



Configuring an IP SLAs Multioperation Scheduler

This document describes how to schedule multiple operations at once using the IP Service Level Agreements (SLAs) Multioperations Scheduler feature.

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Prerequisites for an IP SLAs Multioperation Scheduler

- Configure the IP SLAs operations to be included in a group before scheduling the group.
- Determine the IP SLAs operations you want to schedule as a single group.
- Identify the network traffic type and the location of your network management station.
- Identify the topology and the types of devices in your network.
- Decide on the frequency of testing for each operation.

Information About an IP SLAs Multioperation Scheduler

IP SLAs Multioperations Scheduler

Normal scheduling of IP SLAs operations allows you to schedule one operation at a time. If you have large networks with thousands of IP SLAs operations to monitor network performance, normal scheduling (scheduling each operation individually) will be inefficient and time-consuming.

Multiple operations scheduling allows you to schedule multiple IP SLAs operations using a single command through the command line interface (CLI) or the CISCO-RTTMON-MIB. This feature allows you to control the amount of IP SLAs monitoring traffic by scheduling the operations to run at evenly distributed times. You must specify the operation ID numbers to be scheduled and the time range over which all the IP SLAs operations should start. This feature automatically distributes the IP SLAs operations at equal intervals over a specified time frame. The spacing between the operations (start interval) is calculated and the operations are started.

This distribution of IP SLAs operations helps minimize the CPU utilization and thereby enhances the scalability of the network.

The IP SLAs multiple operations scheduling functionality allows you to schedule multiple IP SLAs operations as a group, using the following configuration parameters:

- Group operation number--Group configuration or group schedule number of the IP SLAs operation to be scheduled.
- Operation ID numbers--A list of IP SLAs operation ID numbers in the scheduled operation group.
- Schedule period--Amount of time for which the IP SLAs operation group is scheduled.
- Ageout--Amount of time to keep the operation in memory when it is not actively collecting information. By default, the operation remains in memory indefinitely.
- Frequency--Amount of time after which each IP SLAs operation is restarted. When the frequency option is specified, it overwrites the operation frequency of all operations belonging to the group. Note that when the frequency option is not specified, the frequency for each operation is set to the value of the schedule period.
- Life--Amount of time the operation actively collects information. The operation can be configured to run indefinitely. By default, the lifetime of an operation is one hour.
- Start time--Time when the operation starts collecting information. You can specify an operation to start immediately or at an absolute start time using hours, minutes, seconds, day, and month.

The IP SLAs multiple operations scheduling functionality schedules the maximum number of operations possible without terminating. However, this functionality skips those IP SLAs operations that are already running or those that are not configured and hence do not exist. The total number of operations will be calculated based on the number of operations specified in the command, irrespective of the number of operations that are missing or already running. The IP SLAs multiple operations scheduling functionality displays a message showing the number of active and missing operations. However, these messages are displayed only if you schedule operations that are not configured or are already running.

A main benefit for scheduling multiple IP SLAs operations is that the load on the network is reduced by distributing the operations equally over a scheduled period. This distribution helps you to achieve more consistent monitoring coverage. To illustrate this scenario, consider configuring 60 operations to start during the same 1-second interval over a 60-second schedule period. If a network failure occurs 30 seconds after all 60 operations have started and the network is restored before the operations are due to start again (in another 30 seconds), then this failure would never be detected by any of the 60 operations. However, if the 60 operations are distributed equally at 1-second intervals over a 60-second schedule period, then some of the operations would detect the network failure. Conversely, if a network failure occurs when all 60 operations are active, then all 60 operations would fail, indicating that the failure is possibly more severe than it really is.

Operations of the same type and same frequency should be used for IP SLAs multiple operations scheduling. If you do not specify a frequency, the default frequency will be the same as that of the schedule period. The schedule period is the period of time in which all the specified operations should run.

The following sections focus on the interaction of the schedule period and frequency values, additional values, such as start time and lifetime values, are not included in the illustrations.

