



# Implementing MPLS Label Distribution Protocol

The Multiprotocol Label Switching (MPLS) is a standards-based solution driven by the Internet Engineering Task Force (IETF) that was devised to convert the Internet and IP backbones from best-effort networks into business-class transport mediums.

MPLS, with its label switching capabilities, eliminates the need for an IP route look-up and creates a virtual circuit (VC) switching function, allowing enterprises the same performance on their IP-based network services as with those delivered over traditional networks such as Frame Relay or ATM.

Label Distribution Protocol (LDP) performs label distribution in MPLS environments. LDP provides the following capabilities:

- LDP performs hop-by-hop or dynamic path setup; it does not provide end-to-end switching services.
- LDP assigns labels to routes using the underlying Interior Gateway Protocols (IGP) routing protocols.
- LDP provides constraint-based routing using LDP extensions for traffic engineering.

Finally, LDP is deployed in the core of the network and is one of the key protocols used in MPLS-based Layer 2 and Layer 3 virtual private networks (VPNs).

## Feature History for Implementing MPLS LDP

Release	Modification
Release 3.2	Support was added for conceptual and configuration information about LDP label advertisement control (Outbound label filtering).
Release 3.3.0	Support was added for these features: <ul style="list-style-type: none"> <li>• Inbound Label Filtering</li> <li>• Local Label Allocation Control</li> <li>• Session Protection</li> <li>• LDP-IGP Synchronization</li> </ul>
Release 3.5.0	Support was added for LDP Auto-configuration.
Release 3.6.0	Support was added for LDP nonstop routing (NSR).

Release	Modification
Release 3.8.0	The feature LDP IGP Synchronization Process Restart Delay was introduced.
Release 4.0.1	Support was added for these features: <ul style="list-style-type: none"> <li>• IP LDP Fast Reroute Loop Free Alternate</li> <li>• Downstream on Demand</li> </ul>
Release 5.1	Support was added for MPLS over IRB.

- [Prerequisites for Implementing Cisco MPLS LDP, page 2](#)
- [Information About Implementing Cisco MPLS LDP, page 2](#)
- [How to Implement MPLS LDP, page 16](#)
- [Configuration Examples for Implementing MPLS LDP, page 48](#)
- [Additional References, page 56](#)

## Prerequisites for Implementing Cisco MPLS LDP

These prerequisites are required to implement MPLS LDP:

- You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.
- You must be running Cisco IOS XR software.
- You must install a composite mini-image and the MPLS package.
- You must activate IGP.
- We recommend to use a lower session holdtime bandwidth such as neighbors so that a session down occurs before an adjacency-down on a neighbor. Therefore, the following default values for the hello times are listed:
  - Holdtime is 15 seconds.
  - Interval is 5 seconds.

For example, the LDP session holdtime can be configured as 30 seconds by using the **holdtime** command.

## Information About Implementing Cisco MPLS LDP

To implement MPLS LDP, you should understand these concepts:

## Overview of Label Distribution Protocol

LDP performs label distribution in MPLS environments. LDP uses hop-by-hop or dynamic path setup, but does not provide end-to-end switching services. Labels are assigned to routes that are chosen by the underlying IGP routing protocols. The Label Switched Paths (LSPs) that result from the routes, forward labeled traffic across the MPLS backbone to adjacent nodes.

### Label Switched Paths

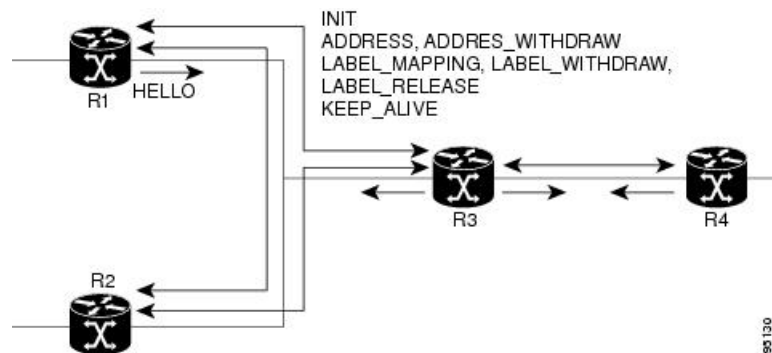
LSPs are created in the network through MPLS. They can be created statically, by RSVP traffic engineering (TE), or by LDP. LSPs created by LDP perform hop-by-hop path setup instead of an end-to-end path.

### LDP Control Plane

The control plane enables label switched routers (LSRs) to discover their potential peer routers and to establish LDP sessions with those peers to exchange label binding information.

This figure shows the control messages exchanged between LDP peers.

**Figure 1: LDP Control Protocol**



LDP uses the hello discovery mechanism to discover its neighbor or peer on the network. When LDP is enabled on an interface, it sends hello messages to a link-local multicast address, and joins a specific multicast group to receive hellos from other LSRs present on the given link. When LSRs on a given link receive hellos, their neighbors are discovered and the LDP session (using TCP) is established.



#### Note

Hellos are not only used to discover and trigger LDP sessions; they are also required to maintain LDP sessions. If a certain number of hellos from a given peer are missed in sequence, LDP sessions are brought down until the peer is discovered again.

LDP also supports non-link neighbors that could be multiple hops away on the network, using the targeted hello mechanism. In these cases, hellos are sent on a directed, unicast address.

The first message in the session establishment phase is the initialization message, which is used to negotiate session parameters. After session establishment, LDP sends a list of all its interface addresses to its peers in an address message. Whenever a new address becomes available or unavailable, the peers are notified regarding such changes via ADDRESS or ADDRESS\_WITHDRAW messages respectively.

When MPLS LDP learns an IGP prefix it allocates a label locally as the inbound label. The local binding between the prefix label is conveyed to its peers via LABEL\_MAPPING message. If the binding breaks and becomes unavailable, a LABEL\_WITHDRAW message is sent to all its peers, which responds with LABEL\_RELEASE messages.

The local label binding and remote label binding received from its peer(s) is used to setup forwarding entries. Using routing information from the IGP protocol and the forwarding information base (FIB), the next active hop is selected. Label binding is learned from the next hop peer, and is used as the outbound label while setting up the forwarding plane.

The LDP session is also kept alive using the LDP keepalive mechanism, where an LSR sends a keepalive message periodically to its peers. If no messages are received and a certain number of keepalive messages are missed from a peer, the session is declared dead, and brought down immediately.

### Related Topics

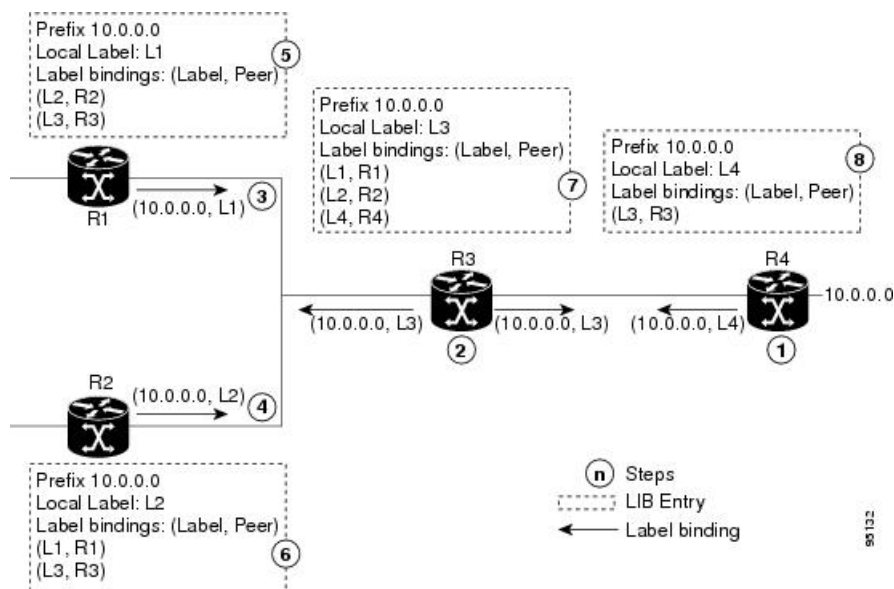
- [Configuring LDP Discovery Parameters, on page 16](#)
- [Configuring LDP Discovery Over a Link, on page 18](#)
- [Configuring LDP Link: Example, on page 48](#)
- [Configuring LDP Discovery for Active Targeted Hellos, on page 20](#)
- [Configuring LDP Discovery for Passive Targeted Hellos, on page 22](#)
- [Configuring LDP Discovery for Targeted Hellos: Example, on page 49](#)

## Exchanging Label Bindings

LDP creates LSPs to perform the hop-by-hop path setup so that MPLS packets can be transferred between the nodes on the MPLS network.

