



## MPLS LDP Graceful Restart

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When a router is configured with Multiprotocol Label Switching (MPLS) Label Distribution Protocol (LDP) Graceful Restart (GR), it assists a neighboring router that has MPLS LDP Stateful Switchover/Nonstop Forwarding (SSO/NSF) Support and Graceful Restart to recover gracefully from an interruption in service. In this Cisco IOS release, MPLS LDP GR functions strictly in helper mode, which means it can only help other routers that are enabled with MPLS SSO/NSF and GR to recover. If the router with LDP GR fails, its peer routers cannot help it recover.

### Notes:

- MPLS LDP SSO/NSF Support and Graceful Restart is supported in Cisco IOS Release 12.2(25)S. For brevity, this feature is called LDP SSO/NSF in this document.
- The MPLS LDP GR feature described in this document refers to helper mode.

When you enable MPLS LDP GR on a router that peers with an MPLS LDP SSO/NSF-enabled router, the SSO/NSF-enabled router can maintain its forwarding state when the LDP session between them is interrupted. While the SSO/NSF-enabled router recovers, the peer router forwards packets using stale information. This enables the SSO/NSF-enabled router to become operational more quickly.

### Finding Support Information for Platforms and Cisco IOS Software Images

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## Restrictions

- MPLS LDP GR is supported in strict helper mode.
- Tag Distribution Protocol (TDP) sessions are not supported. Only LDP sessions are supported.
- MPLS LDP GR cannot be configured on label-controlled ATM (LC-ATM) interfaces.
- MPLS LDP SSO/NSF is supported in IOS Release 12.2(25)S. It is not supported in this release.

## Information About MPLS LDP Graceful Restart

To configure MPLS LDP GR, you need to understand the following concepts:

- [How MPLS LDP Graceful Restart Works, page 2](#)
- [How a Route Processor Advertises That It Supports MPLS LDP Graceful Restart, page 3](#)
- [What Happens If a Route Processor Does Not Have LDP Graceful Restart, page 3](#)

## How MPLS LDP Graceful Restart Works

MPLS LDP GR works in strict helper mode, which means it helps a neighboring route processor that has MPLS LDP SSO/NSF to recover from disruption in service without losing its MPLS forwarding state. The disruption in service could be the result of a TCP or UDP event or the stateful switchover of a route processor. When the neighboring router establishes a new session, the LDP bindings and MPLS forwarding states are recovered.

In the topology shown in [Figure 1](#), the following elements have been configured:

- LDP sessions are established between Router 1 and Router 2, as well as between Router 2 and Router 3.
- Router 2 has been configured with MPLS LDP SSO/NSF. Routers 1 and 3 have been configured with MPLS LDP GR.
- A label switched path (LSP) has been established between Router 1 and Router 3.

**Figure 1**      *Example of a Network Using LDP Graceful Restart*



The following process shows how Routers 1 and 3, which have been configured with LDP GR help Router 2, which has been configured with LDP SSO/NSF recover from a disruption in service:

1. Router 1 notices an interruption in service with Router 2. (Router 3 also performs the same actions in this process.)
2. Router 1 marks all the label bindings from Router 2 as stale, but it continues to use the bindings for MPLS forwarding.

Router 1 reestablishes an LDP session with Router 2, but keeps its stale label bindings. If you issue a **show mpls ldp neighbor** command with the **graceful-restart** keyword, the command output displays the recovering LDP sessions.

3. Both routers readvertise their label binding information. If Router 1 relearns a label from Router 2 after the session has been established, the stale flags are removed. The **show mpls forwarding-table** command displays the information in the MPLS forwarding table, including the local label, outgoing label or VC, prefix, label-switched bytes, outgoing interface, and next hop.