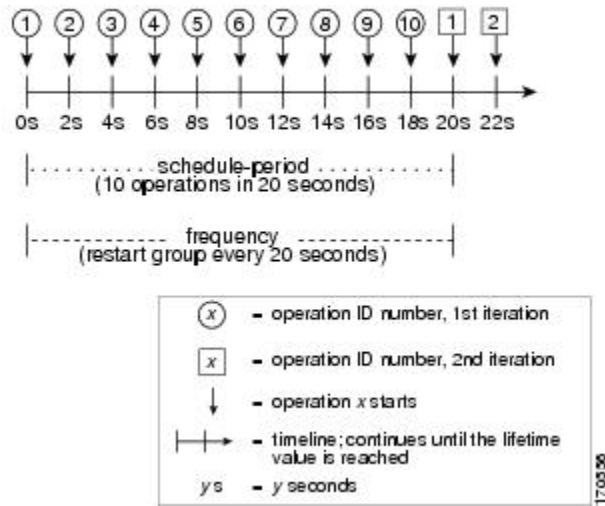
Default Behavior of IP SLAs Multiple Operations Scheduling

The IP SLAs Multiple Operations Scheduling feature allows you to schedule multiple IP SLAs operations as a group.

The figure below illustrates the scheduling of operation group 1 that includes operation 1 to operation 10. Operation group 1 has a schedule period of 20 seconds, which means that all operations in the group will be started at equal intervals within a 20-second period. By default, the frequency is set to the same value as the configured schedule period. As shown in the figure below, configuring the frequency is optional because 20 is the default.

Figure 1: Schedule Period Equals Frequency--Default Behavior

ip sla group schedule 1 1-10 schedule-period 20 [frequency 20]



In this example, the first operation (operation 1) in operation group 1 will start at 0 seconds. All 10 operations in operation group 1 (operation 1 to operation 10) must be started in the schedule period of 20 seconds. The start time of each IP SLAs operation is evenly distributed over the schedule period by dividing the schedule period by the number of operations (20 seconds divided by 10 operations). Therefore, each operation will start 2 seconds after the previous operation.

The frequency is the period of time that passes before the operation group is started again (repeated). If the frequency is not specified, the frequency is set to the value of the schedule period. In the example shown above, operation group 1 will start again every 20 seconds. This configuration provides optimal division (spacing) of operations over the specified schedule period.

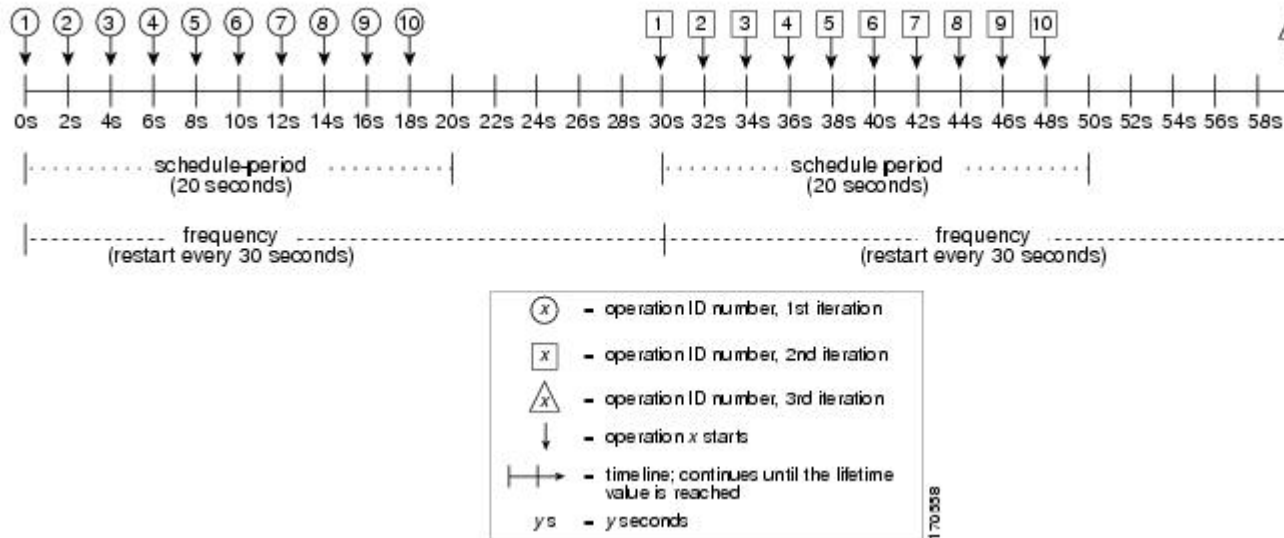
IP SLAs Multiple Operations Scheduling with Scheduling Period Less Than Frequency

