn next-hop
!
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
```

```
 force-explicit-null
 timeout 1000
 scan-interval 1
 secondary-frequency connection-loss 10
 secondary-frequency timeout 10
 delete-scan-factor 2
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react connectionLoss threshold-type
consecutive 3 action-type trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react timeout threshold-type
consecutive 3 action-type trapOnly
ip sla logging traps
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 start-time now
```

Related Commands	Command	Description
	auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.

frequency (am-schedule)

To set the frequency characteristic in an auto IP Service Level Agreements (SLAs) scheduler for restarting auto IP SLAs operations, use the **frequency** command in IP SLA auto-measure schedule configuration mode. To return to the default value, use the **no** form of this command.

frequency {*seconds* | **range** *random-frequency-range*}

no frequency

Syntax Description		
	seconds	Length of time before an operation repeats, in seconds (sec). Range is from 0 to 604800. Default is 60.
	range	Specifies frequencies at which auto IP SLAs operations that share the same schedule will restart are chosen randomly within the specified frequency range. Default is disabled.
	random-frequency-range	Lower and upper limits of the range, in seconds, and separated by a hyphen (**-**), such as 80-100. The hyphen (-) is required.

Command Default   Auto IP SLAs operations restart every 60 sec.

Command Modes   IP SLA auto-measure schedule configuration (config-am-schedule)

Command History	Release	Modification
	15.1(1)T	This command was introduced.

Usage Guidelines   This command changes the value of frequency in an auto IP SLAs scheduler from the default (every 60 sec) to the specified value. The frequency characteristic determines how often an operation in an IP SLAs auto-measure group will repeat once it is started.

Use the **probe-interval** command to configure the interval between the start time of one operation and the start time of the next operation being controlled by the same auto IP SLAs scheduler.

Random Scheduler

The random scheduler option provides the capability to schedule auto IP SLAs operations that share the same scheduler to begin at random intervals over a specified duration of time. The random scheduler option is disabled by default.

To enable the random scheduler option, you must configure the **range** *random-frequency-range* keyword and argument combination. Auto IP SLAs operations being controlled by a random scheduler restart at uniformly distributed random frequencies within the specified frequency range. The following guidelines apply for setting the random frequency range:

- The starting value of the range should be greater than the timeout value of the operations controlled by the scheduler being configured.

- The starting value of the frequency range should be greater than the schedule period (amount of time for which the operations are scheduled). This guideline ensures that the same operation does not get scheduled more than once within the schedule period.

The following guidelines apply if the random scheduler option is enabled:

- The individual operations being controlled by the same auto IP SLAs scheduler will be uniformly distributed to begin at random intervals over the schedule period.

- The operations being controlled by the same auto IP SLAs scheduler restart at uniformly distributed random frequencies within the specified frequency range.

- The minimum interval between the start of each operation being controlled by the same auto IP SLAs scheduler is 100 ms (0.1 sec).

- Only one operation can be scheduled to begin at any given time. If the random scheduler option is disabled, multiple operations can begin at the same time.

- The first operation will always begin at 0 ms of the schedule period.

- The order in which each operation in a multioperation schedule begins is random.

Multioperation Scheduling

Note   A multioperation schedule is created by specifying the same auto IP SLA scheduler for two or more IP SLA auto-measure groups.

The following guidelines apply when you add or delete an operation from an existing multioperation schedule by modifying the configuration of an IP SLAs auto-measure group to add or remove the auto IP SLAs scheduler:

- If two or more operations are added after the multioperation schedule has started, then the start times of the newly added operations will be uniformly distributed based on a time interval that was calculated prior to the addition of the new operations. If two or more operations are added before the multioperation schedule has started, then the time interval is recalculated based on both the existing and newly added operations.

- If an operation is added to a multioperation schedule in which the random scheduler option is enabled, then the start time and frequency of the newly added operation will be randomly chosen within the specified parameters.

- If an operation is added to a multioperation schedule in which the existing operations have aged out or the lifetimes of the existing operations have ended, the newly added operation will start and remain active for the amount of time specified by the multioperation schedule.

- If an active operation is deleted, then the operation will stop collecting information and become inactive.

Examples   The following example shows how to configure an auto IP SLAs scheduler that will cause an auto IP SLAs operation to actively collect data at 3:00 p.m. on April 5. The operation will age out after 12 hours of inactivity, which can be before it starts or after it has finished its life. When the operation ages out, all configuration information for the operation is removed from the running configuration in RAM.

```
Router(config)# ip sla auto schedule apr5
Router(config-am-schedule)# ageout 43200
Router(config-am-schedule)# frequency 70
Router(config-am-schedule)# life 43200
Router(config-am-schedule)# probe-interval 1500
```

```
Router(config-am-schedule)# start-time 15:00 apr 5
Router(config-am-schedule)# end
Router# show ip sla auto schedule apr5
Group sched-id: apr5
    Probe Interval (ms) : 1500
    Group operation frequency (sec): 70
    Status of entry (SNMP RowStatus): Active
    Next Scheduled Start Time: P15:00 apr 5
    Life (sec): 43200
    Entry Ageout (sec): 43200
```

The following example shows how to schedule auto IP SLAs operations 3, 4, and 6 using multioperation scheduling. In this example, the operations are scheduled to begin at equal intervals over a schedule period of 20 seconds. The first operation (or set of operations) is scheduled to start immediately.

