Configuring MPLS LDP Graceful Restart

This chapter describes how to configure Multiprotocol Label Switching (MPLS) Label Distribution Protocol (LDP) graceful restart on Cisco NX-OS devices.

This chapter includes the following sections:

Finding Feature Information

Your software release might not support all the features documented in this module. For the latest caveats and feature information, see the Bug Search Tool at https://tools.cisco.com/bugsearch/ and the release notes for your software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the "New and Changed Information" chapter or the Feature History table below.

Information About MPLS LDP Graceful Restart

MPLS LDP graceful restart is an LDP protocol feature that, in the presence of a temporary LDP control plane disruption, preserves Nonstop Forwarding (NSF) support of data plane traffic being carried on label-switched paths (LSPs).

An example of an LDP control plane disruption is when the LDP control plane on a router restarts. With MPLS LDP graceful restart, that router and all of its neighbors preserve their forwarding state so that traffic continues to be forwarded along the LDP LSPs. As the LDP control plane restarts, that router and its neighbors use graceful restart procedures to transition back to normal control plane operation. The result is that the disruption associated with a control plane restart is greatly reduced.

This section includes the following topics:

Introduction to MPLS LDP Graceful Restart

MPLS LDP graceful restart preserves data plane forwarding along LDP LSPs in the presence of temporary LDP control plane disruption. The disruption might be an LDP control plane restart caused by a supervisor switchover or process restart or a TCP or UDP event that disrupts control plane communication between two LDP control planes, even if neither restarts.

The following example describes how MPLS LDP graceful restart operates in the presence of an LDP control plane restart. Note that this interaction has two different roles: the router with the restarting LDP control plane and the neighbor router that detects a loss and recovery of its LDP session to the restarting router. Each carries out MPLS LDP graceful restart procedures appropriate to its role.

The topology shown in Figure 10-1 has the following elements:

- All three routers are running MPLS LDP, all with graceful restart enabled.
- An LDP session exists between R2 and R1, and another LDP session exists between R2 and R3.
- LDP LSPs have been established, including LSPs that connect R1 and R3 and are carrying data traffic. In a network with more routers, multiple LSPs might traverse R1-R2-R3 in both directions.

Figure 10-1 Example of a Network Using LDP Graceful Restart

The following sequence shows how the three routers cooperate to provide NSF and avoid a disruption to data traffic:

1. At session establishment, each router reports to its neighbors that it supports graceful restart. Each session endpoint knows that both ends of the session support graceful restart.
2. R2 begins a supervisor switchover. R2's LDP control plane and all of its LDP TCP connections and LDP UDP hello adjacencies stop operating. R2's data plane marks all of its label entries as stale but continues to use those entries for forwarding MPLS data traffic.
3. R1 notices a loss of communication with R2. (In this sequence, R3 performs the same actions as R1.) R1 marks all of its label bindings from R2 as stale but continues to use those entries for forwarding data traffic.
4. R1 and R2 reestablish an LDP session. On R1, entering the **show mpls ldp neighbor graceful-restart** command displays information about the recovering session.

5. R2 reacquires its local label binding information. R2's data plane typically provides R2's control plane with the same local label for each prefix that was used prior to the restart.
6. Both routers readvertise their label binding information. If R1 relearns a label from R2, R1 marks the binding as no longer stale. If R2 learns a label from R1 and submits that label to its data plane, the data plane marks the entry as no longer stale.
7. After a certain amount of time has passed, R1's LDP control plane cleans up all entries that are still marked as stale. Similarly, R2's data plane removes all entries that are still marked as stale.

Typically, if no other network disruption occurs during this graceful restart operation, all bindings are relearned from the neighbor with the same label values as before the session restart. In this scenario, all saved bindings are marked as not stale during recovery, and no entries need to be cleaned up.

Another scenario of interest is a TCP or UDP communication failure without an LDP control plane restart. In this case, the two LDP control planes at either end of the session detect the communication failure. Each LDP control plane applies the same procedures as R1 used above, and NSF is achieved. R1 carries out the same MPLS LDP graceful restart procedures whether the communication failure with R2 was caused by a restart of R2's control plane or by a networking issue without a restart of R2's control plane.

You can set various timers to limit how long the routers wait for an LDP session to be reestablished before restarting the router.

What Happens if a Router Does Not Have MPLS LDP Graceful Restart Enabled

When a router that does not support MPLS LDP graceful restart undergoes a control plane restart, its data plane MPLS forwarding entries are freed.

A neighbor of such a router, detecting a loss of communication, frees all bindings from the restarting router. This behavior occurs whether the neighbor supports MPLS LDP graceful restart or not. A neighbor that supports MPLS LDP graceful restart learns at session establishment that the restarting router is not supporting MPLS LDP graceful restart. The neighbor does not run graceful restart procedures when detecting a loss of communication to the restarting router.

The cleanup actions of both the restarting router and its neighbor cause any data traffic on the old LSPs to be dropped until recovery activities have addressed the situation. Recovery activities include traffic reroute or the reestablishment of MPLS LDP LSPs or both.

How a Router Advertises that it Supports MPLS LDP Graceful Restart

A router that supports MPLS LDP graceful restart announces its capabilities to its neighbors in the fault tolerant (FT) type-length-value (TLV) in the LDP initialization message. The router sends the LDP initialization message to a neighbor as part of establishing an LDP session.

The FT session TLV includes the following information:

- The Learn from Network (L) flag is set to 1, which indicates that the router is configured to perform MPLS LDP graceful restart.
- The Reconnect Timeout field shows the time (in milliseconds) that the neighbor should wait for a reconnection if the LDP session is lost. If the timer is set to 0 and the local router fails, its peers do not wait for it to recover.