The frequency value is the amount of time that passes before the schedule group is restarted, if the schedule period is less than the frequency, there will be a period of time in which no operations are started.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 2. Operation group 2 has a schedule period of 20 seconds and a frequency of 30 seconds.

Figure 2: Schedule Period Is Less Than Frequency

```
ip sla group schedule 2 1-10 schedule-period 20 frequency 30
```



In this example, the first operation (operation 1) in operation group 2 will start at 0 seconds. All 10 operations in operation group 2 (operation 1 to operation 10) must be started in the schedule period of 20 seconds. The start time of each IP SLAs operation is evenly distributed over the schedule period by dividing the schedule period by the number of operations (20 seconds divided by 10 operations). Therefore, each operation will start 2 seconds after the previous operation.

In the first iteration of operation group 2, operation 1 starts at 0 seconds, and the last operation (operation 10) starts at 18 seconds. However, because the group frequency has been configured to 30 seconds each operation in the operation group is restarted every 30 seconds. So, after 18 seconds, there is a gap of 10 seconds as no operations are started in the time from 19 seconds to 29 seconds. Hence, at 30 seconds, the second iteration of operation group 2 starts. As all ten operations in the operation group 2 must start at an evenly distributed interval in the configured schedule period of 20 seconds, the last operation (operation 10) in the operation group 2 will always start 18 seconds after the first operation (operation 1).

As illustrated in the figure above, the following events occur:

- At 0 seconds, the first operation (operation 1) in operation group 2 is started.
- At 18 seconds, the last operation (operation 10) in operation group 2 is started. This means that the first iteration (schedule period) of operation group 1 ends here.
- From 19 to 29 seconds, no operations are started.
- At 30 seconds, the first operation (operation 1) in operation group 2 is started again. The second iteration of operation group 2 starts here.
- At 48 seconds (18 seconds after the second iteration started) the last operation (operation 10) in operation group 2 is started, and the second iteration of operation group 2 ends.
- At 60 seconds, the third iteration of operation group 2 starts.

This process continues until the lifetime of operation group 2 ends. The lifetime value is configurable. The default lifetime for an operation group is forever.

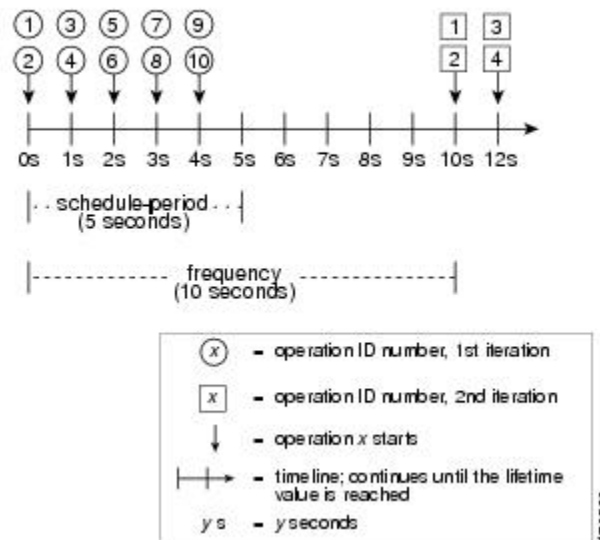
Multiple Operations Scheduling When the Number of IP SLAs Operations Are Greater Than the Schedule Period