```
Router(config)# ip sla auto schedule multi
Router(config-am-schedule)# probe-interval 20
Router(config-am-schedule)# start-time now
Router(config-am-schedule)# end
Router#
Router# show ip sla auto schedule multi
Group sched-id: multi
    Probe Interval (ms) : 20
    Group operation frequency (sec): 60
    Status of entry (SNMP RowStatus): Active
    Next Scheduled Start Time: Now
    Life (sec): 3600
    Entry Ageout (sec): never
Router#configure terminal
Router(config)# ip sla auto group type ip icmp-echo 3
Router(config-am-group)# template 3
Router(config-am-group)# schedule multi
Router(config-am-group)# destination 3
Router(config-am-group)# exit
Router(config)# ip sla auto group type ip icmp-echo 4
Router(config-am-group)# template 4
Router(config-am-group)# schedule multi
Router(config-am-group)# destination 4
Router(config-am-group)# exit
Router(config)# ip sla auto group type ip icmp-echo 6
Router(config-am-group)# template 6
Router(config-am-group)# schedule multi
Router(config-am-group)# destination 6
Router(config-am-group)# exit
Router(config)#
```

Related Commands	Command	Description
	probe-interval	Specifies interval for staggering the start times of auto IP SLAs operations
	show ip sla auto schedule	Displays configuration including default values of auto IP SLAs schedulers.

frequency (IP SLA)

To set the rate at which a specified IP Service Level Agreements (SLAs) operation repeats, use the **frequency** (IP SLA) command in the appropriate submode of IP SLA configuration or IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

frequency *seconds*

no frequency

Syntax Description

seconds	Number of seconds between the IP SLAs operations. The default is 60.

Defaults

60 seconds

Command Modes

IP SLA Configuration

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP jitter configuration (config-ip-sla-icmpjitter)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
UDP jitter configuration (config-ip-sla-jitter)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Monitor Configuration

DHCP configuration (config-sla-monitor-dhcp)
DLSw configuration (config-sla-monitor-dlsw)
DNS configuration (config-sla-monitor-dns)
FTP configuration (config-sla-monitor-ftp)
HTTP configuration (config-sla-monitor-http)
ICMP echo configuration (config-sla-monitor-echo)
ICMP path echo configuration (config-sla-monitor-pathEcho)
ICMP path jitter configuration (config-sla-monitor-pathJitter)
TCP connect configuration (config-sla-monitor-tcp)
UDP echo configuration (config-sla-monitor-udp)
UDP jitter configuration (config-sla-monitor-jitter)
VoIP configuration (config-sla-monitor-voip)

> ✎
> **Note** The configuration mode varies depending on the Cisco IOS release you are running and the operation
> type configured. See the "Usage Guidelines" section for more information.

Command History

Release	Modification
11.2	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SRB	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
12.2(33)SRC	The VCCV configuration mode was added.
12.2(33)SB	The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	The Ethernet echo and Ethernet jitter configuration modes were added.

Usage Guidelines A single IP SLAs operation will repeat at a given frequency for the lifetime of the operation. For example, a User Datagram Protocol (UDP) jitter operation with a frequency of 60 sends a collection of data packets (simulated network traffic) once every 60 seconds, for the lifetime of the operation. The default simulated traffic for a UDP jitter operation consists of ten packets sent 20 milliseconds apart. This "payload" is sent when the operation is started, then is sent again 60 seconds later.

If an individual IP SLAs operation takes longer to execute than the specified frequency value, a statistics counter called "busy" is incremented rather than immediately repeating the operation.

Consider the following guidelines before configuring the **frequency** (IP SLA), **timeout** (IP SLA), and **threshold** (IP SLA) commands. For the IP SLAs UDP jitter operation, the following guidelines are recommended:

- (**frequency** *seconds*) > ((**timeout** *milliseconds*) + N)

- (**timeout** *milliseconds*) > (**threshold** *milliseconds*)

where N = (**num-packets** *number-of-packets*) * (**interval** *interpacket-interval*). Use the **udp-jitter** command to configure the **num-packets** *number-of-packets* and **interval** *interpacket-interval* values.

For all other IP SLAs operations, the following configuration guideline is recommended:

(**frequency** *seconds*) > (**timeout** *milliseconds*) > (**threshold** *milliseconds*)

> ✎
> **Note** We recommend that you do not set the frequency value to less than 60 seconds because the potential overhead from numerous active operations could significantly affect network performance.

The **frequency** (IP SLA) command is supported in IPv4 networks. This command is also supported in IPv6 networks when configuring an IP SLAs operation that supports IPv6 addresses.

IP SLAs Operation Configuration Dependence on Cisco IOS Release

The Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 7). You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

The configuration mode for the **frequency** (IP SLA) command varies depending on the Cisco IOS release you are running (see Table 7) and the operation type configured. For example, if you are running Cisco IOS Release 12.4 and the ICMP echo operation type is configured, you would enter the **frequency** (IP SLA) command in ICMP echo configuration mode (config-sla-monitor-echo) within IP SLA monitor configuration mode.

Table 7   Command Used to Begin Configuration of an IP SLAs Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(4)T, 12.0(32)SY, 12.2(33)SRB, 12.2(33)SB, 12.2(33)SXI , or later releases	**ip sla**	IP SLA configuration
12.3(14)T, 12.4, 12.4(2)T, 12.2(31)SB2, or 12.2(33)SXH	**ip sla monitor**	IP SLA monitor configuration

Examples   The following examples show how to configure an IP SLAs ICMP echo operation (operation 10) to repeat every 90 seconds. Note that the Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 7).

IP SLA Configuration

This example shows the **frequency** (IP SLA) command being used in an IPv4 network in ICMP echo configuration mode within IP SLA configuration mode:

```
ip sla 10
 icmp-echo 172.16.1.175
 frequency 90
!
ip sla schedule 10 life 300 start-time after 00:05:00
```

IP SLA Monitor Configuration

This example shows the frequency (IP SLA) command being used in an IPv4 network in ICMP echo configuration mode within IP SLA monitor configuration mode:

```
ip sla monitor 10
 type echo protocol ipIcmpEcho 172.16.1.175
 frequency 90
!
ip sla monitor schedule 10 life 300 start-time after 00:05:00
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

Command	Description
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
timeout (IP SLA)	Sets the amount of time the IP SLAs operation waits for a response from its request packet.

ftp get

To configure a Cisco IOS IP Service Level Agreements (SLAs) File Transfer Protocol (FTP) GET operation, use the **ftp get** command in IP SLA configuration mode.

ftp get *url* [**source-ip** {*ip-address* | *hostname*}] [**mode** {**passive** | **active**}

Syntax Description		
url	URL location information for the file to be retrieved.	
source-ip {*ip-address*	*hostname*}	(Optional) Specifies the source IP address or hostname. When a source IP address or hostname is not specified, IP SLAs chooses the IP address nearest to the destination.	
mode {**passive**	**active**}	(Optional) Specifies the FTP transfer mode as either passive or active. The default is passive transfer mode.	

Defaults   No IP SLAs operation type is configured for the operation being configured.

Command Modes   IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **type ftp operation get url** command.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **type ftp operation get url** command.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **type ftp operation get url** command.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **type ftp operation get url** command.

Usage Guidelines   The *url* argument must be in one of the following formats:

- ftp://username:password@host/filename
- ftp://host/filename

If the username and password are not specified, the defaults are anonymous and test, respectively.

You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples   In the following example, an FTP operation is configured. User1 is the username and password1 is the password; host1 is the host and file1 is the filename.

```
ip sla 3
 ftp get ftp://user1:password1@host1/file1
!
ip sla schedule 3 start-time now
```

Related Commands	Command	Description
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

history buckets-kept

To set the number of history buckets that are kept during the lifetime of a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history buckets-kept** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

history buckets-kept *size*

no history buckets-kept

Syntax Description	*size*	Number of history buckets kept during the lifetime of the operation. The default is 50.

