Configuring MPLS Traffic Engineering—RSVP Graceful Restart

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Prerequisites for MPLS TE—RSVP Graceful Restart

Perform the following tasks on devices before configuring the MPLS Traffic Engineering—RSVP Graceful Restart feature:

- Configure the Resource Reservation Protocol (RSVP).
- Enable MPLS.
- Configure traffic engineering (TE).
- Enable graceful restart.

Restrictions for MPLS TE—RSVP Graceful Restart

- Graceful restart supports node failure only.
- Cisco recommends that you configure interface hellos only if the neighbor device does not support node hellos.
- Unnumbered interfaces are not supported.
- You cannot configure an interface hello for graceful restart and a hello state timeout (HST) on the same interface.

Information About MPLS TE—RSVP Graceful Restart

The following section provides information about MPLS TE—RSVP Graceful Restart.

Graceful Restart Operation

The MPLS Traffic Engineering—RSVP Graceful Restart feature allows a neighboring Route Processor (RP) to recover from disruption in control plane service (specifically, the Label Distribution Protocol (LDP) component) without losing its Multiprotocol Label Switching (MPLS) forwarding state. This feature has the following benefits:

- Graceful restart allows a node to recover state information from its neighbor when there is an RP failure or the device has undergone a stateful switchover (SSO).
- Graceful restart allows session information recovery with minimal disruption to the network.
- A node can perform a graceful restart to help a neighbor recover its state by keeping the label bindings and state information to provide a quick recovery of the failed node and not affect the traffic that is currently forwarded.

The node failure may be completely transparent to other nodes in the network.

RSVP graceful restart preserves the label values and forwarding information and works with third-party or Cisco Devices seamlessly.

RSVP graceful restart depends on RSVP hello messages to detect that a neighbor went down. Hello messages include Hello Request or Hello Acknowledgment (ACK) objects between two neighbors.

A node hello is transmitted when graceful restart is globally configured and the first LSP to the neighbor is created.

Interface hello is an optional configuration. If you configure the graceful restart Hello command on an interface, the interface hello is considered to be an additional hello instance with the neighbor.

The Device transmits an interface hello for graceful restart when all of the following conditions are met:

- Graceful restart is configured globally.
- Graceful restart is configured on the interface.
- An LSP to the neighboring Device is created and goes over the interface.

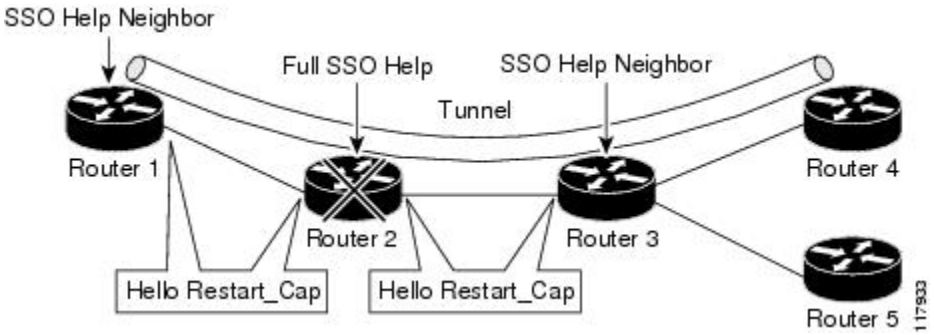
Cisco recommends that you use node hellos if the neighbor supports node hellos, and configure interface hellos only if the neighbor Device does not support node hellos.

Interface hellos differ from node hellos. as follows:

- **Interface hello** —The source address in the IP header of the hello message has an IP address that matches the interface that the Hello message sent out. The destination address in the IP header is the interface address of the neighbor on the other side of the link. A TTL of 1 is used for per-interface hellos as it is destined for the directly-connected neighbor.
- **Node hello** —The source address in the IP header of the Hello message includes the TE Device ID of the sending Device. The destination address of the IP header has the Device ID of the neighbor to which this message is sent. A TTL of more than 1 is used.

The figure below shows the graceful restart extension to these messages that an object called Restart_Cap, which tells neighbors that a node, may be capable of restarting if a failure occurs. The time-to-live (TTL) in these messages is set to 255 so that adjacencies can be maintained through alternate paths even if the link between two neighbors goes down.