The minimum time interval between the start of IP SLAs operations in a group operation is 1 second. Therefore, if the number of operations to be multiple scheduled is greater than the schedule period, the IP SLAs multiple operations scheduling functionality will schedule more than one operation to start within the same 1-second interval. If the number of operations getting scheduled does not equally divide into 1-second intervals, then the operations are equally divided at the start of the schedule period with the remaining operations to start at the last 1-second interval.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 3. Operation group 3 has a schedule period of 5 seconds and a frequency of 10 seconds.

Figure 3: Number of IP SLAs Operations Is Greater Than the Schedule Period--Even Distribution

ip sla group schedule 3 1-10 schedule-period 5 frequency 10



In this example, when dividing the schedule period by the number of operations (5 seconds divided by 10 operations, which equals one operation every 0.5 seconds) the start time of each IP SLAs operation is less than 1 second. Since the minimum time interval between the start of IP SLAs operations in a group operation is 1 second, the IP SLAs multiple operations scheduling functionality instead calculates how many operations it should start in each 1-second interval by dividing the number of operations by the schedule period (10 operations divided by 5 seconds). Therefore, as shown in the figure above, two operations will be started every 1 second.

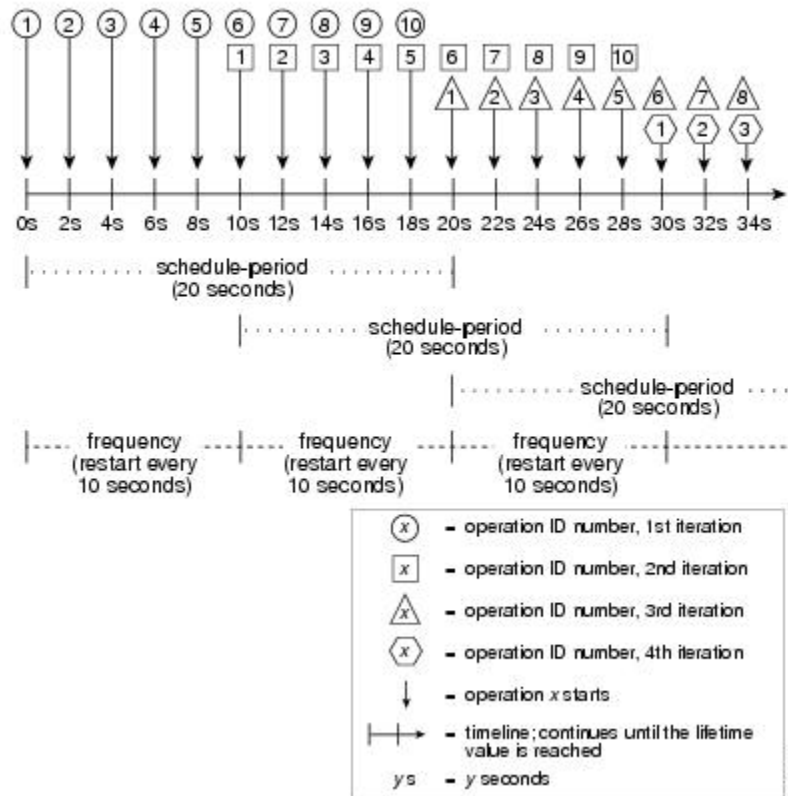
As the frequency is set to 10 in this example, each iteration of operation group 3 will start 10 seconds after the start of the previous iteration. However, this distribution is not optimal as there is a gap of 5 seconds (frequency minus schedule period) between the cycles.

If the number of operations getting scheduled does not equally divide into 1-second intervals, then the operations are equally divided at the start of the schedule period with the remaining operations to start at the last 1-second interval.