Command Default   The default number of buckets kept is 50 buckets.

Command Modes   **IP SLA Configuration**

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Parameters Configuration

ICMP echo configuration (config-icmp-ech-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **buckets-of-history-kept** command.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **buckets-of-history-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SRC	The VCCV configuration mode was added.

Release	Modification
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **buckets-of-history-kept** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **buckets-of-history-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, TCP connect, and UDP echo configuration submodes in IP SLA template parameters configuration mode were added.

Usage Guidelines

Each time IP SLAs starts an operation, a new bucket is created until the number of history buckets matches the specified size or the lifetime of the operation expires. History buckets do not wrap.

To define the lifetime of an IP SLAs operation, use the **ip sla schedule** global configuration command. To define the lifetime of an auto IP SLAs operation template in Cisco IP SLAs Engine 3.0, use the **life** command in IP SLAs auto-measure schedule configuration mode.

Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

The **history buckets-kept** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

By default, the history for an IP SLAs operation is not collected. If history is collected, each bucket contains one or more history entries from the operation. When the operation type is Internet Control Message Protocol (ICMP) path echo, an entry is created for each hop along the path that the operation takes to reach its destination.

The type of entry stored in the history table is controlled by the **history filter** command.

The total number of entries stored in the history table is controlled by the combination of the **samples-of-history-kept**, **history buckets-kept**, and **history lives-kept** commands.

Note Collecting history increases the RAM usage. Collect history only if you think there is a problem in the network.

Examples

The following example shows how to configure an ICMP echo operation to keep 25 history buckets during the operation lifetime. The example shows the **history buckets-kept** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla schedule 1 start-time now life forever
ip sla 1
 icmp-echo 172.16.161.21
 history buckets-kept 25
```

```
 history lives-kept 1
!
ip sla schedule 1 start-time now life forever
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip icmp-echo 1
Router(config-tplt-icmp-ech)# parameters
Router(config-icmp-ech-params)# history buckets-kept 25
Router(config-icmp-ech-params)# end
Router# show ip sla auto template type ip icmp-echo 1
IP SLAs Auto Template: 1
    Measure Type: icmp-echo
.
.
.
Statistics Aggregation option:
        Hours of statistics kept: 5
    History options:
        History filter: none
        Max number of history records kept: 25
        Lives of history kept: 1
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

Related Commands	Command	Description
	history filter	Defines the type of information kept in the history table for the IP SLAs operation.
	history lives-kept	Sets the number of lives maintained in the history table for the IP SLAs operation.
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
	life	Specifies the lifetime characteristic in an auto IP SLAs scheduler
	samples-of-history-kept	Sets the number of entries kept in the history table per bucket.

history distributions-of-statistics-kept

To set the number of statistics distributions kept per hop during a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history distributions-of-statistics-kept** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

> **history distributions-of-statistics-kept** *size*

> **no history distributions-of-statistics-kept**

Syntax Description	*size*	Number of statistics distributions kept per hop. The default is 1.

Command Default The default is 1 distribution.

Command Modes **IP SLA Configuration**

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP jitter configuration (config-ip-sla-icmpjitter)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
UDP jitter configuration (config-ip-sla-jitter)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Parameters Configuration

ICMP echo configuration (config-icmp-ech-params)
ICMP jitter configuration (config-icmp-jtr-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)
UDP jitter configuration (config-udp-jtr-params)

Command History	Release	Modification
	12.4(4)T	This command was introduced. This command replaces the **distributions-of-statistics-kept** command.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.

Release	Modification
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **distributions-of-statistics-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SRC	The VCCV configuration mode was added.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **distributions-of-statistics-kept** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **distributions-of-statistics-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, ICMP jitter, TCP connect, UDP echo, and UDP jitter configuration submodes of IP SLA template parameters configuration mode were added.

Usage Guidelines

In most situations, you do not need to change the number of statistics distributions kept or the time interval for each distribution. Change these parameters only when distributions are needed, for example, when performing statistical modeling of your network.

Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

To set the statistics distributions interval, use the **history statistics-distribution-interval** command.

When the number of distributions reaches the size specified, no further distribution-based information is stored.

The **history distributions-of-statistics-kept** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

For the IP SLAs Internet Control Message Protocol (ICMP) path echo operation, the amount of router memory required to maintain the distribution statistics table is based on multiplying all of the values set by the following four commands:

• **history distributions-of-statistics-kept**

• **hops-of-statistics-kept**

• **paths-of-statistics-kept**

• **history hours-of-statistics-kept**

The general equation used to calculate the memory requirement to maintain the distribution statistics table for an ICMP path echo operation is as follows:
Memory allocation = (160 bytes) * (**history distributions-of-statistics-kept** *size*) * (**hops-of-statistics-kept** *size*) * (**paths-of-statistics-kept** *size*) * (**history hours-of-statistics-kept** *hours*)

Note To avoid significant impact on router memory, careful consideration should be used when configuring the **history distributions-of-statistics-kept**, **hops-of-statistics-kept**, **paths-of-statistics-kept**, and **history hours-of-statistics-kept** commands.