- The Recovery Time field shows the time (in milliseconds) that the neighbor should retain the MPLS forwarding state during a recovery currently in progress. For example, if a neighbor restarted and did not preserve the MPLS forwarding state across the restart, the neighbor should set its recovery time to 0.

Note The reconnect time applies to the next communication loss while the recovery time applies to the recovery from the preceding communication loss.

Licensing Requirements for MPLS LDP Graceful Restart

Product	License Requirement
Cisco NX-OS	MPLS LDP graceful restart requires an MPLS license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for MPLS LDP Graceful Restart

MPLS LDP graceful restart has the following prerequisites:

- You must enable MPLS LDP on the device.
- Ensure that MPLS LDP graceful restart has not been disabled on the device.
- For Nonstop Forwarding (NSF) to occur, MPLS LDP graceful restart must be present on the restarting router and its peers.

Default Settings for MPLS LDP Graceful Restart

Table 10-1 lists the default settings for MPLS LDP graceful restart parameters.

Table 10-1 Default MPLS LDP Graceful Restart Parameters

Parameters	Default
MPLS LDP graceful restart	Enabled
Forwarding state holding time	600 seconds
Max recovery time	120 seconds
Neighbor liveness timer	120 seconds

Configuring MPLS LDP Graceful Restart

The MPLS LDP graceful restart feature is globally disabled or enabled.

You must not disable MPLS LDP graceful restart on the routers in order for forwarding to be preserved during an interruption in service.

When you disable or enable LDP graceful restart, it has no effect on existing LDP sessions. This configuration change applies to new sessions that are established after the change.

Prerequisites

Ensure that you are in the correct VDC (or use the **switchto vdc** command).

Ensure that MPLS LDP is enabled on the device.

SUMMARY STEPS

1. **configure terminal**
2. **mpls ldp configuration**
3. [**no**] **graceful-restart** [**timers** {**forwarding-holding** *seconds* | **max-recovery** *seconds* | **neighbor-liveness** *seconds*}]
4. (Optional) **show mpls ldp graceful-restart**
5. (Optional) **show mpls ldp neighbor graceful restart**
6. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal** **Example:** switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	**mpls ldp configuration** **Example:** switch(config)# mpls ldp configuration switch(config-ldp)#	Enters LDP configuration mode.
Step 3	[**no**] **graceful-restart** [**timers** {**forwarding-holding** *seconds* | **max-recovery** *seconds* | **neighbor-liveness** *seconds*}] **Example:** switch(config-ldp)# graceful-restart timers max-recovery 100	Disables or enables the router to protect the LDP bindings and MPLS forwarding state during a disruption in service. MPLS LDP graceful restart is enabled by default. (Optional) You can configure the following graceful-restart timers if the default values need to be changed: • **forwarding-holding**—Specifies the amount of time that the MPLS forwarding state should be preserved after the control plane restarts. The range is from 30 to 600 seconds. • **max-recovery**—Specifies the amount of time that a router should hold stale label-FEC bindings after an LDP session has been reestablished. The range is from 15 to 600 seconds. • **neighbor-liveness**—Specifies the amount of time that a router should wait for an LDP session to be reestablished. The range is from 5 to 300 seconds.
Step 4	**show mpls ldp graceful-restart** **Example:** switch(config-ldp)# show mpls ldp graceful-restart	(Optional) Displays this router's LDP graceful-restart configuration.

	Command	Purpose
Step 5	**show mpls ldp neighbor graceful-restart** **Example:** switch(config-ldp)# show mpls ldp neighbor graceful-restart	(Optional) Displays the graceful-restart parameters for this router's sessions with its LDP neighbors.
Step 6	**copy running-config startup-config** **Example:** switch(config-ldp)# copy running-config startup-config	(Optional) Copies the running configuration to the startup configuration.

Verifying the MPLS LDP Graceful Restart Configuration

To display the MPLS LDP graceful restart configuration, perform one of the following tasks:

Command	Purpose
show mpls ldp graceful-restart	Displays the LDP graceful-restart configuration.
show mpls ldp neighbor graceful-restart	Displays the graceful-restart parameters for the router's sessions with its LDP neighbors.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS MPLS Command Reference*.

Configuration Examples for MPLS LDP Graceful Restart

The following example shows how to enable MPLS LDP graceful restart, if it has been disabled, in order to preserve the LDP session during an interruption in service:

```
switch# configure terminal
switch(config)# mpls ldp configuration
switch(config-ldp)# graceful-restart
switch(config-ldp)# show mpls ldp graceful-restart neighbor-liveness 200
LDP Graceful Restart is enabled
Neighbor Liveness Timer: 200 seconds
Max Recovery Time: 120 seconds
Forwarding State Holding Time: 600 seconds
Down Neighbor Database (0 records):
Graceful Restart-enabled Sessions:
```

Additional References for MPLS LDP Graceful Restart

For additional information related to implementing MPLS LDP graceful restart, see the following sections:

- Related Documents, page 10-8
- MIBs, page 10-8

Related Documents

Related Topic	Document Title
CLI commands	*Cisco Nexus 7000 Series NX-OS MPLS Command Reference*

MIBs

MIB	MIBs Link
MPLS-LDP-STD-MIB	To locate and download MIBs, go to the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

Feature History for MPLS LDP Graceful Restart

Table 10-2 lists the release history for this feature.

Table 10-2 Feature History for MPLS LDP Graceful Restart

Feature Name	Releases	Feature Information
MPLS LDP graceful restart	5.2(1)	This feature was introduced.