The figure below illustrates the scheduling of operation 1 to operation 10 within operation group 4. Operation group 4 has a schedule period of 4 seconds and a frequency of 5 seconds.

Figure 5: IP SLAs Group Scheduling with Schedule Period Greater Than Frequency

ip sla group schedule 5 1-10 schedule-period 20 frequency 10



In this example, the first operation (operation 1) in operation group 5 will start at 0 seconds. All 10 operations in operation group 5 (operation 1 to operation 10) must be started in the schedule period of 20 seconds. The start time of each IP SLAs operation is evenly distributed over the schedule period by dividing the schedule period by the number of operations (20 seconds divided by 10 operations). Therefore, each operation will start 2 seconds after the previous operation.

In the first iteration of operation group 5, operation 1 starts at 0 seconds, and operation 10, the last operation in the operation group, starts at 18 seconds. Because the operation group is configured to restart every 10 seconds (**frequency 10**), the second iteration of operation group 5 starts again at 10 seconds, before the first iteration is completed. Therefore, an overlap of operations 6 to 10 of the first iteration occurs with operations 1 to 5 of the second iteration during the time period of 10 to 18 seconds (see the figure above). Similarly, there is an overlap of operations 6 to 10 of the second iteration with operations 1 to 5 of the third iteration during the time period of 20 to 28 seconds.

In this example, the start time of operation 1 and operation 6 need not be at exactly the same time, but will be within the same 2-second interval.

The configuration described in this section is not recommended as you can configure multiple operations to start within the same 1-second interval by configuring the number of operations greater than the schedule period. For information, see the "Multiple Operations Scheduling When the Number of IP SLAs Operations Are Greater Than the Schedule Period" section.

IP SLAs Random Scheduler

The IP SLAs Random Scheduler feature is an enhancement to the existing IP SLAs Multioperation Scheduling feature. The IP SLAs Multioperation Scheduling feature provides the capability to easily schedule multiple IP SLAs operations to begin at intervals equally distributed over a specified duration of time and to restart at a specified frequency. With the IP SLAs Random Scheduler feature, you can now schedule multiple IP SLAs operations to begin at random intervals uniformly distributed over a specified duration of time and to restart at uniformly distributed random frequencies within a specified frequency range. Random scheduling improves the statistical metrics for assessing network performance.



Note The IP SLAs Random Scheduler feature is not in compliance with RFC2330 because it does not account for inter-packet randomness.

The IP SLAs random scheduler option is disabled by default. To enable the random scheduler option, you must set a frequency range when configuring a group schedule in global configuration mode. The group of operations restarts at uniformly distributed random frequencies within the specified frequency range. The following guidelines apply for setting the frequency range:

- The starting value of the frequency range should be greater than the timeout values of all the operations in the group operation.
- The starting value of the frequency range should be greater than the schedule period (amount of time for which the group operation is 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 in a group operation will be uniformly distributed to begin at random intervals over the schedule period.
- The group of operations restarts at uniformly distributed random frequencies within the specified frequency range.
- The minimum time interval between the start of each operation in a group operation is 100 milliseconds (0.1 seconds). If the random scheduler option is disabled, the minimum time interval is 1 second.
- 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 milliseconds of the schedule period.
- The order in which each operation in a group operation begins is random.

How to Configure an IP SLAs Multioperation Scheduler

Scheduling Multiple IP SLAs Operations



Note

- All IP SLAs operations to be scheduled must be already configured.
- The frequency of all operations scheduled in a multioperation group should be the same.
- List of one or more operation ID numbers to be added to a multioperation group is limited to a maximum of 125 characters, including commas (.).