Examples In the following examples, the statistics distribution is set to five and the distribution interval is set to 10 ms for an ICMP echo operation. Consequently, the first distribution will contain statistics from 0 to 9 ms, the second distribution will contain statistics from 10 to 19 ms, the third distribution will contain statistics from 20 to 29 ms, the fourth distribution will contain statistics from 30 to 39 ms, and the fifth distribution will contain statistics from 40 ms to infinity. The examples show the **history distributions-of-statistics-kept** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla 1
 icmp-echo 172.16.161.21
 history distributions-of-statistics-kept 5
 history statistics-distribution-interval 10
!
ip sla schedule 1 life forever start-time now
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip icmp-echo 1
Router(config-tplt-icmp-ech)# parameters
Router(config-icmp-ech-params)# history distributions-of-statistics-kept 5
Router(config-icmp-ech-params)# history statistics-distribution-interval 10
Router(config-icmp-ech-params)# end
Router# show ip sla auto template type ip icmp-echo 1
IP SLAs Auto Template: 1
    Measure Type: icmp-echo (control enabled)
    Description:
.
.
.
Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 10
        Max number of distributions buckets: 5
```

Related Commands

Command	Description
history hours-of-statistics-kept	Sets the number of hours for which statistics are maintained for the IP SLAs operation.
history statistics-distribution-interval	Sets the time interval for each statistics distribution kept for the IP SLAs operation.
hops-of-statistics-kept	Sets the number of hops for which statistics are maintained per path for the IP SLAs operation.
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

Command	Description
ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
paths-of-statistics-kept	Sets the number of paths for which statistics are maintained per hour for the IP SLAs operation.

history enhanced

To enable enhanced history gathering for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history enhanced** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode.

history enhanced [**interval** *seconds*] [**buckets** *number-of-buckets*]

Syntax Description		
interval *seconds*		(Optional) Number of seconds (sec) that enhanced history should be gathered in each bucket. When this time expires, enhanced history statistics are gathered in a new bucket. The default is 900 (15 minutes).
buckets *number-of-buckets*		(Optional) Number of history buckets that should be retained in system memory. When this number is reached, statistic gathering for the operation ends. The default is 100.

Command Default   Enhanced history gathering is disabled.

Syntax Description

IP SLA Configuration

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
UDP jitter configuration (config-ip-sla-jitter)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Parameters Configuration

ICMP echo configuration (config-icmp-ech-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)
UDP jitter configuration (config-udp-jtr-params)

Command History	Release	Modification
	12.4(4)T	This command was introduced. This command replaces the **enhanced-history** command.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.

Release	Modification
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **enhanced-history** command. The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SRC	The VCCV configuration mode was added.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **enhanced-history** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **enhanced-history** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, TCP connect, UDP echo, and UDP jitter configuration submodes in IP SLA template parameters configuration mode were added.

Usage Guidelines   This command enables enhanced history for the IP SLAs operation.

Performance statistics are stored in buckets that separate the accumulated data. Each bucket consists of data accumulated over the specified time interval. When the interval expires, history statistics are gathered in a new bucket. When the specified number of buckets is reached, statistic gathering for the operation ends.

By default, IP SLAs maintains two hours of aggregated statistics for each operation. Value from each operation cycle is aggregated with the previously available data within a given hour. The Enhanced History feature in IP SLAs allows for the aggregation interval to be shorter than one hour.

The **history enhanced** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

Prior to Cisco IOS Release 12.4(24)T, you can configure this command for IP SLAs VoIP RTP operation but operations are unaffected.

In Cisco IOS Release 12.4(24)T and later releases, you cannot configure this command for IP SLAs VoIP RTP operations. If you attempt to configure this command in voip rtp configuration mode, the following message appears.

```
Router(config-ip-sla-voip-rtp)# history enhanced interval 1200 buckets 99
%enhanced-history cannot be set for this probe
```

Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

Examples   In the following examples, an Internet Control Message Protocol (ICMP) echo operation is configured with the standard enhanced history characteristics. The example shows the **history enhanced** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla 3
 icmp-echo 172.16.1.175
 history enhanced interval 900 buckets 100
!
ip sla schedule 3 start-time now life forever
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip icmp-echo 3
Router(config-tplt-icmp-ech)# parameters
Router(config-icmp-ech-params)# history enhanced interval 900 buckets 100
Router(config-icmp-ech-params)# end
Router# show ip sla auto template type ip icmp-echo
IP SLAs Auto Template: 3
    Measure Type: icmp-echo (control enabled)
.
.
.
Statistics Aggregation option:
        Hours of statistics kept: 2
        Enhanced aggregation interval: 900 seconds
        Max number of enhanced interval buckets: 100
    History options:
        History filter: none
        Max number of history records kept: 15
        Lives of history kept: 0
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
show ip sla auto summary-statistics	Displays the current operational status and statistics for IP SLAs auto-measure groups.
show ip sla auto template	Displays configuration including default values of auto IP SLAs operation templates.
show ip sla enhanced-history collection-statistics	Displays data for all collected history buckets for the specified IP SLAs operation, with data for each bucket shown individually.
show ip sla enhanced-history distribution-statistics	Displays enhanced history data for all collected buckets in a summary table.

history filter

To define the type of information kept in the history table for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history filter** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

history filter {**none** | **all** | **overThreshold** | **failures**}

no history filter {**none** | **all** | **overThreshold** | **failures**}

Syntax Description		
none		No history is kept. This is the default.
all		All operations attempted are kept in the history table.
overThreshold		Only packets that are over the threshold are kept in the history table.
failures		Only packets that fail for any reason are kept in the history table.

Command Default   No IP SLAs history is kept for an operation.

Command Modes   **IP SLA Configuration**

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Parameters Configuration

ICMP echo configuration (config-icmp-ech-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)

Command History	Release	Modification
	12.4(4)T	This command was introduced. This command replaces the **filter-for-history** command.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.

Release	Modification
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **filter-for-history** command. The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SRC	The VCCV configuration mode was added.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **filter-for-history** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **filter-for-history** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, TCP connect, and UDP echo configuration submodes in IP SLA template parameters configuration mode were added.

Usage Guidelines　　Use the **history filter** command to control what gets stored in the history table for an IP SLAs operation. To control how much history gets saved in the history table, use the **history lives-kept**, **history buckets-kept**, and the **samples-of-history-kept** commands.

The **history filter** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

For auto IP SLAs in Cisco IOS IP SLAs Engine 3.0—Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

An IP SLAs operation can collect history and capture statistics. By default, the history for an IP SLAs operation is not collected. When a problem arises where history is useful (for example, a large number of timeouts are occurring), use the **history lives-kept** command to enable history collection.

Note　　Collecting history increases the RAM usage. Collect history only when you think there is a problem in the network.

Examples　　In the following example, only operation packets that fail are kept in the history table. The example shows the **history filter** command being used in an IPv4 network.

IP SLA auto-Measure Template

```
ip sla auto template type ip icmp-echo
 icmp-echo 172.16.161.21
  history lives-kept 1
  history filter failures
!
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip icmp-echo 1
Router(config-tplt-icmp-ech)# parameters
Router(config-icmp-ech-params)# history filter failures
Router(config-icmp-ech-params)# end
Router# show ip sla auto template type ip icmp-echo
IP SLAs Auto Template: 1
    Measure Type: icmp-echo
.
.
.
Statistics Aggregation option:
        Hours of statistics kept: 2
    History options:
        History filter: failures
        Max number of history records kept: 15
        Lives of history kept: 0
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

	Command	Description
Related Commands	**history buckets-kept**	Sets the number of history buckets that are kept during the lifetime of the IP SLAs operation.
	history lives-kept	Sets the number of lives maintained in the history table for the IP SLAs operation.
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
	samples-of-history-kept	Sets the number of entries kept in the history table per bucket for the IP SLAs operation.

history hours-of-statistics-kept

To set the number of hours for which statistics are maintained for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history hours-of-statistics-kept** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

> **history hours-of-statistics-kept** *hours*

> **no history hours-of-statistics-kept**

Syntax Description

hours	Number of hours that statistics are maintained. The default is 2.