Figure 1: How Graceful Restart Works



The Restart_Cap object has two values—the restart time, which is the sender's time to restart the RSVP_TE component and exchange hello messages after a failure; and the recovery time, which is the desired time that the sender wants the receiver to synchronize the RSVP and MPLS databases.

In the figure above, graceful restart is enabled on Device 1, Device 2, Device 3, and Device 4. For simplicity, assume that all Devices are restart capable. A TE label switched path (LSP) is signaled from Device 1 to Device 4.

Device 2 and Device 3 exchange periodic graceful restart hello messages every 10000 ms (10 seconds), and so do Device 2 and Device 1 and Device 3 and Device 4. Assume that Device 2 advertises its restart time as 60000 ms (60 seconds) and its recovery time as 60000 ms (60 seconds) as shown in the following example:

```
23:33:36: Outgoing Hello:
23:33:36:   version:1 flags:0000 cksum:883C ttl:255 reserved:0 length:32
23:33:36:   HELLO               type HELLO REQUEST length 12:
23:33:36:   Src_Instance: 0x6EDA8BD7, Dst_Instance: 0x00000000
23:33:36:   RESTART_CAP         type 1 length 12:
23:33:36:   Restart_Time: 0x0000EA60
, Recovery_Time: 0x0000EA60
```

Note The restart and recovery time are shown in **bold** in the last entry.

Device 3 records this into its database. Also, both neighbors maintain the neighbor status as UP. However, Device 3's control plane fails at some point (for example, a Primary Route Processor failure). As a result, RSVP and TE lose their signaling information and states although data packets continue to be forwarded by the line cards.

When four ACK messages are missed from Device 2 (40 seconds), Device 3 declares communication with Device 2 lost "indicated by LOST" and starts the restart time to wait for the duration advertised in Device 2's restart time previously and recorded (60 seconds). Device 1 and Device 2 suppress all RSVP messages to Device 3 except hellos. Device 3 keeps sending the RSVP Path and Resv refresh messages to Device 4 and Device 5 so that they do not expire the state for the LSP; however, Device 3 suppresses these messages for Device 2.

Note A node restarts if it misses four ACKs or its hello src_instance (last source instance sent to its neighbor) changes so that its restart time = 0.

Before the restart time expires, Device 2 restarts and loads its configuration and graceful restart makes the configuration of Device 2 send the hello messages with a new source instance to all the data links attached. However, because Device 2 has lost the neighbor states, it does not know what destination instance it should use in those messages; therefore, all destination instances are set to 0.

When Device 3 sees the hello from Device 2, Device 3 stops the restart time for Device 2 and sends an ACK message back. When Device 3 sees a new source instance value in Device 2's hello message, Device 3 knows that Device 2 had a control plane failure. Device 2 gets Device 3's source instance value and uses it as the destination instance going forward.

Device 3 also checks the recovery time value in the hello message from Device 2. If the recovery time is 0, Device 3 knows that Device 2 was not able to preserve its forwarding information and Device 3 deletes all RSVP state that it had with Device 2.

If the recovery time is greater than 0, Device 1 sends Device 2 Path messages for each LSP that it had previously sent through Device 2. If these messages were previously refreshed in summary messages, they are sent individually during the recovery time. Each of these Path messages includes a Recovery_Label object containing the label value received from Device 2 before the failure.

When Device 3 receives a Path message from Device 2, Device 3 sends a Resv message upstream. However, Device 3 suppresses the Resv message until it receives a Path message.

How to Configure MPLS TE—RSVP Graceful Restart

This section describes how to configure MPLS TE—RSVP Graceful Restart.

Enabling Graceful Restart

To enable graceful restart, perform this procedure.

Note It is optional that you configure graceful restart on an interface.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**ip rsvp signalling hello graceful-restart mode help-neighbor** **Example:** `Device(config)# ip rsvp signalling hello graceful-restart mode help-neighbor`	Sets the number of DSCP hello messages on a neighboring device with restart capability.
Step 4	**interface** *type number* **Example:** `Device(config)# interface POS 1/0/0`	(Optional) Configures the interface type and number and enters interface configuration mode.
Step 5	**ip rsvp signalling hello graceful-restart** **Example:** `Device(config-if)# ip rsvp signalling hello graceful-restart`	(Optional) Enables RSVP TE graceful restart capability on a neighboring device.
Step 6	**exit** **Example:** `Device(config)# exit`	Exits to privileged EXEC mode.