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	ip sla group schedule <i>group-operation-number operation-id-numbers</i> schedule-period <i>schedule-period-range</i> [ageout <i>seconds</i>] [frequency <i>group-operation-frequency</i>] [life {forever <i>seconds</i> }] [start-time {hh:mm[:ss] [month day day month] pending now after hh:mm:ss}] Example: Device(config)# ip sla group schedule 1 3,4,6-9 schedule-period 50 frequency range 80-100	Specifies an IP SLAs operation group number and the range of operation numbers to be scheduled in global configuration mode.
Step 4	exit Example: Device(config)# exit	Returns to the privileged EXEC mode.
Step 5	show ip sla group schedule Example: Device# show ip sla group schedule	(Optional) Displays the IP SLAs group schedule details.

	Command or Action	Purpose
Step 6	show ip sla configuration Example: Device# show ip sla configuration	(Optional) Displays the IP SLAs configuration details.

Enabling the IP SLAs Random Scheduler

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	ip sla group schedule <i>group-operation-number operation-id-numbers</i> schedule-period <i>seconds</i> [ageout <i>seconds</i>] [frequency <i>seconds</i> range <i>random-frequency-range</i>] [life { forever <i>seconds</i> }] [start-time { <i>hh:mm[:ss]</i> [<i>month day</i> <i>day month</i>]} pending now after <i>hh:mm:ss</i>] Example: Device(config)# ip sla group schedule 2 1-3 schedule-period 50 frequency range 80-100	Specifies the scheduling parameters of a group of IP SLAs operations. <ul style="list-style-type: none"> • To enable the IP SLAs random scheduler option, you must configure the frequency range <i>random-frequency-range</i> keywords and argument.
Step 4	exit Example: Device(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.

Verifying IP SLAs Multiple Operations Scheduling

Procedure

	Command or Action	Purpose
Step 1	show ip sla statistics Example: Device# show ip sla statistics	(Optional) Displays the IP SLAs operation details.
Step 2	show ip sla group schedule Example: Device# show ip sla group schedule	(Optional) Displays the IP SLAs group schedule details.
Step 3	show ip sla configuration Example: Device# show ip sla configuration	(Optional) Displays the IP SLAs configuration details.

Examples

After you have scheduled the multiple IP SLAs operations, you can verify the latest operation details using the appropriate **show** commands.

The following example schedules IP SLAs operations 1 through 20 in the operation group 1 with a schedule period of 60 seconds and a life value of 1200 seconds. By default, the frequency is equivalent to the schedule period. In this example, the start interval is 3 seconds (schedule period divided by number of operations).

```
Device# ip sla group schedule 1 1-20 schedule-period 60 life 1200
```

The following example shows the details of the scheduled multiple IP SLAs operation using the **show ip sla group schedule** command.

```
Device# show ip sla group schedule
Group Entry Number: 1
Probes to be scheduled: 1-20
Total number of probes: 20
Schedule period: 60
Group operation frequency: Equals schedule period
Status of entry (SNMP RowStatus): Active
Next Scheduled Start Time: Start Time already passed
Life (seconds): 1200
Entry Ageout (seconds): never
```

The following example shows the details of the scheduled multiple IP SLAs operation using the **show ip sla configuration** command. The last line in the example indicates that the IP SLAs operations are multiple scheduled (TRUE).

```
Device# show ip sla configuration 1
```

```

Entry number: 1
Owner:
Tag:
Type of operation to perform: udpEcho
Target address: 10.2.31.121
Source address: 0.0.0.0
Target port: 9001
Source port: 0
Request size (ARR data portion): 16
Operation timeout (milliseconds): 5000
Type Of Service parameters: 0x0
Verify data: No
Data pattern:
Vrf Name:
Control Packets: enabled
Operation frequency (seconds): 60
Next Scheduled Start Time: Start Time already passed
Life (seconds): 1200
Entry Ageout (seconds): never
Recurring (Starting Everyday): FALSE
Status of entry (SNMP RowStatus): Active
Threshold (milliseconds): 5000
Number of statistic hours kept: 2
Number of statistic distribution buckets kept: 1
Statistic distribution interval (milliseconds): 20
Enhanced History:
Number of history Lives kept: 0
Number of history Buckets kept: 15
History Filter Type: None
Group Scheduled : TRUE