This figure illustrates the process of label binding exchange for setting up LSPs.

**Figure 2: Setting Up Label Switched Paths**



For a given network (10.0.0.0), hop-by-hop LSPs are set up between each of the adjacent routers (or, nodes) and each node allocates a local label and passes it to its neighbor as a binding:

- 1 R4 allocates local label L4 for prefix 10.0.0.0 and advertises it to its neighbors (R3).
- 2 R3 allocates local label L3 for prefix 10.0.0.0 and advertises it to its neighbors (R1, R2, R4).
- 3 R1 allocates local label L1 for prefix 10.0.0.0 and advertises it to its neighbors (R2, R3).
- 4 R2 allocates local label L2 for prefix 10.0.0.0 and advertises it to its neighbors (R1, R3).
- 5 R1's label information base (LIB) keeps local and remote labels bindings from its neighbors.
- 6 R2's LIB keeps local and remote labels bindings from its neighbors.
- 7 R3's LIB keeps local and remote labels bindings from its neighbors.
- 8 R4's LIB keeps local and remote labels bindings from its neighbors.

**Related Topics**

[Setting Up LDP Neighbors, on page 25](#)

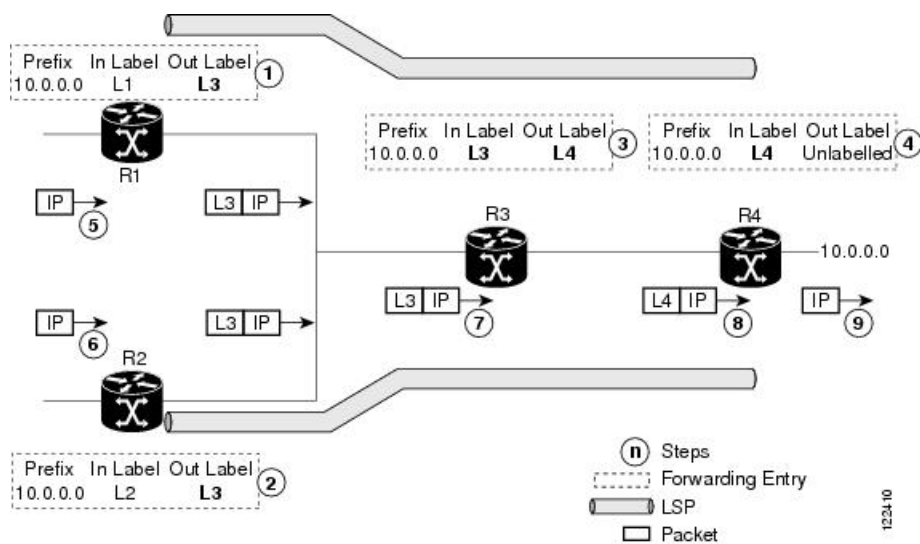
[Configuring LDP Neighbors: Example, on page 50](#)

**LDP Forwarding**

Once label bindings are learned, the LDP control plane is ready to setup the MPLS forwarding plane as shown in the following figure.

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**Figure 3: Forwarding Setup**



- 1 Because R3 is next hop for 10.0.0.0 as notified by the FIB, R1 selects label binding from R3 and installs forwarding entry (Layer 1, Layer 3).

- 2 Because R3 is next hop for 10.0.0.0 (as notified by FIB), R2 selects label binding from R3 and installs forwarding entry (Layer 2, Layer 3).
- 3 Because R4 is next hop for 10.0.0.0 (as notified by FIB), R3 selects label binding from R4 and installs forwarding entry (Layer 3, Layer 4).
- 4 Because next hop for 10.0.0.0 (as notified by FIB) is beyond R4, R4 uses NO-LABEL as the outbound and installs the forwarding entry (Layer 4); the outbound packet is forwarded IP-only.
- 5 Incoming IP traffic on ingress LSR R1 gets label-imposed and is forwarded as an MPLS packet with label L3.
- 6 Incoming IP traffic on ingress LSR R2 gets label-imposed and is forwarded as an MPLS packet with label L3.
- 7 R3 receives an MPLS packet with label L3, looks up in the MPLS label forwarding table and switches this packet as an MPLS packet with label L4.
- 8 R4 receives an MPLS packet with label L4, looks up in the MPLS label forwarding table and finds that it should be Unlabeled, pops the top label, and passes it to the IP forwarding plane.
- 9 IP forwarding takes over and forwards the packet onward.

### Related Topics

[Setting Up LDP Forwarding, on page 27](#)

[Configuring LDP Forwarding: Example, on page 50](#)

## LDP Graceful Restart

LDP (Label Distribution Protocol) graceful restart provides a control plane mechanism to ensure high availability and allows detection and recovery from failure conditions while preserving Nonstop Forwarding (NSF) services. Graceful restart is a way to recover from signaling and control plane failures without impacting forwarding.

Without LDP graceful restart, when an established session fails, the corresponding forwarding states are cleaned immediately from the restarting and peer nodes. In this case LDP forwarding restarts from the beginning, causing a potential loss of data and connectivity.

The LDP graceful restart capability is negotiated between two peers during session initialization time, in FT SESSION TLV. In this typed length value (TLV), each peer advertises the following information to its peers:

### Reconnect time

Advertises the maximum time that other peer will wait for this LSR to reconnect after control channel failure.

### Recovery time

Advertises the maximum time that the other peer has on its side to reinstate or refresh its states with this LSR. This time is used only during session reestablishment after earlier session failure.

### FT flag

Specifies whether a restart could restore the preserved (local) node state for this flag.

Once the graceful restart session parameters are conveyed and the session is up and running, graceful restart procedures are activated.

When configuring the LDP graceful restart process in a network with multiple links, targeted LDP hello adjacencies with the same neighbor, or both, make sure that graceful restart is activated on the session before any hello adjacency times out in case of neighbor control plane failures. One way of achieving this is by configuring a lower session hold time between neighbors such that session timeout occurs before hello adjacency timeout. It is recommended to set LDP session hold time using the following formula:

$$\text{Session Holdtime} \leq (\text{Hello holdtime} - \text{Hello interval}) * 3$$

This means that for default values of 15 seconds and 5 seconds for link Hello holdtime and interval respectively, session hold time should be set to 30 seconds at most.

For more information about LDP commands, see *MPLS Label Distribution Protocol Commands* module of the *Cisco IOS XR MPLS Command Reference for the Cisco XR 12000 Series Router*.

**Related Topics**

[Setting Up LDP NSF Using Graceful Restart, on page 29](#)

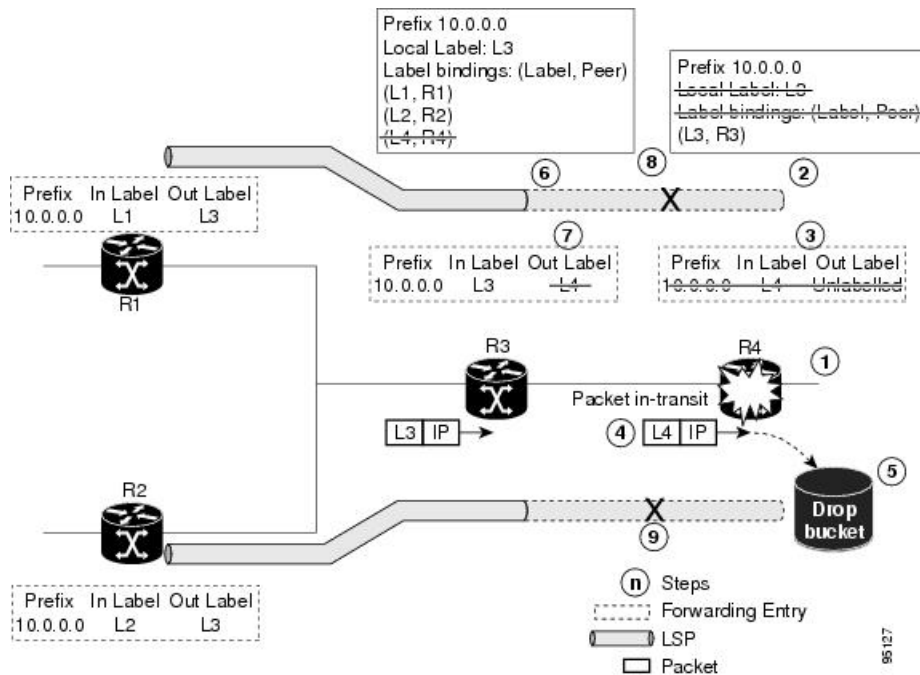
[Configuring LDP Nonstop Forwarding with Graceful Restart: Example, on page 50](#)

**Control Plane Failure**

When a control plane failure occurs, connectivity can be affected. The forwarding states installed by the router control planes are lost, and the in-transit packets could be dropped, thus breaking NSF.