You can set various graceful restart timers. See the following commands for more information:

- **mpls ldp graceful-restart timers neighbor-liveness**
- **mpls ldp graceful-restart timers max-recovery**

## How a Route Processor Advertises That It Supports MPLS LDP Graceful Restart

A route processor that is configured to perform MPLS LDP GR includes the Fault Tolerant (FT) Type Length Value (TLV) in the LDP initialization message. The route processor sends the LDP initialization message to a neighbor to establish 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 route processor is configured to perform MPLS LDP GR.
- The Reconnect Timeout field shows the time (in milliseconds) that the neighbor should wait for a reconnection if the LDP session is lost. In this release, the timer is set to 0, which indicates that if the local router fails, its peers should not wait for it to recover. The timer setting indicates that the local router is working in helper mode.
- The Recovery Time field shows the time (in milliseconds) that the neighbor should retain the MPLS forwarding state during a recovery. If a neighbor did not preserve the MPLS forwarding state before the restart of the control plane, the neighbor sets the recovery time to 0.

## What Happens If a Route Processor Does Not Have LDP Graceful Restart

If two route processors establish an LDP session and one route processor is not configured for MPLS LDP GR, the two route processors create a normal LDP session but do not have the ability to perform MPLS LDP GR. Both route processors must be configured for MPLS LDP GR.

# How to Configure MPLS LDP Graceful Restart

This section contains the following procedures:

- [Configuring MPLS LDP Graceful Restart, page 4](#) (required)
- [Verifying the Configuration, page 5](#) (optional)

## Configuring MPLS LDP Graceful Restart

You must enable MPLS LDP GR on all route processors for an LDP session to be preserved during an interruption in service.

MPLS LDP GR is enabled globally. When you enable MPLS LDP GR, it has no effect on existing LDP sessions. New LDP sessions that are established can perform MPLS LDP GR.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip cef [distributed]**
4. **mpls ldp graceful-restart**
5. **interface type slot/port**
6. **mpls ip**
7. **mpls label protocol {ldp | tdp | both}**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>• Enter your password if prompted.</li></ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>ip cef [distributed]</b>  <b>Example:</b> Router(config)# ip cef distributed	Enables Cisco Express Forwarding (CEF).
Step 4	<b>mpls ldp graceful-restart</b>  <b>Example:</b> Router(config)# mpls ldp graceful-restart	Enables the router to protect the LDP bindings and MPLS forwarding state during a disruption in service.

	Command or Action	Purpose
Step 5	<code>interface type slot/port</code>  <b>Example:</b> Router(config)# interface pos 3/0	Specifies an interface and enters interface configuration mode.
Step 6	<code>mpls ip</code>  <b>Example:</b> Router(config-if)# mpls ip	Configures MPLS hop-by-hop forwarding for an interface.
Step 7	<code>mpls label protocol {ldp   tdp   both}</code>  <b>Example:</b> Router(config-if)# mpls label protocol ldp	Configures the use of LDP for an interface. You must use LDP.

**Note**

You can also issue the `mpls label protocol ldp` command in global configuration mode, which enables LDP on all interfaces configured for MPLS.

## Verifying the Configuration

The following commands help verify that MPLS LDP GR has been configured correctly:

<code>show mpls ldp neighbor</code> with the <code>graceful-restart</code> keyword	Displays the Graceful Restart information for LDP sessions.
<code>show mpls ldp graceful-restart</code>	Displays Graceful Restart sessions and session parameters.

# Configuration Example for MPLS LDP Graceful Restart

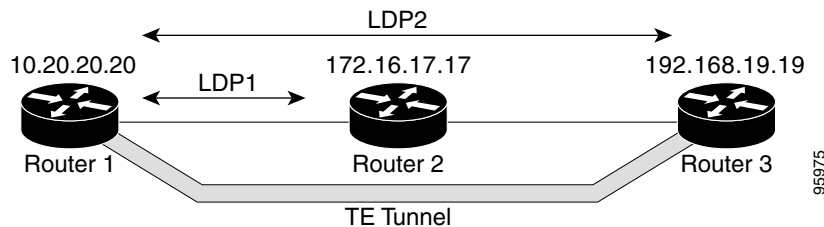
Figure 2 shows a configuration where MPLS LDP GR is enabled on Router 1 and MPLS LDP SSO/NSF is enabled on Routers 2 and 3. In this configuration example, Router 1 creates an LDP session with Router 2. Router 1 also creates a targeted session with Router 3 through a traffic engineering tunnel using Router 2.