```

The following example shows the latest operation start time of the scheduled multiple IP SLAs operation, when the operations are scheduled at equal intervals, using the **show ip sla statistics** command:

```

Device# show ip sla statistics | include Latest operation start time
Latest operation start time: *03:06:21.760 UTC Tue Oct 21 2003
Latest operation start time: *03:06:24.754 UTC Tue Oct 21 2003
Latest operation start time: *03:06:27.751 UTC Tue Oct 21 2003
Latest operation start time: *03:06:30.752 UTC Tue Oct 21 2003
Latest operation start time: *03:06:33.754 UTC Tue Oct 21 2003
Latest operation start time: *03:06:36.755 UTC Tue Oct 21 2003
Latest operation start time: *03:06:39.752 UTC Tue Oct 21 2003
Latest operation start time: *03:06:42.753 UTC Tue Oct 21 2003
Latest operation start time: *03:06:45.755 UTC Tue Oct 21 2003
Latest operation start time: *03:06:48.752 UTC Tue Oct 21 2003
Latest operation start time: *03:06:51.753 UTC Tue Oct 21 2003
Latest operation start time: *03:06:54.755 UTC Tue Oct 21 2003
Latest operation start time: *03:06:57.752 UTC Tue Oct 21 2003
Latest operation start time: *03:07:00.753 UTC Tue Oct 21 2003
Latest operation start time: *03:07:03.754 UTC Tue Oct 21 2003
Latest operation start time: *03:07:06.752 UTC Tue Oct 21 2003
Latest operation start time: *03:07:09.752 UTC Tue Oct 21 2003
Latest operation start time: *03:07:12.753 UTC Tue Oct 21 2003
Latest operation start time: *03:07:15.755 UTC Tue Oct 21 2003
Latest operation start time: *03:07:18.752 UTC Tue Oct 21 2003

```

Configuration Examples for an IP SLAs Multioperation Scheduler

Example Scheduling Multiple IP SLAs Operations

The following example shows how to schedule IP SLAs operations 1 to 10 in the operation group 1 with a schedule period of 20 seconds. By default, the frequency is equivalent to the schedule period.

```
Device# ip sla group schedule 1 1-10 schedule-period 20
```

The following example shows the details of the scheduled multiple IP SLAs operation using the **show ip sla group schedule** command. The last line in the example indicates that the IP SLAs operations are multiple scheduled (TRUE).

```
Device# show ip sla group schedule
Multi-Scheduling Configuration:
Group Entry Number: 1
Probes to be scheduled: 1-10
Schedule period :20
Group operation frequency: 20
Multi-scheduled: TRUE
```

Example Enabling the IP SLAs Random Scheduler

The following example shows how to schedule IP SLAs operations 1 to 3 as a group (identified as group 2). In this example, the operations are scheduled to begin at uniformly distributed random intervals over a schedule period of 50 seconds. The first operation is scheduled to start immediately. The interval is chosen from the specified range upon every invocation of the probe. The random scheduler option is enabled and the uniformly distributed random frequencies at which the group of operations will restart is chosen within the range of 80-100 seconds.

```
ip sla group schedule 2 1-3 schedule-period 50 frequency range 80-100 start-time now
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS IP SLAs commands	Cisco IOS IP SLAs Command Reference, All Releases
Cisco IOS IP SLAs: general information	“Cisco IOS IP SLAs Overview” module of the <i>Cisco IOS IP SLAs Configuration Guide</i> .
Multioperation scheduling for IP SLAs	“Configuring Multioperation Scheduling of IP SLAs Operations” module of the <i>Cisco IOS P SLAs Configuration Guide</i>

Related Topic	Document Title
Proactive threshold monitoring for IP SLAs	“Configuring Proactive Threshold Monitoring of IP SLAs Operations” module of the <i>Cisco IOS IP SLAs Configuration Guide</i>

MIBs

MIBs	MIBs Link
CISCO-RTTMON-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html