This figure illustrates a control plane failure and shows the process and results of a control plane failure leading to loss of connectivity.

**Figure 4: Control Plane Failure**



- 1 The R4 LSR control plane restarts.
- 2 LIB is lost when the control plane restarts.
- 3 The forwarding states installed by the R4 LDP control plane are immediately deleted.
- 4 Any in-transit packets flowing from R3 to R4 (still labeled with L4) arrive at R4.
- 5 The MPLS forwarding plane at R4 performs a lookup on local label L4 which fails. Because of this failure, the packet is dropped and NSF is not met.
- 6 The R3 LDP peer detects the failure of the control plane channel and deletes its label bindings from R4.
- 7 The R3 control plane stops using outgoing labels from R4 and deletes the corresponding forwarding state (rewrites), which in turn causes forwarding disruption.
- 8 The established LSPs connected to R4 are terminated at R3, resulting in broken end-to-end LSPs from R1 to R4.
- 9 The established LSPs connected to R4 are terminated at R3, resulting in broken LSPs end-to-end from R2 to R4.

## Phases in Graceful Restart

The graceful restart mechanism is divided into different phases:

### Control communication failure detection

Control communication failure is detected when the system detects either:

- Missed LDP hello discovery messages
- Missed LDP keepalive protocol messages
- Detection of Transmission Control Protocol (TCP) disconnection a with a peer

### Forwarding state maintenance during failure

Persistent forwarding states at each LSR are achieved through persistent storage (checkpoint) by the LDP control plane. While the control plane is in the process of recovering, the forwarding plane keeps the forwarding states, but marks them as stale. Similarly, the peer control plane also keeps (and marks as stale) the installed forwarding rewrites associated with the node that is restarting. The combination of local node forwarding and remote node forwarding plane states ensures NSF and no disruption in the traffic.

### Control state recovery

Recovery occurs when the session is reestablished and label bindings are exchanged again. This process allows the peer nodes to synchronize and to refresh stale forwarding states.

### Related Topics

[Setting Up LDP NSF Using Graceful Restart, on page 29](#)

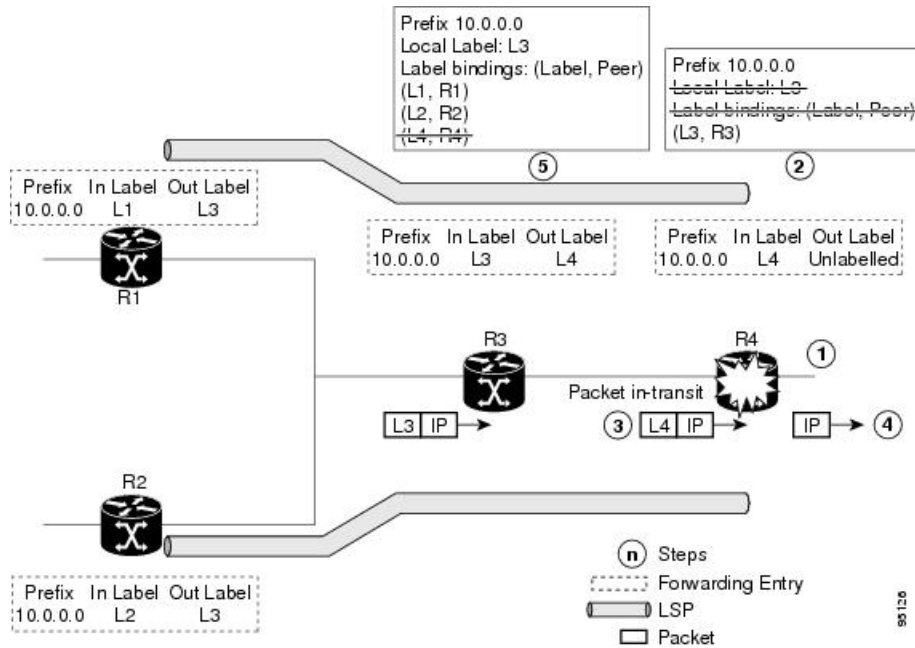
[Configuring LDP Nonstop Forwarding with Graceful Restart: Example, on page 50](#)



## Recovery with Graceful-Restart

This figure illustrates the process of failure recovery using graceful restart.

**Figure 5: Recovering with Graceful Restart**



- 1 The router R4 LSR control plane restarts.
- 2 With the control plane restart, LIB is gone but forwarding states installed by R4's LDP control plane are not immediately deleted but are marked as stale.
- 3 Any in-transit packets from R3 to R4 (still labeled with L4) arrive at R4.
- 4 The MPLS forwarding plane at R4 performs a successful lookup for the local label L4 as forwarding is still intact. The packet is forwarded accordingly.
- 5 The router R3 LDP peer detects the failure of the control plane and channel and deletes the label bindings from R4. The peer, however, does not delete the corresponding forwarding states but marks them as stale.
- 6 At this point there are no forwarding disruptions.
- 7 The peer also starts the neighbor reconnect timer using the reconnect time value.
- 8 The established LSPs going toward the router R4 are still intact, and there are no broken LSPs.

When the LDP control plane recovers, the restarting LSR starts its forwarding state hold timer and restores its forwarding state from the checkpointed data. This action reinstates the forwarding state and entries and marks them as old.

The restarting LSR reconnects to its peer, indicated in the FT Session TLV, that it either was or was not able to restore its state successfully. If it was able to restore the state, the bindings are resynchronized.

The peer LSR stops the neighbor reconnect timer (started by the restarting LSR), when the restarting peer connects and starts the neighbor recovery timer. The peer LSR checks the FT Session TLV if the restarting

peer was able to restore its state successfully. It reinstates the corresponding forwarding state entries and receives binding from the restarting peer. When the recovery timer expires, any forwarding state that is still marked as stale is deleted.

If the restarting LSR fails to recover (restart), the restarting LSR forwarding state and entries will eventually timeout and is deleted, while neighbor-related forwarding states or entries are removed by the Peer LSR on expiration of the reconnect or recovery timers.

#### Related Topics

[Setting Up LDP NSF Using Graceful Restart, on page 29](#)

[Configuring LDP Nonstop Forwarding with Graceful Restart: Example, on page 50](#)

## Label Advertisement Control (Outbound Filtering)

By default, LDP advertises labels for all the prefixes to all its neighbors. When this is not desirable (for scalability and security reasons), you can configure LDP to perform outbound filtering for local label advertisement for one or more prefixes to one more peers. This feature is known as *LDP outbound label filtering*, or *local label advertisement control*.

#### Related Topics

[Configuring Label Advertisement Control \(Outbound Filtering\), on page 23](#)

[Configuring Label Advertisement \(Outbound Filtering\): Example, on page 49](#)

## Label Acceptance Control (Inbound Filtering)

By default, LDP accepts labels (as remote bindings) for all prefixes from all peers. LDP operates in liberal label retention mode, which instructs LDP to keep remote bindings from all peers for a given prefix. For security reasons, or to conserve memory, you can override this behavior by configuring label binding acceptance for set of prefixes from a given peer.

The ability to filter remote bindings for a defined set of prefixes is also referred to as *LDP inbound label filtering*.



#### Note

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Inbound filtering can also be implemented using an outbound filtering policy; however, you may not be able to implement this system if an LDP peer resides under a different administration domain. When both inbound and outbound filtering options are available, we recommend that you use outbound label filtering.

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#### Related Topics

[Configuring Label Acceptance Control \(Inbound Filtering\), on page 31](#)

[Configuring Label Acceptance \(Inbound Filtering\): Example, on page 51](#)

## Local Label Allocation Control

By default, LDP allocates local labels for all prefixes that are not Border Gateway Protocol (BGP) prefixes<sup>1</sup>. This is acceptable when LDP is used for applications other than Layer 3 virtual private networks (L3VPN) core transport. When LDP is used to set up transport LSPs for L3VPN traffic in the core, it is not efficient or even necessary to allocate and advertise local labels for, potentially, thousands of IGP prefixes. In such a case, LDP is typically required to allocate and advertise local label for loopback /32 addresses for PE routers. This is accomplished using LDP local label allocation control, where an access list can be used to limit allocation of local labels to a set of prefixes. Limiting local label allocation provides several benefits, including reduced memory usage requirements, fewer local forwarding updates, and fewer network and peer updates.