## Note

MPLS LDP SSO/NSF is supported in Cisco IOS Release 12.2(25)S. It is not supported in this release.

**Figure 2** MPLS LDP Graceful Restart Configuration Example



### Router 1 configured with LDP GR:

```
boot system slot0:rsp-pv-mz
hw-module slot 2 image slot0:rsp-pv-mz
hw-module slot 3 image slot0:rsp-pv-mz
!
ip subnet-zero
ip cef
mpls label range 16 10000 static 10001 1048575
mpls label protocol ldp
mpls ldp logging neighbor-changes
mpls ldp graceful-restart
mpls traffic-eng tunnels
no mpls traffic-eng auto-bw timers frequency 0
mpls ldp router-id Loopback0 force
!
interface Loopback0
  ip address 20.20.20.20 255.255.255.255
  no ip directed-broadcast
  no ip mroute-cache
!
interface Tunnell
  ip unnumbered Loopback0
  no ip directed-broadcast
  mpls label protocol ldp
  mpls ip
  tunnel destination 19.19.19.19
  tunnel mode mpls traffic-eng
  tunnel mpls traffic-eng autoroute announce
  tunnel mpls traffic-eng priority 7 7
  tunnel mpls traffic-eng bandwidth 500
  tunnel mpls traffic-eng path-option 1 dynamic
!
interface ATM5/1/0
  no ip address
  no ip directed-broadcast
  atm clock INTERNAL
```

```

        no atm enable-ilmi-trap
        no atm ilmi-keepalive
    !
interface ATM5/1/0.5 point-to-point
    ip address 12.0.0.2 255.0.0.0
    no ip directed-broadcast
    no atm enable-ilmi-trap
    pvc 6/100
        encapsulation aal5snap
    mpls label protocol ldp
    mpls traffic-eng tunnels
    mpls ip
    ip rsvp bandwidth 1000
!
router ospf 100
    log-adjacency-changes
    redistribute connected
    network 12.0.0.0 0.255.255.255 area 100
    network 20.20.20.20 0.0.0.0 area 100
    mpls traffic-eng router-id Loopback0
    mpls traffic-eng area 100

```

#### Router 2 configured with LDP SSO/NSF:

```

boot system slot0:rsp-pv-mz
hw-module slot 2 image slot0:rsp-pv-mz
hw-module slot 3 image slot0:rsp-pv-mz
!
redundancy
    mode sso
!
ip cef
no ip domain-lookup
mpls label range 17 10000 static 10001 1048575
mpls label protocol ldp
mpls ldp logging neighbor-changes
mpls ldp graceful-restart
mpls traffic-eng tunnels
no mpls traffic-eng auto-bw timers frequency 0
no mpls advertise-labels
mpls ldp router-id Loopback0 force
!
interface Loopback0
    ip address 17.17.17.17 255.255.255.255
    no ip directed-broadcast
!
interface ATM4/0/0
    no ip address
    no ip directed-broadcast
    no ip mroute-cache
    atm clock INTERNAL
    atm sonet stm-1
    no atm enable-ilmi-trap
    no atm ilmi-keepalive
!
interface ATM4/0/0.5 point-to-point
    ip address 12.0.0.1 255.0.0.0
    no ip directed-broadcast
    no atm enable-ilmi-trap
    pvc 6/100
        encapsulation aal5snap
    mpls label protocol ldp
    mpls traffic-eng tunnels
    mpls ip

```

```

        ip rsvp bandwidth 1000
    !
interface POS5/1/0
    ip address 11.0.0.1 255.0.0.0
    no ip directed-broadcast
    encapsulation ppp
    mpls label protocol ldp
    mpls traffic-eng tunnels
    mpls ip
    no peer neighbor-route
    clock source internal
    ip rsvp bandwidth 1000
!
router ospf 100
    log-adjacency-changes
    redistribute connected
    nsf enforce global
    network 11.0.0.0 0.255.255.255 area 100
    network 12.0.0.0 0.255.255.255 area 100
    network 17.17.17.17 0.0.0.0 area 100
    mpls traffic-eng router-id Loopback0
    mpls traffic-eng area 100
!
ip classless