Command Default The default is 2 hours.

Command Modes

IP SLA Configuration

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP jitter configuration (config-ip-sla-icmpjitter)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
UDP jitter configuration (config-ip-sla-jitter)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Parameters Configuration

ICMP echo configuration (config-icmp-ech-params)
ICMP jitter configuration (config-icmp-jtr-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)
UDP jitter configuration (config-udp-jtr-params)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **hours-of-statistics-kept** command.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.

Release	Modification
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **hours-of-statistics-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SRC	The VCCV configuration mode was added.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **hours-of-statistics-kept** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **hours-of-statistics-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, ICMP jitter, TCP connect, UDP echo, and UDP jitter configuration submodes in IP SLA template parameters configuration mode were added.

Usage Guidelines   When the number of hours exceeds the specified value, the statistics table wraps (that is, the oldest information is replaced by newer information).

For the IP SLAs Internet Control Message Protocol (ICMP) path echo operation, the amount of router memory required to maintain the distribution statistics table is based on multiplying all of the values set by the following four commands:

- **history distributions-of-statistics-kept**
- **hops-of-statistics-kept**
- **paths-of-statistics-kept**
- **history hours-of-statistics-kept**

The general equation used to calculate the memory requirement to maintain the distribution statistics table for an ICMP path echo operation is as follows:
Memory allocation = (160 bytes) * (**history distributions-of-statistics-kept** *size*) * (**hops-of-statistics-kept** *size*) * (**paths-of-statistics-kept** *size*) * (**history hours-of-statistics-kept** *hours*)

✎
Note   To avoid significant impact on router memory, careful consideration should be used when configuring the **history distributions-of-statistics-kept**, **hops-of-statistics-kept**, **paths-of-statistics-kept**, and **history hours-of-statistics-kept** commands.

The **history hours-of-statistics-kept** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

For auto IP SLAs in Cisco IOS IP SLAs Engine 3.0—Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

Examples   The following examples shows how to maintain 3 hours of statistics for an ICMP echo operation. The example shows the **history hours-of-statistics-kept** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla 2
 icmp-echo 172.16.1.177
 history hours-of-statistics-kept 3
!
ip sla schedule 2 life forever start-time now
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip icmp-echo 2
Router(config-tplt-icmp-ech)# parameters
Router(config-icmp-ech-params)# history hours-of-statistics-kept 3
Router(config-icmp-ech-params)# end
Router# show ip sla auto template type ip icmp-echo
IP SLAs Auto Template: 2
    Measure Type: icmp-echo
.
.
.
Statistics Aggregation option:
        Hours of statistics kept: 3
    History options:
        History filter: none
        Max number of history records kept: 15
        Lives of history kept: 0
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

Related Commands

Command	Description
history distributions-of-statistics-kept	Sets the number of statistics distributions kept per hop during the lifetime of the IP SLAs operation.
history statistics-distribution-interval	Sets the time interval for each statistics distribution kept for the IP SLAs operation.
hops-of-statistics-kept	Sets the number of hops for which statistics are maintained per path for the IP SLAs operation.
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
paths-of-statistics-kept	Sets the number of paths for which statistics are maintained per hour for the IP SLAs operation.

history lives-kept

To set the number of lives maintained in the history table for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history lives-kept** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

> **history lives-kept** *lives*
>
> **no history lives-kept**

Syntax Description	*lives*	Number of lives maintained in the history table for the operation. If you specify 0 lives, history is not collected for the operation.

Command Default   The default is 0 lives.

Command Modes   **IP SLA Configuration**

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Configuration

ICMP echo configuration (config-icmp-ech-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)

Command History	Release	Modification
	12.4(4)T	This command was introduced. This command replaces the **lives-of-history-kept** command.
	12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
	12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **lives-of-history-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
	12.2(33)SRC	The VCCV configuration mode was added.

Release	Modification
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **lives-of-history-kept** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **lives-of-history-kept** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, TCP connect, and UDP echo configuration submodes in IP SLA template parameters configuration mode were added.

Usage Guidelines   The following rules apply to the **history lives-kept** command:

- The number of lives you can specify is dependent on the type of operation you are configuring.

- The default value of 0 lives means that history is not collected for the operation.

- When the number of lives exceeds the specified value, the history table wraps (that is, the oldest information is replaced by newer information).

- When an operation makes a transition from a pending to active state, a life starts. When the life of an operation ends, the operation makes a transition from an active to pending state.

The **history lives-kept** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

To disable history collection, use the **no history lives-kept** command rather than the **history filter none** command. The **no history lives-kept** command disables history collection before an IP SLAs operation is attempted. The **history filter** command checks for history inclusion after the operation attempt is made.

Examples   The following example shows how to maintain the history for five lives of an ICMP echo operation. The example shows the **history lives-kept** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla 1
 icmp-echo 172.16.1.176
 history lives-kept 5
!
ip sla schedule 1 life forever start-time now
```

IP SLA Template Parameters Configuration

```
Router(config)# ip sla auto template type ip icmp-echo 1
Router(config-tplt-icmp-ech)# parameters
Router(config-icmp-ech-params)# history lives-kept 5
```

```
Router(config-icmp-ech-params)# end
Router# show ip sla auto template type ip icmp-echo
IP SLAs Auto Template: 1
    Measure Type: icmp-echo
.
.
.
Statistics Aggregation option:
        Hours of statistics kept: 2
    History options:
        History filter: none
        Max number of history records kept: 15
        Lives of history kept: 5
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 20
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

Related Commands	Command	Description
	history buckets-kept	Sets the number of history buckets that are kept during the lifetime of the IP SLAs operation.
	history filter	Defines the type of information kept in the history table for the IP SLAs operation.
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
	samples-of-history-kept	Sets the number of entries kept in the history table per bucket for the IP SLAs operation.

history statistics-distribution-interval

To set the time interval for each statistics distribution kept for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **history statistics-distribution-interval** command in the appropriate submode of IP SLA configuration or IP SLA template parameters configuration mode. To return to the default value, use the **no** form of this command.

> **history statistics-distribution-interval** *milliseconds*

> **no history statistics-distribution-interval**

Syntax Description

milliseconds	Number of milliseconds (ms) used for each statistics distribution kept. The default is 20.

Command Default The default interval used for each statistics kept is 20 ms.