**Tip**

You can configure label allocation using an IP access list to specify a set of prefixes that local labels can allocate and advertise.

**Related Topics**

[Configuring Local Label Allocation Control, on page 33](#)

[Configuring Local Label Allocation Control: Example, on page 51](#)

## Session Protection

When a link comes up, IP converges earlier and much faster than MPLS LDP and may result in MPLS traffic loss until MPLS convergence. If a link flaps, the LDP session will also flap due to loss of link discovery. LDP session protection minimizes traffic loss, provides faster convergence, and protects existing LDP (link) sessions by means of “parallel” source of targeted discovery hello. An LDP session is kept alive and neighbor label bindings are maintained when links are down. Upon reestablishment of primary link adjacencies, MPLS convergence is expedited as LDP need not relearn the neighbor label bindings.

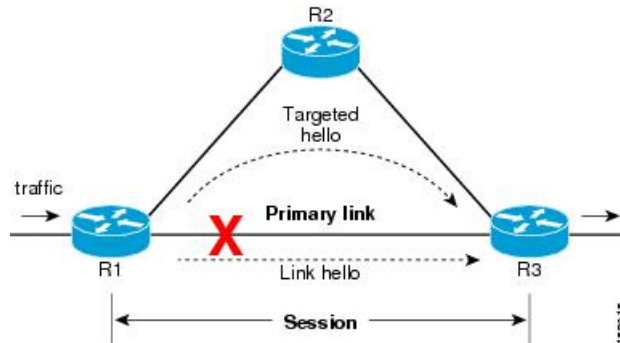
LDP session protection lets you configure LDP to automatically protect sessions with all or a given set of peers (as specified by peer-acl). When configured, LDP initiates backup targeted hellos automatically for neighbors for which primary link adjacencies already exist. These backup targeted hellos maintain LDP sessions when primary link adjacencies go down.

The Session Protection figure illustrates LDP session protection between neighbors R1 and R3. The primary link adjacency between R1 and R3 is directly connected link and the backup; targeted adjacency is maintained between R1 and R3. If the direct link fails, LDP link adjacency is destroyed, but the session is kept up and

<sup>1</sup> For L3VPN Inter-AS option C, LDP may also be required to assign local labels for some BGP prefixes.

running using targeted hello adjacency (through R2). When the direct link comes back up, there is no change in the LDP session state and LDP can converge quickly and begin forwarding MPLS traffic.

**Figure 6: Session Protection**



**Note** When LDP session protection is activated (upon link failure), protection is maintained for an unlimited period time.

### Related Topics

[Configuring Session Protection, on page 34](#)

[Configuring LDP Session Protection: Example, on page 51](#)

## IGP Synchronization

Lack of synchronization between LDP and IGP can cause MPLS traffic loss. Upon link up, for example, IGP can advertise and use a link before LDP convergence has occurred; or, a link may continue to be used in IGP after an LDP session goes down.

LDP IGP synchronization synchronizes LDP and IGP so that IGP advertises links with regular metrics only when MPLS LDP is converged on that link. LDP considers a link converged when at least one LDP session is up and running on the link for which LDP has sent its applicable label bindings and received at least one label binding from the peer. LDP communicates this information to IGP upon link up or session down events and IGP acts accordingly, depending on sync state.

In the event of an LDP graceful restart session disconnect, a session is treated as converged as long as the graceful restart neighbor is timed out. Additionally, upon local LDP restart, a checkpointed recovered LDP graceful restart session is used and treated as converged and is given an opportunity to connect and resynchronize.

Under certain circumstances, it might be required to delay declaration of resynchronization to a configurable interval. LDP provides a configuration option to delay declaring synchronization up for up to 60 seconds. LDP communicates this information to IGP upon linkup or session down events.

**Note**

The configuration for LDP IGP synchronization resides in respective IGPs (OSPF and IS-IS) and there is no LDP-specific configuration for enabling of this feature. However, there is a specific LDP configuration for IGP sync delay timer.

**Related Topics**

- [Configuring LDP IGP Synchronization: OSPF, on page 35](#)
- [Configuring LDP IGP Synchronization—OSPF: Example, on page 52](#)
- [Configuring LDP IGP Synchronization: ISIS, on page 36](#)
- [Configuring LDP IGP Synchronization—ISIS: Example, on page 52](#)
- [Configuring LDP IGP Synchronization Delay Interval, on page 38](#)

## IGP Auto-configuration

To enable LDP on a large number of interfaces, IGP auto-configuration lets you automatically configure LDP on all interfaces associated with a specified IGP interface; for example, when LDP is used for transport in the core network. However, there needs to be one IGP set up to enable LDP auto-configuration.

Typically, LDP assigns and advertises labels for IGP routes and must often be enabled on all active interfaces by an IGP. Without IGP auto-configuration, you must define the set of interfaces under LDP, a procedure that is time-intensive and error-prone.

**Note**

LDP auto-configuration is supported for IPv4 unicast family in the default VRF. The IGP is responsible for verifying and applying the configuration.

You can also disable auto-configuration on a per-interface basis. This permits LDP to enable all IGP interfaces except those that are explicitly disabled and prevents LDP from enabling an interface when LDP auto-configuration is configured under IGP.

**Related Topics**

- [Enabling LDP Auto-Configuration for a Specified OSPF Instance, on page 40](#)
- [Enabling LDP Auto-Configuration in an Area for a Specified OSPF Instance, on page 42](#)
- [Disabling LDP Auto-Configuration, on page 44](#)
- [Configuring LDP Auto-Configuration: Example, on page 52](#)

## IGP Synchronization Process Restart Delay

In the LDP IGP synchronization process, failures and restarts bear a heavy stress on the network. Multiple IGP synchronization notifications from LDP to IGP, and potential generation of multiple SPF and LSAs are known to effect the CPU load considerably. This results in considerable traffic loss when the LDP process fails.

The LDP IGP Synchronization Process Restart Delay is a feature that enables a process-level delay for synchronization events when the LDP fails or restarts. This delay defers the sending of sync-up events to the IGP until most or all the LDP sessions converge and also allows the LDP to stabilize. This allows the LDP

process failure to be less stressful, since IGP receive all the sync-up events in one bulk. This means that IGP is required to run the SPF and LSAs only one time with an overall view of the sync-up events.

**Note**

By default the IGP Synchronization Process Restart Delay is disabled and can be enabled by running the configuration command **mpls ldp igp sync delay on-proc-restart** .

**Related Topics**

[Configuring LDP IGP Synchronization Process Restart Delay, on page 39](#)

## LDP Nonstop Routing

LDP nonstop routing (NSR) functionality makes failures, such as Route Processor (RP) or Distributed Route Processor (DRP) failover, invisible to routing peers with minimal to no disruption of convergence performance. By default, NSR is globally enabled on all LDP sessions except AToM.

A disruption in service may include any of these events:

- Route processor (RP) or distributed route processor (DRP) failover
- LDP process restart
- In-service system upgrade (ISSU)
- Minimum disruption restart (MDR)

**Note**

Unlike graceful restart functionality, LDP NSR does not require protocol extensions and does not force software upgrades on other routers in the network, nor does LDP NSR require peer routers to support NSR.

Process failures of active TCP or LDP results in session loss and, as a result, NSR cannot be provided unless RP switchover is configured as a recovery action. For more information about how to configure switchover as a recovery action for NSR, see *Configuring Transports* module in *Cisco IOS XR IP Addresses and Services Configuration Guide for the Cisco XR 12000 Series Router*.

**Related Topics**

[Configuring LDP Nonstop Routing, on page 45](#)

## IP LDP Fast Reroute Loop Free Alternate

The IP Fast Reroute is a mechanism that enables a router to rapidly switch traffic, after an adjacent link failure, node failure, or both, towards a pre-programmed loop-free alternative (LFA) path. This LFA path is used to switch traffic until the router installs a new primary next hop again, as computed for the changed network topology.

The goal of LFA FRR is to reduce failure reaction time to 50 milliseconds by using a pre-computed alternate next hop, in the event that the currently selected primary next hop fails, so that the alternate can be rapidly used when the failure is detected.

This feature targets to address the fast convergence ability by detecting, computing, updating or enabling prefix independent pre-computed alternate loop-free paths at the time of failure.

IGP pre-computes a backup path per IGP prefix. IGP selects one and only one backup path per primary path. RIB installs the best path and download path protection information to FIB by providing correct annotation for protected and protecting paths. FIB pre-installs the backup path in dataplane. Upon the link or node failure, the routing protocol detects the failure, all the backup paths of the impacted prefixes are enabled in a prefix-independent manner.