Setting a DSCP Value

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip rsvp signalling hello graceful-restart dscp** *num* **Example:**	Sets the number of DSCP hello messages on a graceful restart-enabled Device.

	Command or Action	Purpose
	`Device(config)# ip rsvp signalling hello graceful-restart dscp 30`	
Step 4	**end** **Example:** `Device(config)# end`	Exits to privileged EXEC mode.

Setting a Hello Refresh Interval

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip rsvp signalling hello graceful-restart refresh interval** *interval-value* **Example:** `Device(config)# ip rsvp signalling hello graceful-restart refresh interval 5000`	Sets a hello refresh interval on a device with graceful restart enabled.
Step 4	**end** **Example:** `Device(config)# end`	Exits to privileged EXEC mode.

Setting a Missed Refresh Limit

Procedure

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

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip rsvp signalling hello graceful-restart refresh misses** *msg-count* **Example:** `Device(config)# ip rsvp signalling hello graceful-restart refresh misses 5`	Sets a refresh limit on a device with graceful restart enabled.
Step 4	**end** **Example:** `Device(config)# end`	Exits to privileged EXEC mode.

Verifying Graceful Restart Configuration

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**show ip rsvp hello graceful-restart** **Example:** `Device# show ip rsvp hello graceful-restart`	Displays information about the status of graceful restart and related parameters.
Step 3	**end** **Example:** `Device# end`	Exits to user EXEC mode.

Configuration Examples for MPLS TE—RSVP Graceful Restart

The following section provides configuration examples for MPLS TE—RSVP Graceful Restart.

Example: MPLS TE—RSVP Graceful Restart Example

In the following example, graceful restart is enabled, and related parameters, including a DSCP value, a refresh interval, and a missed refresh limit are set:

```
Device# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Device(config)# ip rsvp signalling hello graceful-restart mode help-neighbor
Device(config)# ip rsvp signalling hello graceful-restart dscp 30
Device(config)# ip rsvp signalling hello graceful-restart refresh interval 10000
Device(config)# ip rsvp signalling hello graceful-restart refresh misses 4
Device(config)# end
```

The following example verifies the status of graceful restart and the configured parameters:

```
Device# show ip rsvp hello graceful-restart
Graceful Restart:Enabled (help-neighbor only)
  Refresh interval:10000 msecs
  Refresh misses:4
  DSCP:0x30
  Advertised restart time:0 secs
  Advertised recovery time:0 secs
  Maximum wait for recovery:3600000 secs
```

Additional References

Related Documents

Related Topic	Document Title
RSVP commands: complete command syntax, command mode, defaults, usage guidelines, and examples	Cisco IOS Quality of Service Solutions Command Reference
Quality of service (QoS) classification	Classification Overview
QoS signalling	Signalling Overview
QoS congestion management	Congestion Management Overview
Stateful switchover	Stateful Switchover
MPLS Label Distribution Protocol	MPLS Label Distribution Protocol (LDP)
Information on stateful switchover, Cisco nonstop forwarding, graceful restart	NSF/SSO—MPLS TE and RSVP Graceful Restart
RSVP hello state timer	MPLS Traffic Engineering: RSVP Hello State Timer

Standards

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

MIBs

MIBs	MIBs Link
No new or modified MIBS are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 3209	*RSVP-TE: Extensions to RSVP for LSP Tunnels*
RFC 3473	*Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Extensions*
RFC 3478	*Graceful Restart Mechanism for Label Distribution*

Technical Assistance

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

Feature History for MPLS Traffic Engineering—RSVP Graceful Restart

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Cupertino 17.7.1	MPLS Traffic Engineering—RSVP Graceful Restart	The MPLS Traffic Engineering—RSVP Graceful Restart feature allows a neighboring Route Processor (RP) to recover from disruption in control plane service (specifically, the Label Distribution Protocol (LDP) component) without losing its Multiprotocol Label Switching (MPLS) forwarding state. This feature was implemented on the Cisco Catalyst 9500 Series Switches and Cisco Catalyst 9500 Series Switches- High Performance.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/