Command Modes **IP SLA Configuration**

DHCP configuration (config-ip-sla-dhcp)
DLSw configuration (config-ip-sla-dlsw)
DNS configuration (config-ip-sla-dns)
Ethernet echo (config-ip-sla-ethernet-echo)
Ethernet jitter (config-ip-sla-ethernet-jitter)
FTP configuration (config-ip-sla-ftp)
HTTP configuration (config-ip-sla-http)
ICMP echo configuration (config-ip-sla-echo)
ICMP jitter configuration (config-ip-sla-icmpjitter)
ICMP path echo configuration (config-ip-sla-pathEcho)
ICMP path jitter configuration (config-ip-sla-pathJitter)
TCP connect configuration (config-ip-sla-tcp)
UDP echo configuration (config-ip-sla-udp)
UDP jitter configuration (config-ip-sla-jitter)
VCCV configuration (config-sla-vccv)
VoIP configuration (config-ip-sla-voip)

IP SLA Template Parameters Configuration

ICMP echo configuration (config-icmp-ech-params)
ICMP jitter configuration (config-icmp-jtr-params)
TCP connect configuration (config-tcp-conn-params)
UDP echo configuration (config-udp-ech-params)
UDP jitter configuration (config-udp-jtr-params)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **statistics-distribution-interval** command.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.

Release	Modification
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **statistics-distribution-interval** command. The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SRC	The VCCV configuration mode was added.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **statistics-distribution-interval** command. The following configuration modes were added: • Ethernet echo • Ethernet jitter • VCCV
12.4(20)T	The Ethernet echo and Ethernet jitter configuration modes were added.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **statistics-distribution-interval** command. The Ethernet echo and Ethernet jitter configuration modes were added.
15.1(1)T	This command was modified. The ICMP echo, ICMP jitter, TCP connect, UDP echo, and UDP jitter configuration submodes in IP SLA template parameters configuration mode were added.

Usage Guidelines

In most situations, you do not need to change the time interval for each statistics distribution or number of distributions kept. Only change these parameters when distributions are needed, for example, when performing statistical modeling of your network.

To set the number of statistics distributions kept, use the **history statistics-distribution-interval** command.

The **history statistics-distribution-interval** command is supported in IPv4 networks. This command is also supported in IPv6 networks to configure an IP SLAs operation that supports IPv6 addresses.

Before you can use this command to configure auto IP SLAs operation templates, you must enter the **parameters** command in IP SLA template configuration mode.

Examples

In the following examples, the statistics distribution is set to five and the distribution interval is set to 10 ms for an IP SLAs operation. Consequently, the first distribution will contain statistics from 0 to 9 ms, the second distribution will contain statistics from 10 to 19 ms, the third distribution will contain statistics from 20 to 29 ms, the fourth distribution will contain statistics from 30 to 39 ms, and the fifth distribution will contain statistics from 40 ms to infinity.

The example shows the **history statistics-distribution-interval** command being used in an IPv4 network.

IP SLA Configuration

```
ip sla 1
 icmp-echo 172.16.161.21
 history distributions-of-statistics-kept 5
 history statistics-distribution-interval 10
!
ip sla schedule 1 life forever start-time now
```

IP SLA Template Parameters Configuration

```
Router(config)#ip sla auto template type ip icmp-echo 3
Router(config-tplt-icmp-ech)#parameters
Router(config-icmp-ech-params)#history enhanced interval 900 buckets 100
Router(config-icmp-ech-params)#end
Router# show ip sla auto template type ip udp-echo
R1#show ip sla auto template type ip icmp-echo 5
IP SLAs Auto Template: 5
    Measure Type: icmp-echo
.
.
.
History options:
        History filter: none
        Max number of history records kept: 15
        Lives of history kept: 0
    Statistics Distributions options:
        Distributions characteristics: RTT
        Distributions bucket size: 10
        Max number of distributions buckets: 1
    Reaction Configuration: None
```

	Command	Description
Related Commands	**history distributions-of-statistics-kept**	Sets the number of statistics distributions kept per hop during the IP SLAs operation's lifetime.
	history hours-of-statistics-kept	Sets the number of hours for which statistics are maintained for the IP SLAs operation.
	hops-of-statistics-kept	Sets the number of hops for which statistics are maintained per path for the IP SLAs operation.
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla auto template	Begins configuration for an auto IP SLAs operation template and enters IP SLA template configuration mode.
	paths-of-statistics-kept	Sets the number of paths for which statistics are maintained per hour for the IP SLAs operation.

hops-of-statistics-kept

To set the number of hops for which statistics are maintained per path for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **hops-of-statistics-kept** command in the appropriate submode of IP SLA configuration or IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

hops-of-statistics-kept *size*

no hops-of-statistics-kept

Syntax Description		
size	Number of hops for which statistics are maintained per path. The default is 16.	

Defaults   16 hops

Command Modes   **IP SLA Configuration**

ICMP path echo configuration (config-ip-sla-pathEcho)

IP SLA Monitor Configuration

ICMP path echo configuration (config-sla-monitor-pathEcho)

Note   The configuration mode varies depending on the Cisco IOS release you are running and the operation type configured. See the "Usage Guidelines" section for more information.

Command History

Release	Modification
11.2	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines   When the number of hops reaches the size specified, no further hop-based information is stored.

Note   This command is supported by the IP SLAs Internet Control Message Protocol (ICMP) path echo operation only.

For the IP SLAs ICMP path echo operation, the amount of router memory required to maintain the distribution statistics table is based on multiplying all of the values set by the following four commands:

- **distributions-of-statistics-kept**

- **hops-of-statistics-kept**
- **paths-of-statistics-kept**
- **hours-of-statistics-kept**

The general equation used to calculate the memory requirement to maintain the distribution statistics table for an ICMP path echo operation is as follows:
Memory allocation = (160 bytes) * (**distributions-of-statistics-kept** *size*) * (**hops-of-statistics-kept** *size*) * (**paths-of-statistics-kept** *size*) * (**hours-of-statistics-kept** *hours*)

Note To avoid significant impact on router memory, careful consideration should be used when configuring the **distributions-of-statistics-kept**, **hops-of-statistics-kept**, **paths-of-statistics-kept**, and **hours-of-statistics-kept** commands.

IP SLAs Operation Configuration Dependence on Cisco IOS Release

The Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 8). You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

The configuration mode for the **hops-of-statistics-kept** command varies depending on the Cisco IOS release you are running (see Table 8) and the operation type configured. For example, if you are running Cisco IOS Release 12.4 and the ICMP path echo operation type is configured, you would enter the **hops-of-statistics-kept** command in ICMP path echo configuration mode (config-sla-monitor-pathEcho) within IP SLA monitor configuration mode.