### Prerequisites

The Label Distribution Protocol (LDP) can use the loop-free alternates as long as these prerequisites are met:

The Label Switching Router (LSR) running LDP must distribute its labels for the Forwarding Equivalence Classes (FECs) it can provide to all its neighbors, regardless of whether they are upstream, or not.

There are two approaches in computing LFAs:

- **Link-based (per-link)**--In link-based LFAs, all prefixes reachable through the primary (protected) link share the same backup information. This means that the whole set of prefixes, sharing the same primary, also share the repair or fast reroute (FRR) ability. The per-link approach protects only the next hop address. The per-link approach is suboptimal and not the best for capacity planning. This is because all traffic is redirected to the next hop instead of being spread over multiple paths, which may lead to potential congestion on link to the next hop. The per-link approach does not provide support for node protection.
- **Prefix-based (per-prefix)**--Prefix-based LFAs allow computing backup information per prefix. It protects the destination address. The per-prefix approach is the preferred approach due to its greater applicability, and the greater protection and better bandwidth utilization that it offers.




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**Note** The repair or backup information computed for a given prefix using prefix-based LFA may be different from the computed by link-based LFA.

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The per-prefix LFA approach is preferred for LDP IP Fast Reroute LFA for these reasons:

- Better node failure resistance
- Better capacity planning and coverage

### Features Not Supported

These interfaces and features are not supported for the IP LDP Fast Reroute Loop Free Alternate feature:

- BVI interface (IRB) is not supported either as primary or backup path.
- GRE tunnel is not supported either as primary or backup path.
- In a multi-topology scenerio, the route in topology T can only use LFA within topology T. Hence, the availability of a backup path depends on the topology.

For more information about configuring the IP Fast Reroute Loop-free alternate , see Implementing IS-IS on Cisco IOS XR Software module of the *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*.

**Related Topics**

[Configure IP LDP Fast Reroute Loop Free Alternate: Examples, on page 53](#)

[Verify IP LDP Fast Reroute Loop Free Alternate: Example, on page 54](#)

## Downstream on Demand

This Downstream on demand feature adds support for downstream-on-demand mode, where the label is not advertised to a peer, unless the peer explicitly requests it. At the same time, since the peer does not automatically advertise labels, the label request is sent whenever the next-hop points out to a peer that no remote label has been assigned.

To enable downstream-on-demand mode, this configuration must be applied at mpls ldp configuration mode:

**mpls ldp downstream-on-demand with ACL**

The ACL contains a list of peer IDs that are configured for downstream-on-demand mode. When the ACL is changed or configured, the list of established neighbors is traversed. If a session's downstream-on-demand configuration has changed, the session is reset in order that the new downstream-on-demand mode can be configured. The reason for resetting the session is to ensure that the labels are properly advertised between the peers. When a new session is established, the ACL is verified to determine whether the session should negotiate for downstream-on-demand mode. If the ACL does not exist or is empty, downstream-on-demand mode is not configured for any neighbor.

For it to be enabled, the Downstream on demand feature has to be configured on both peers of the session. If only one peer in the session has downstream-on-demand feature configured, then the session does not use downstream-on-demand mode.

If, after, a label request is sent, and no remote label is received from the peer, the router will periodically resend the label request. After the peer advertises a label after receiving the label request, it will automatically readvertise the label if any label attribute changes subsequently.

**Related Topics**

[Configuring LDP Downstream on Demand mode, on page 47](#)

## How to Implement MPLS LDP

A typical MPLS LDP deployment requires coordination among several global neighbor routers. Various configuration tasks are required to implement MPLS LDP :

### Configuring LDP Discovery Parameters

Perform this task to configure LDP discovery parameters (which may be crucial for LDP operations).

**Note**


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The LDP discovery mechanism is used to discover or locate neighbor nodes.

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## SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **router-id** *ip-address*
4. **discovery { hello | targeted-hello } holdtime** *seconds*
5. **discovery { hello | targeted-hello } interval** *seconds*
6. Use the **commit** or **end** command.
7. (Optional) **show mpls ldp parameters**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
<b>Step 3</b>	<b>router-id</b> <i>ip-address</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>router-id 192.168.70.1</b>	Specifies the router ID of the local node.  <ul style="list-style-type: none"> <li>• In Cisco IOS XR software, the router ID is specified as an interface IP address. By default, LDP uses the global router ID (configured by the global router ID process).</li> </ul>
<b>Step 4</b>	<b>discovery { hello   targeted-hello } holdtime</b> <i>seconds</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>discovery hello holdtime 30</b> RP/0/0/CPU0:router(config-ldp)# <b>discovery targeted-hello holdtime 180</b>	Specifies the time that a discovered neighbor is kept without receipt of any subsequent hello messages. The default value for the <i>seconds</i> argument is 15 seconds for link hello and 90 seconds for targeted hello messages.
<b>Step 5</b>	<b>discovery { hello   targeted-hello } interval</b> <i>seconds</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>discovery hello interval 15</b> RP/0/0/CPU0:router(config-ldp)# <b>discovery targeted-hello interval 20</b>	Selects the period of time between the transmission of consecutive hello messages. The default value for the <i>seconds</i> argument is 5 seconds for link hello messages and 10 seconds for targeted hello messages.

	Command or Action	Purpose
<b>Step 6</b>	Use the <b>commit</b> or <b>end</b> command.	<p><b>commit</b>—Saves the configuration changes and remains within the configuration session.</p> <p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
<b>Step 7</b>	<p><b>show mpls ldp parameters</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router # show mpls ldp parameters</pre>	<p>(Optional)</p> <p>Displays all the current MPLS LDP parameters.</p>

### Related Topics

[LDP Control Plane, on page 3](#)

## Configuring LDP Discovery Over a Link

Perform this task to configure LDP discovery over a link.



**Note** There is no need to enable LDP globally.

### Before You Begin

A stable router ID is required at either end of the link to ensure the link discovery (and session setup) is successful. If you do not assign a router ID to the routers, the system will default to the global router ID. Default router IDs are subject to change and may cause an unstable discovery.

## SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **router-id** *ip-address*
4. **interface** *type interface-path-id*
5. Use the **commit** or **end** command.
6. (Optional) **show mpls ldp discovery**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
Step 2	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router (config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
Step 3	<b>router-id</b> <i>ip-address</i>  <b>Example:</b> RP/0/0/CPU0:router (config-ldp)# <b>router-id 192.168.70.1</b>	Specifies the router ID of the local node. <ul style="list-style-type: none"> <li>• In Cisco IOS XR software, the router ID is specified as an interface name or IP address. By default, LDP uses the global router ID (configured by the global router ID process).</li> </ul>
Step 4	<b>interface</b> <i>type interface-path-id</i>  <b>Example:</b> RP/0/0/CPU0:router (config-ldp)# <b>interface tunnel-te 12001</b> RP/0/0/CPU0:router (config-ldp-if)#	Enters interface configuration mode for the LDP protocol. Interface type must be Tunnel-TE.
Step 5	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

	Command or Action	Purpose
Step 6	<b>show mpls ldp discovery</b>  <b>Example:</b>  RP/0/0/CPU0:router# <b>show mpls ldp discovery</b>	(Optional) Displays the status of the LDP discovery process. This command, without an interface filter, generates a list of interfaces over which the LDP discovery process is running. The output information contains the state of the link (xmt/rcv hellos), local LDP identifier, the discovered peer's LDP identifier, and holdtime values.

### Related Topics

[LDP Control Plane, on page 3](#)

[Configuring LDP Link: Example, on page 48](#)

## Configuring LDP Discovery for Active Targeted Hellos

Perform this task to configure LDP discovery for active targeted hellos.



### Note

The active side for targeted hellos initiates the unicast hello toward a specific destination.

### Before You Begin

These prerequisites are required to configure LDP discovery for active targeted hellos:

- Stable router ID is required at either end of the targeted session. If you do not assign a router ID to the routers, the system will default to the global router ID. Please note that default router IDs are subject to change and may cause an unstable discovery.
- One or more MPLS Traffic Engineering tunnels are established between non-directly connected LSRs.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **router-id** *ip-address*
4. **interface** *type interface-path-id*
5. Use the **commit** or **end** command.
6. (Optional) **show mpls ldp discovery**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
<b>Step 3</b>	<b>router-id</b> <i>ip-address</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>router-id 192.168.70.1</b>	Specifies the router ID of the local node.  In Cisco IOS XR software, the router ID is specified as an interface name or IP address. By default, LDP uses the global router ID (configured by global router ID process).
<b>Step 4</b>	<b>interface</b> <i>type interface-path-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>interface tunnel-te 12001</b>	Enters interface configuration mode for the LDP protocol.
<b>Step 5</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.  <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
<b>Step 6</b>	<b>show mpls ldp discovery</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>show mpls ldp discovery</b>	(Optional) Displays the status of the LDP discovery process. This command, without an interface filter, generates a list of interfaces over which the LDP discovery process is running. The output information contains the state of the link (xmt/rcv hellos), local LDP identifier, the discovered peer's LDP identifier, and holdtime values.