```

### Router 3 configured with LDP SSO/NSF:

```

boot system slot0:rsp-pv-mz
hw-module slot 2 image slot0:rsp-pv-mz
hw-module slot 3 image slot0:rsp-pv-mz
!
redundancy
    mode sso
!
ip subnet-zero
ip cef
!
no ip finger
no ip domain-lookup
mpls label protocol ldp
mpls ldp neighbor 11.11.11.11 targeted ldp
mpls ldp logging neighbor-changes
mpls ldp graceful-restart
mpls traffic-eng tunnels
no mpls traffic-eng auto-bw timers frequency 0
mpls ldp discovery directed-hello interval 12
mpls ldp discovery directed-hello holdtime 130
mpls ldp discovery directed-hello accept
mpls ldp router-id Loopback0 force
!
interface Loopback0
    ip address 19.19.19.19 255.255.255.255
    no ip directed-broadcast
!
interface POS1/0
    ip address 11.0.0.2 255.0.0.0
    no ip directed-broadcast
    encapsulation ppp
    mpls label protocol ldp
    mpls traffic-eng tunnels
    mpls ip
    no peer neighbor-route
    clock source internal
    ip rsvp bandwidth 1000

```



```
!  
router ospf 100  
    log-adjacency-changes  
    redistribute connected  
    nsf enforce global  
    network 11.0.0.0 0.255.255.255 area 100  
    network 19.19.19.19 0.0.0.0 area 100  
    mpls traffic-eng router-id Loopback0  
    mpls traffic-eng area 100  
!  
ip classless
```

# Additional References

## Related Documents

Related Topic	Document Title
MPLS Label Distribution Protocol	<a href="#">MPLS Label Distribution Protocol (LDP)</a>

## Standards

Standards	Title
None	—

## MIBs

MIBs <sup>1</sup>	MIBs Link
<ul style="list-style-type: none"> <li>MPLS Label Distribution Protocol MIB Version 8 Upgrade</li> </ul>	<p>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:</p> <p><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></p>

1. Not all supported MIBs are listed.

## RFCs

RFCs <sup>1</sup>	Title
RFC 3036	<i>LDP Specification</i>
RFC 3478	<i>Graceful Restart Mechanism for Label Distribution</i>

1. Not all supported RFCs are listed.

## Technical Assistance

Description	Link
The Cisco Technical Support & Documentation website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	<a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a>

# Feature Information for MPLS LDP Graceful Restart

Table 1 lists the release history for this feature.

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## Note

Table 1 lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 1** Feature Information for MPLS LDP Graceful Restart

Feature Name	Releases	Feature Information
MPLS LDP Graceful Restart	12.0(29)S 12.3(14)T 12.2(33)SRA	<p>MPLS LDP Graceful Restart assists a neighboring router that has MPLS LDP Stateful Switchover/Nonstop Forwarding (SSO/NSF) Support and Graceful Restart to recover gracefully from an interruption in service.</p> <p>In Cisco IOS Release 12.0(29)S, this feature was introduced.</p> <p>This feature was integrated into Cisco IOS Release 12.3(14)T.</p> <p>This feature was integrated into Cisco IOS Release 12.2(33)SRA.</p> <p>The following sections provide information about this feature:</p> <ul style="list-style-type: none"> <li>• <a href="#">Information About MPLS LDP Graceful Restart, page 2</a></li> <li>• <a href="#">How to Configure MPLS LDP Graceful Restart, page 4</a></li> </ul> <p>The following commands were introduced or modified:</p> <ul style="list-style-type: none"> <li>• <b>debug mpls ldp graceful-restart</b></li> <li>• <b>mpls ldp graceful-restart</b></li> <li>• <b>mpls ldp graceful-restart timers max-recovery</b></li> <li>• <b>mpls ldp graceful-restart timers neighbor-liveness</b></li> <li>• <b>show mpls ip binding</b></li> <li>• <b>show mpls ldp bindings</b></li> <li>• <b>show mpls ldp graceful-restart</b></li> <li>• <b>show mpls ldp neighbor</b></li> </ul>

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