Table 8 Command Used to Begin Configuration of an IP SLAs Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(4)T, 12.0(32)SY, 12.2(33)SRB, 12.2(33)SB, 12.2(33)SXI , or later releases	**ip sla**	IP SLA configuration
12.3(14)T, 12.4, 12.4(2)T, 12.2(31)SB2, or 12.2(33)SXH	**ip sla monitor**	IP SLA monitor configuration

Examples The following examples show how to monitor the statistics of IP SLAs ICMP path echo operation 2 for ten hops only. Note that the Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 8).

IP SLA Configuration

```
ip sla 2
 path-echo 172.16.1.177
 hops-of-statistics-kept 10
!
ip sla schedule 2 life forever start-time now
```

IP SLA Monitor Configuration

```
ip sla monitor 2
 type pathecho protocol ipIcmpEcho 172.16.1.177
 hops-of-statistics-kept 10
```

```
!
ip sla monitor schedule 2 life forever start-time now
```

Related Commands	Command	Description
	distributions-of-statistics-kept	Sets the number of statistics distributions kept per hop during the lifetime of the IP SLAs operation.
	hours-of-statistics-kept	Sets the number of hours for which statistics are maintained for the IP SLAs operation.
	ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
	ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
	paths-of-statistics-kept	Sets the number of paths for which statistics are maintained per hour for the IP SLAs operation.
	statistics-distribution-interval	Sets the time interval for each statistics distribution kept for the IP SLAs operation.

hours-of-statistics-kept

Note Effective with Cisco IOS Release 12.4(4)T, 12.2(33)SRB, 12.2(33)SB, and 12.2(33)SXI, the **hours-of-statistics-kept** command is replaced by the **history hours-of-statistics-kept** command. See the **history hours-of-statistics-kept** command for more information.

To set the number of hours for which statistics are maintained for a Cisco IOS IP Service Level Agreements (SLAs) operation, use the **hours-of-statistics-kept** command in the appropriate submode of IP SLA monitor configuration mode. To return to the default value, use the **no** form of this command.

hours-of-statistics-kept *hours*

no hours-of-statistics-kept

Syntax Description

hours	Number of hours that statistics are maintained. The default is 2.

Defaults 2 hours

Command Modes DHCP configuration (config-sla-monitor-dhcp)
DLSw configuration (config-sla-monitor-dlsw)
DNS configuration (config-sla-monitor-dns)
FTP configuration (config-sla-monitor-ftp)
HTTP configuration (config-sla-monitor-http)
ICMP echo configuration (config-sla-monitor-echo)
ICMP path echo configuration (config-sla-monitor-pathEcho)
ICMP path jitter configuration (config-sla-monitor-pathJitter)
TCP connect configuration (config-sla-monitor-tcp)
UDP echo configuration (config-sla-monitor-udp)
UDP jitter configuration (config-sla-monitor-jitter)
VoIP configuration (config-sla-monitor-voip)

Command History

Release	Modification
11.2	This command was introduced.
12.4(4)T	This command was replaced by the **history hours-of-statistics-kept** command.
12.2(33)SRB	This command was replaced by the **history hours-of-statistics-kept** command.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Release	Modification
12.2(33)SB	This command was replaced by the **history hours-of-statistics-kept** command.
12.2(33)SXI	This command was replaced by the **history hours-of-statistics-kept** command.

Usage Guidelines   When the number of hours exceeds the specified value, the statistics table wraps (that is, the oldest information is replaced by newer information).

For the IP SLAs Internet Control Message Protocol (ICMP) path echo operation, the amount of router memory required to maintain the distribution statistics table is based on multiplying all of the values set by the following four commands:

- **distributions-of-statistics-kept**
- **hops-of-statistics-kept**
- **paths-of-statistics-kept**
- **hours-of-statistics-kept**

The general equation used to calculate the memory requirement to maintain the distribution statistics table for an ICMP path echo operation is as follows:
Memory allocation = (160 bytes) * (**distributions-of-statistics-kept** *size*) * (**hops-of-statistics-kept** *size*) * (**paths-of-statistics-kept** *size*) * (**hours-of-statistics-kept** *hours*)

Note   To avoid significant impact on router memory, careful consideration should be used when configuring the **distributions-of-statistics-kept**, **hops-of-statistics-kept**, **paths-of-statistics-kept**, and **hours-of-statistics-kept** commands.

Note   You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

Examples   The following example shows how to maintain 3 hours of statistics for IP SLAs ICMP path echo operation 2.

```
ip sla monitor 2
 type pathecho protocol ipIcmpEcho 172.16.1.177
 hours-of-statistics-kept 3
!
ip sla monitor schedule 2 life forever start-time now
```

Related Commands

Command	Description
distributions-of-statistics-kept	Sets the number of statistics distributions kept per hop during the lifetime of the IP SLAs operation.
hops-of-statistics-kept	Sets the number of hops for which statistics are maintained per path for the IP SLAs operation.

Command	Description
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
paths-of-statistics-kept	Sets the number of paths for which statistics are maintained per hour for the IP SLAs operation.
statistics-distribution-interval	Sets the time interval for each statistics distribution kept for the IP SLAs operation.

hours-of-statistics-kept (LSP discovery)

To set the number of hours for which label switched path (LSP) discovery group statistics are maintained for a Cisco IOS IP Service Level Agreements (SLAs) LSP Health Monitor operation, use the **hours-of-statistics-kept** command in auto IP SLA MPLS LSP discovery parameters configuration mode. To return to the default value, use the **no** form of this command.

hours-of-statistics-kept *hours*

no hours-of-statistics-kept

Syntax Description	*hours*	Number of hours that statistics are maintained. The default is 2.

Command Default   2 hours

Command Modes   Auto IP SLA MPLS LSP discovery parameters configuration (config-auto-ip-sla-mpls-lpd-params)

Command History

Release	Modification
12.2(31)SB2	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines   The LSP discovery group statistics are distributed in one-hour increments. Since the number of LSP discovery groups for a single LSP Health Monitor operation can be significantly large, the collection of group statistics is restricted to a maximum of 2 hours. If the *number* argument is set to zero, no LSP discovery group statistics are maintained.

Use the **path-discover** command to enable the LSP discovery option for an IP SLAs LSP Health Monitor operation and enter auto IP SLA MPLS LSP discovery parameters configuration mode.