## Related Topics

[LDP Control Plane, on page 3](#)

[Configuring LDP Discovery for Targeted Hellos: Example, on page 49](#)

## Configuring LDP Discovery for Passive Targeted Hellos

Perform this task to configure LDP discovery for passive targeted hellos.

A passive side for targeted hello is the destination router (tunnel tail), which passively waits for an incoming hello message. Because targeted hellos are unicast, the passive side waits for an incoming hello message to respond with hello toward its discovered neighbor.

### Before You Begin

Stable router ID is required at either end of the link to ensure that the link discovery (and session setup) is successful. If you do not assign a router ID to the routers, the system defaults to the global router ID. Default router IDs are subject to change and may cause an unstable discovery.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **router-id** *ip-address*
4. **discovery targeted-hello accept**
5. Use the **commit** or **end** command.
6. (Optional) **show mpls ldp discovery**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <code>mpls ldp</code>	Enters MPLS LDP configuration mode.
<b>Step 3</b>	<b>router-id</b> <i>ip-address</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <code>router-id 192.168.70.1</code>	Specifies the router ID of the local node. <ul style="list-style-type: none"> <li>• In Cisco IOS XR software, the router ID is specified as an interface IP address. By default, LDP uses the global router ID (configured by global router ID process).</li> </ul>

	Command or Action	Purpose
Step 4	<b>discovery targeted-hello accept</b>  <b>Example:</b> <pre>RP/0/0/CPU0:router(config-ldp)# discovery targeted-hello accept</pre>	Directs the system to accept targeted hello messages from any source and activates passive mode on the LSR for targeted hello acceptance. <ul style="list-style-type: none"> <li>• This command is executed on the receiver node (with respect to a given MPLS TE tunnel).</li> <li>• You can control the targeted-hello acceptance using the <b>discovery targeted-hello accept</b> command.</li> </ul>
Step 5	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
Step 6	<b>show mpls ldp discovery</b>  <b>Example:</b> <pre>RP/0/0/CPU0:router# show mpls ldp discovery</pre>	(Optional) Displays the status of the LDP discovery process. This command, without an interface filter, generates a list of interfaces over which the LDP discovery process is running. The output information contains the state of the link (xmt/rcv hellos), local LDP identifier, the discovered peer's LDP identifier, and holdtime values.

### Related Topics

[LDP Control Plane, on page 3](#)

[Configuring LDP Discovery for Targeted Hellos: Example, on page 49](#)

## Configuring Label Advertisement Control (Outbound Filtering)

Perform this task to configure label advertisement (outbound filtering).

By default, a label switched router (LSR) advertises all incoming label prefixes to each neighboring router. You can control the exchange of label binding information using the **mpls ldp label advertise** command. Using the optional keywords, you can advertise selective prefixes to all neighbors, advertise selective prefixes to defined neighbors, or disable label advertisement to all peers for all prefixes.



### Note

Prefixes and peers advertised selectively are defined in the access list.

**Before You Begin**

Before configuring label advertisement, enable LDP and configure an access list.

**SUMMARY STEPS**

1. **configure**
2. **mpls ldp**
3. **label advertise** { **disable** | **for** *prefix-acl* [ **to** *peer-acl* ] | **interface** *type interface-path-id* }
4. Use the **commit** or **end** command.

**DETAILED STEPS**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
<b>Step 3</b>	<b>label advertise</b> { <b>disable</b>   <b>for</b> <i>prefix-acl</i> [ <b>to</b> <i>peer-acl</i> ]   <b>interface</b> <i>type interface-path-id</i> }  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>label advertise interface POS 0/1/0/0</b> RP/0/0/CPU0:router(config-ldp)# <b>for pfx_acl1 to peer_acl1</b>	Configures label advertisement by specifying one of the following options:  <b>disable</b> Disables label advertisement to all peers for all prefixes (if there are no other conflicting rules).  <b>interface</b> Specifies an interface for label advertisement of an interface address.  <b>for</b> <i>prefix-acl</i> <b>to</b> <i>peer-acl</i> Specifies neighbors to advertise and receive label advertisements.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.  <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> </ul>



	Command or Action	Purpose
		<ul style="list-style-type: none"> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

**Related Topics**

[Label Advertisement Control \(Outbound Filtering\), on page 10](#)

[Configuring Label Advertisement \(Outbound Filtering\): Example, on page 49](#)

## Setting Up LDP Neighbors

Perform this task to set up LDP neighbors.

**Before You Begin**

Stable router ID is required at either end of the link to ensure the link discovery (and session setup) is successful. If you do not assign a router ID to the routers, the system will default to the global router ID. Default router IDs are subject to change and may cause an unstable discovery.

**SUMMARY STEPS**

1. **configure**
2. **mpls ldp**
3. **interface** *type interface-path-id*
4. **discovery transport-address** [ *ip-address* | **interface** ]
5. **exit**
6. **holdtime** *seconds*
7. **neighbor** *ip-address* **password** [ *encryption* ] *password*
8. **backoff** *initial maximum*
9. Use the **commit** or **end** command.
10. (Optional) **show mpls ldp neighbor**

**DETAILED STEPS**

	Command or Action	Purpose
Step 1	<p><b>configure</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router# configure</pre>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
<b>Step 3</b>	<b>interface type interface-path-id</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>interface POS 0/1/0/0</b>	Enters interface configuration mode for the LDP protocol.
<b>Step 4</b>	<b>discovery transport-address [ ip-address   interface ]</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp-if)# <b>discovery transport-address 192.168.1.42</b>  or  RP/0/0/CPU0:router(config-ldp)# <b>discovery transport-address interface</b>	Provides an alternative transport address for a TCP connection. <ul style="list-style-type: none"> <li>• Default transport address advertised by an LSR (for TCP connections) to its peer is the router ID.</li> <li>• Transport address configuration is applied for a given LDP-enabled interface.</li> <li>• If the interface version of the command is used, the configured IP address of the interface is passed to its neighbors as the transport address.</li> </ul>
<b>Step 5</b>	<b>exit</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp-if)# <b>exit</b>	Exits the current configuration mode.
<b>Step 6</b>	<b>holdtime seconds</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>holdtime 30</b>	Changes the time for which an LDP session is maintained in the absence of LDP messages from the peer. <ul style="list-style-type: none"> <li>• Outgoing keepalive interval is adjusted accordingly (to make three keepalives in a given holdtime) with a change in session holdtime value.</li> <li>• Session holdtime is also exchanged when the session is established.</li> <li>• In this example holdtime is set to 30 seconds, which causes the peer session to timeout in 30 seconds, as well as transmitting outgoing keepalive messages toward the peer every 10 seconds.</li> </ul>
<b>Step 7</b>	<b>neighbor ip-address password [ encryption ] password</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>neighbor 192.168.2.44 password secretpasswd</b>	Configures password authentication (using the TCP MD5 option) for a given neighbor.

	Command or Action	Purpose
<b>Step 8</b>	<b>backoff</b> <i>initial maximum</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>backoff</b> <b>10 20</b>	Configures the parameters for the LDP backoff mechanism. The LDP backoff mechanism prevents two incompatibly configured LSRs from engaging in an unthrottled sequence of session setup failures. If a session setup attempt fails due to such incompatibility, each LSR delays its next attempt (backs off), increasing the delay exponentially with each successive failure until the maximum backoff delay is reached.
<b>Step 9</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
<b>Step 10</b>	<b>show mpls ldp neighbor</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>show mpls ldp</b> <b>neighbor</b>	(Optional) Displays the status of the LDP session with its neighbors. This command can be run with various filters as well as with the brief option.

### Related Topics

[Configuring LDP Neighbors: Example, on page 50](#)

## Setting Up LDP Forwarding

Perform this task to set up LDP forwarding.

By default, the LDP control plane implements the penultimate hop popping (PHOP) mechanism. The PHOP mechanism requires that label switched routers use the implicit-null label as a local label for the given Forwarding Equivalence Class (FEC) for which LSR is the penultimate hop. Although PHOP has certain advantages, it may be required to extend LSP up to the ultimate hop under certain circumstances (for example, to propagate MPL QoS). This is done using a special local label (explicit-null) advertised to the peers after which the peers use this label when forwarding traffic toward the ultimate hop (egress LSR).

### Before You Begin

Stable router ID is required at either end of the link to ensure the link discovery (and session setup) is successful. If you do not assign a router ID to the routers, the system will default to the global router ID. Default router IDs are subject to change and may cause an unstable discovery.

## SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **explicit-null**
4. Use the **commit** or **end** command.
5. (Optional) **show mpls ldp forwarding**
6. (Optional) **show mpls forwarding**
7. (Optional) **ping ip-address**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.
Step 2	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <code>mpls ldp</code>	Enters MPLS LDP configuration mode.
Step 3	<b>explicit-null</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <code>explicit-null</code>	Causes a router to advertise an explicit null label in situations where it normally advertises an implicit null label (for example, to enable an ultimate-hop disposition instead of PHOP).
Step 4	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.  <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
Step 5	<b>show mpls ldp forwarding</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>show mpls ldp forwarding</code>	(Optional) Displays the MPLS LDP view of installed forwarding states (rewrites).

	Command or Action	Purpose
Step 6	<b>show mpls forwarding</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>show mpls forwarding</b>	(Optional) Displays a global view of all MPLS installed forwarding states (rewrites) by various applications (LDP, TE, and static).
Step 7	<b>ping ip-address</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>ping 192.168.2.55</b>	(Optional) Checks for connectivity to a particular IP address (going through MPLS LSP as shown in the <b>show mpls forwarding</b> command).

### Related Topics

[LDP Forwarding, on page 5](#)

[Configuring LDP Forwarding: Example, on page 50](#)

## Setting Up LDP NSF Using Graceful Restart

Perform this task to set up NSF using LDP graceful restart.

LDP graceful restart is a way to enable NSF for LDP. The correct way to set up NSF using LDP graceful restart is to bring up LDP neighbors (link or targeted) with additional configuration related to graceful restart.

### Before You Begin

Stable router ID is required at either end of the link to ensure the link discovery (and session setup) is successful. If you do not assign a router ID to the routers, the system will default to the global router ID. Default router IDs are subject to change and may cause an unstable discovery.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **interface** *type interface-path-id*
4. **exit**
5. **graceful-restart**
6. **graceful-restart forwarding-state-holdtime** *seconds*
7. **graceful-restart reconnect-timeout** *seconds*
8. Use the **commit** or **end** command.
9. (Optional) **show mpls ldp parameters**
10. (Optional) **show mpls ldp neighbor**
11. (Optional) **show mpls ldp graceful-restart**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
Step 2	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
Step 3	<b>interface</b> <i>type interface-path-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>interface</b> <b>pos 0/1/0/0</b> RP/0/0/CPU0:router(config-ldp-if)#	Enters interface configuration mode for the LDP protocol.
Step 4	<b>exit</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp-if)# <b>exit</b>	Exits the current configuration mode.
Step 5	<b>graceful-restart</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>graceful-restart</b>	Enables the LDP graceful restart feature.
Step 6	<b>graceful-restart forwarding-state-holdtime</b> <i>seconds</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>graceful-restart</b> <b>forwarding-state-holdtime 180</b>	<p>Specifies the length of time that forwarding can keep LDP-installed forwarding states and rewrites, and specifies when the LDP control plane restarts.</p> <ul style="list-style-type: none"> <li>• After restart of the control plane, when the forwarding state holdtime expires, any previously installed LDP forwarding state or rewrite that is not yet refreshed is deleted from the forwarding.</li> <li>• Recovery time sent after restart is computed as the current remaining value of the forwarding state hold timer.</li> </ul>
Step 7	<b>graceful-restart reconnect-timeout</b> <i>seconds</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>graceful-restart reconnect-timeout 169</b>	Specifies the length of time a neighbor waits before restarting the node to reconnect before declaring an earlier graceful restart session as down. This command is used to start a timer on the peer (upon a neighbor restart). This timer is referred to as <i>Neighbor Liveness</i> timer.

	Command or Action	Purpose
<b>Step 8</b>	Use the <b>commit</b> or <b>end</b> command.	<p><b>commit</b>—Saves the configuration changes and remains within the configuration session.</p> <p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
<b>Step 9</b>	<p><b>show mpls ldp parameters</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router# show mpls ldp parameters</pre>	(Optional) Displays all the current MPLS LDP parameters.
<b>Step 10</b>	<p><b>show mpls ldp neighbor</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router# show mpls ldp neighbor</pre>	(Optional) Displays the status of the LDP session with its neighbors. This command can be run with various filters as well as with the brief option.
<b>Step 11</b>	<p><b>show mpls ldp graceful-restart</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router# show mpls ldp graceful-restart</pre>	(Optional) Displays the status of the LDP graceful restart feature. The output of this command not only shows states of different graceful restart timers, but also a list of graceful restart neighbors, their state, and reconnect count.

### Related Topics

[LDP Graceful Restart, on page 6](#)

[Phases in Graceful Restart, on page 8](#)

[Recovery with Graceful-Restart, on page 9](#)

[Configuring LDP Nonstop Forwarding with Graceful Restart: Example, on page 50](#)

## Configuring Label Acceptance Control (Inbound Filtering)

Perform this task to configure LDP inbound label filtering.

**Note**

By default, there is no inbound label filtering performed by LDP and thus an LSR accepts (and retains) all remote label bindings from all peers.

**SUMMARY STEPS**

1. **configure**
2. **mpls ldp**
3. **label accept for** *prefix-acl* **from** *ip-address*
4. Use the **commit** or **end** command.

**DETAILED STEPS**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <code>mpls ldp</code>	Enters the MPLS LDP configuration mode.
<b>Step 3</b>	<b>label accept for</b> <i>prefix-acl</i> <b>from</b> <i>ip-address</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <code>label accept for pfx_acl_1 from 192.168.1.1</code> RP/0/0/CPU0:router(config-ldp)# <code>label accept for pfx_acl_2 from 192.168.2.2</code>	Configures inbound label acceptance for prefixes specified by prefix-acl from neighbor (as specified by its IP address).
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.  <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>—Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>



**Related Topics**

[Label Acceptance Control \(Inbound Filtering\)](#), on page 10

[Configuring Label Acceptance \(Inbound Filtering\): Example](#), on page 51

## Configuring Local Label Allocation Control

Perform this task to configure label allocation control.

**Note**

By default, local label allocation control is disabled and all non-BGP prefixes are assigned local labels.

**SUMMARY STEPS**

1. **configure**
2. **mpls ldp**
3. **label allocate for** *prefix-acl*
4. Use the **commit** or **end** command.

**DETAILED STEPS**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <code>mpls ldp</code>	Enters the MPLS LDP configuration mode.
<b>Step 3</b>	<b>label allocate for</b> <i>prefix-acl</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <code>label allocate for pfx_acl_1</code>	Configures label allocation control for prefixes as specified by prefix-acl.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> </ul>

	Command or Action	Purpose
		<ul style="list-style-type: none"> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

### Related Topics

[Local Label Allocation Control](#), on page 11

[Configuring Local Label Allocation Control: Example](#), on page 51

## Configuring Session Protection

Perform this task to configure LDP session protection.

By default, there is no protection is done for link sessions by means of targeted hellos.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **session protection** [ *for peer-acl* ] [ **duration** *seconds* ]
4. Use the **commit** or **end** command.

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <code>mpls ldp</code>	Enters the MPLS LDP configuration mode.
<b>Step 3</b>	<b>session protection</b> [ <i>for peer-acl</i> ] [ <b>duration</b> <i>seconds</i> ]  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <code>session protection for peer_acl_1 duration 60</code>	Configures LDP session protection for peers specified by peer-acl with a maximum duration, in seconds.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.

	Command or Action	Purpose
		<p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

### Related Topics

[Session Protection, on page 11](#)

[Configuring LDP Session Protection: Example, on page 51](#)

## Configuring LDP IGP Synchronization: OSPF

Perform this task to configure LDP IGP Synchronization under OSPF.



### Note

By default, there is no synchronization between LDP and IGPs.

### SUMMARY STEPS

1. **configure**
2. **router ospf** *process-name*
3. Use one of the following commands:
  - **mpls ldp sync**
  - **area** *area-id* **mpls ldp sync**
  - **area** *area-id* **interface** *name* **mpls ldp sync**
4. Use the **commit** or **end** command.