Examples   The following example shows how to configure operation parameters, proactive threshold monitoring, and scheduling options using the LSP Health Monitor. In this example, the LSP discovery option is enabled for LSP Health Monitor operation 1. Operation 1 is configured to automatically create IP SLAs LSP ping operations for the equal-cost multipaths to all Border Gateway Protocol (BGP) next hop neighbors in use by all VPN routing and forwarding (VRF) instances associated with the source Provider Edge (PE) router. LSP discovery group statistics are collected every 1 hour.

```
auto ip sla mpls-lsp-monitor 1
 type echo ipsla-vrf-all
 path-discover
!
 maximum-sessions 2
 session-timeout 60
 interval 2
 timeout 4
 force-explicit-null
 hours-of-statistics-kept 1
```

```
 scan-period 30
!
auto ip sla mpls-lsp-monitor schedule 1 schedule-period 60 frequency 100 start-time now
!
auto ip sla mpls-lsp-monitor reaction-configuration 1 react lpd tree-trace action-type
trapOnly
auto ip sla mpls-lsp-monitor reaction-configuration 1 react lpd lpd-group retry 3
action-type trapOnly
```

Related Commands	Command	Description
	auto ip sla mpls-lsp-monitor	Begins configuration for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS configuration mode.
	path-discover	Enables the LSP discovery option for an IP SLAs LSP Health Monitor operation and enters auto IP SLA MPLS LSP discovery parameters configuration mode.

http (IP SLA)

To configure a Cisco IOS IP Service Level Agreements (SLAs) HTTP operation, use the **http** command in IP SLA configuration mode.

> **http** {**get** | **raw**} *url* [**name-server** *ip-address*] [**version** *version-number*] [**source-ip** {*ip-address* | *hostname*}] [**source-port** *port-number*] [**cache** {**enable** | **disable**}] [**proxy** *proxy-url*]

Syntax Description

get	Specifies an HTTP GET operation.
raw	Specifies an HTTP RAW operation.
url	URL of destination HTTP server.
name-server *ip-address*	(Optional) Specifies the destination IP address of a Domain Name System (DNS) Server.
version *version-number*	(Optional) Specifies the version number.
source-ip {*ip-address*	*hostname*}	(Optional) Specifies the source IP address or hostname. When a source IP address or hostname is not specified, IP SLAs chooses the IP address nearest to the destination.
source-port *port-number*	(Optional) Specifies the source port number. When a port number is not specified, IP SLAs chooses an available port.
cache {**enable**	**disable**}	(Optional) Enables or disables download of a cached HTTP page.
proxy *proxy-url*	(Optional) Specifies proxy information or URL.

Defaults

No IP SLAs operation type is configured for the operation being configured.

Command Modes

IP SLA configuration (config-ip-sla)

Command History

Release	Modification
12.4(4)T	This command was introduced. This command replaces the **type http operation** command.
12.0(32)SY	This command was integrated into Cisco IOS Release 12.0(32)SY.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB. This command replaces the **type http operation** command.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB. This command replaces the **type http operation** command.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI. This command replaces the **type http operation** command.

Usage Guidelines   You must configure the type of IP SLAs operation, such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo, before you can configure any of the other parameters of the operation. To change the operation type of an existing IP SLAs operation, you must first delete the IP SLAs operation (using the **no ip sla** global configuration command) and then reconfigure the operation with the new operation type.

Examples   In the following example, IP SLAs HTTP operation 6 is configured as an HTTP RAW operation. The destination URL is http://www.cisco.com.

```
ip sla 6
 http raw http://www.cisco.com
 http-raw-request
 GET /index.html HTTP/1.0\r\n
 \r\n
!
ip sla schedule 6 start-time now
```

Related Commands

Command	Description
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.

http-raw-request

To explicitly specify the options for a GET request for a Cisco IOS IP Service Level Agreements (SLAs) Hypertext Transfer Protocol (HTTP) operation, use the **http-raw-request** command in the appropriate submode of IP SLA configuration or IP SLA monitor configuration mode.

> **http-raw-request**

Syntax Description   This command has no arguments or keywords.

Defaults   No options are specified for a GET request.

Command Modes   **IP SLA Configuration**

HTTP configuration (config-ip-sla-http)

IP SLA Monitor Configuration

HTTP configuration (config-sla-monitor-http)

Note   The configuration mode varies depending on the Cisco IOS release you are running and the operation type configured. See the "Usage Guidelines" section for more information.

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines   Use the **http-raw-request** command to explicitly specify the content of an HTTP request. Use HTTP version 1.0 commands after entering the **http-raw-request** command.

IP SLAs will specify the content of an HTTP request if you use the **type http operation get** command. IP SLAs will send the HTTP request, receive the reply, and report round-trip time (RTT) statistics (including the size of the page returned).

IP SLAs Operation Configuration Dependence on Cisco IOS Release

The Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 9). You must configure the type of IP SLAs operation (such as User Datagram Protocol [UDP] jitter or Internet Control Message Protocol [ICMP] echo) before you can configure any of the other parameters of the operation.

The configuration mode for the **http-raw-request** command varies depending on the Cisco IOS release you are running (see Table 9) and the operation type configured. For example, if you are running Cisco IOS Release 12.4 and the HTTP operation type is configured, you would enter the **http-raw-request** command in HTTP configuration mode (config-sla-monitor-http) within IP SLA monitor configuration mode.

Table 9   Command Used to Begin Configuration of an IP SLAs Operation Based on Cisco IOS Release

Cisco IOS Release	Global Configuration Command	Command Mode Entered
12.4(4)T, 12.0(32)SY, 12.2(33)SRB, 12.2(33)SB, 12.2(33)SXI , or later releases	**ip sla**	IP SLA configuration
12.3(14)T, 12.4, 12.4(2)T, 12.2(31)SB2, or 12.2(33)SXH	**ip sla monitor**	IP SLA monitor configuration

Examples

In the following examples, IP SLAs operation 6 is created and configured as an HTTP operation. The HTTP **GET** command is explicitly specified. Note that the Cisco IOS command used to begin configuration for an IP SLAs operation varies depending on the Cisco IOS release you are running (see Table 9).

IP SLA Configuration

```
ip sla 6
 http raw http://www.cisco.com
 http-raw-request
 GET /index.html HTTP/1.0\r\n
 \r\n
!
ip sla schedule 6 start-time now
```

IP SLA Monitor Configuration

```
ip sla monitor 6
 type http operation raw url http://www.cisco.com
 http-raw-request
 GET /index.html HTTP/1.0\r\n
 \r\n
!
ip sla monitor schedule 6 start-time now
```

Related Commands

Command	Description
http (IP SLA)	Configures an HTTP IP SLAs operation in IP SLA configuration mode.
ip sla	Begins configuration for an IP SLAs operation and enters IP SLA configuration mode.
ip sla monitor	Begins configuration for an IP SLAs operation and enters IP SLA monitor configuration mode.
type http operation	Configures an HTTP IP SLAs operation in IP SLA monitor configuration mode.