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
<b>Step 2</b>	<b>router ospf process-name</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# router ospf 100	Identifies the OSPF routing process and enters OSPF configuration mode.
<b>Step 3</b>	Use one of the following commands: <ul style="list-style-type: none"> <li>• <b>mpls ldp sync</b></li> <li>• <b>area area-id mpls ldp sync</b></li> <li>• <b>area area-id interface name mpls ldp sync</b></li> </ul> <b>Example:</b> RP/0/0/CPU0:router(config-ospf)# mpls ldp sync	Enables LDP IGP synchronization on an interface.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

## Related Topics

[IGP Synchronization, on page 12](#)

[Configuring LDP IGP Synchronization—OSPF: Example, on page 52](#)

## Configuring LDP IGP Synchronization: ISIS

Perform this task to configure LDP IGP Synchronization under ISIS.



**Note** By default, there is no synchronization between LDP and ISIS.

## SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **interface** *type interface-path-id*
4. **address-family** **ipv4 unicast**
5. **mpls ldp sync**
6. Use the **commit** or **end** command.

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
<b>Step 2</b>	<b>router isis</b> <i>instance-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>router isis</b> 100 RP/0/0/CPU0:router(config-isis)#	Enables the Intermediate System-to-Intermediate System (IS-IS) routing protocol and defines an IS-IS instance.
<b>Step 3</b>	<b>interface</b> <i>type interface-path-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config-isis)# <b>interface</b> <b>POS 0/2/0/0</b> RP/0/0/CPU0:router(config-isis-if)#	Configures the IS-IS protocol on an interface and enters ISIS interface configuration mode.
<b>Step 4</b>	<b>address-family</b> <b>ipv4 unicast</b>  <b>Example:</b> RP/0/0/CPU0:router(config-isis-if)# <b>address-family</b> <b>ipv4 unicast</b> RP/0/0/CPU0:router(config-isis-if-af)#	Enters address family configuration mode for configuring IS-IS routing for a standard IP Version 4 (IPv4) address prefix.
<b>Step 5</b>	<b>mpls ldp sync</b>  <b>Example:</b> RP/0/0/CPU0:router(config-isis-if-af)# <b>mpls</b> <b>ldp sync</b>	Enables LDP IGP synchronization.
<b>Step 6</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.

	Command or Action	Purpose
		<p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

### Related Topics

[IGP Synchronization, on page 12](#)

[Configuring LDP IGP Synchronization—ISIS: Example, on page 52](#)

## Configuring LDP IGP Synchronization Delay Interval

Perform this task to configure the LDP IGP synchronization delay interval.

By default, LDP does not delay declaring sync up as soon as convergence conditions are met.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **igp sync delay** *delay-time*
4. Use the **commit** or **end** command.

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><b>configure</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router# configure</pre>	Enters global configuration mode.
<b>Step 2</b>	<p><b>mpls ldp</b></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router(config)# mpls ldp</pre>	Enters the MPLS LDP configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<p><code>igp sync delay <i>delay-time</i></code></p> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router(config-ldp)# <b>igp sync delay 30</b></pre>	Configures LDP IGP synchronization delay in seconds.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<p><b>commit</b>—Saves the configuration changes and remains within the configuration session.</p> <p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

### Related Topics

[IGP Synchronization, on page 12](#)

## Configuring LDP IGP Synchronization Process Restart Delay

Perform this task to enable process restart delay when an LDP fails or restarts.



### Note

By default, the LDP IGP Synchronization Process Restart Delay feature is disabled.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. Use one of the following commands:
  - `igp sync delay seconds`
  - `igp sync delay on-proc-restart delay-time`
4. Use the **commit** or **end** command.

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters the MPLS LDP configuration mode.
<b>Step 3</b>	Use one of the following commands: <ul style="list-style-type: none"> <li>• <b>igp sync delay</b> <i>seconds</i></li> <li>• <b>igp sync delay on-proc-restart</b> <i>delay-time</i></li> </ul> <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>igp sync delay</b> 30	Configures LDP IGP delay in seconds.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.  <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

## Related Topics

[IGP Synchronization Process Restart Delay](#), on page 13

## Enabling LDP Auto-Configuration for a Specified OSPF Instance

Perform this task to enable IGP auto-configuration globally for a specified OSPF process name.

You can disable auto-configuration on a per-interface basis. This lets LDP enable all IGP interfaces except those that are explicitly disabled.





**Note** This feature is supported for IPv4 unicast family in default VRF only.

## SUMMARY STEPS

1. **configure**
2. **router ospf** *process-name*
3. **mpls ldp auto-config**
4. **area** *area-id*
5. **interface** *type interface-path-id*
6. Use the **commit** or **end** command.

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
<b>Step 2</b>	<b>router ospf</b> <i>process-name</i>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>router ospf</b> 190 RP/0/0/CPU0:router(config-ospf)#	Enters a uniquely identifiable OSPF routing process. The process name is any alphanumeric string no longer than 40 characters without spaces.
<b>Step 3</b>	<b>mpls ldp auto-config</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ospf)# <b>mpls ldp auto-config</b>	Enables LDP auto-configuration.
<b>Step 4</b>	<b>area</b> <i>area-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ospf)# <b>area 8</b>	Configures an OSPF area and identifier.  <i>area-id</i>  Either a decimal value or an IP address.
<b>Step 5</b>	<b>interface</b> <i>type interface-path-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ospf-ar)# <b>interface pos 0/6/0/0</b>	Enables LDP auto-configuration on the specified interface.  <b>Note</b> LDP configurable limit for maximum number of interfaces does not apply to IGP auto-configuration interfaces.
<b>Step 6</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.

	Command or Action	Purpose
		<p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

### Related Topics

[IGP Auto-configuration, on page 13](#)

[Configuring LDP Auto-Configuration: Example, on page 52](#)

[Disabling LDP Auto-Configuration, on page 44](#)

## Enabling LDP Auto-Configuration in an Area for a Specified OSPF Instance

Perform this task to enable IGP auto-configuration in a defined area with a specified OSPF process name.

You can disable auto-configuration on a per-interface basis. This lets LDP enable all IGP interfaces except those that are explicitly disabled.



### Note

This feature is supported for IPv4 unicast family in default VRF only.

### SUMMARY STEPS

1. **configure**
2. **router ospf** *process-name*
3. **area** *area-id*
4. **mpls ldp auto-config**
5. **interface** *type interface-path-id*
6. Use the **commit** or **end** command.

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
<b>Step 2</b>	<b>router ospf <i>process-name</i></b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>router ospf 100</b> RP/0/0/CPU0:router(config-ospf)#	Enters a uniquely identifiable OSPF routing process. The process name is any alphanumeric string no longer than 40 characters without spaces.
<b>Step 3</b>	<b>area <i>area-id</i></b>  <b>Example:</b> RP/0/0/CPU0:router(config-ospf)# <b>area 8</b> RP/0/0/CPU0:router(config-ospf-ar)#	Configures an OSPF area and identifier.  <b><i>area-id</i></b>  Either a decimal value or an IP address.
<b>Step 4</b>	<b>mpls ldp auto-config</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ospf-ar)# <b>mpls ldp auto-config</b>	Enables LDP auto-configuration.
<b>Step 5</b>	<b>interface <i>type interface-path-id</i></b>  <b>Example:</b> RP/0/0/CPU0:router(config-ospf-ar)# <b>interface pos 0/6/0/0</b> RP/0/0/CPU0:router(config-ospf-ar-if)	Enables LDP auto-configuration on the specified interface. The LDP configurable limit for maximum number of interfaces does not apply to IGP auto-config interfaces.
<b>Step 6</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session.  <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

**Related Topics**

[IGP Auto-configuration, on page 13](#)

[Configuring LDP Auto-Configuration: Example, on page 52](#)

[Disabling LDP Auto-Configuration, on page 44](#)

## Disabling LDP Auto-Configuration

Perform this task to disable IGP auto-configuration.

You can disable auto-configuration on a per-interface basis. This lets LDP enable all IGP interfaces except those that are explicitly disabled.

**SUMMARY STEPS**

1. **configure**
2. **mpls ldp**
3. **interface** *type interface-path-id*
4. **igp auto-config disable**
5. Use the **commit** or **end** command.

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b> RP/0/0/CPU0:router(config-ldp)#	Enters the MPLS LDP configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type interface-path-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>interface</b> <b>pos 0/6/0/0</b>	Enters interface configuration mode and configures an interface.
<b>Step 4</b>	<b>igp auto-config disable</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp-if)# <b>igp</b> <b>auto-config disable</b>	Disables auto-configuration on the specified interface.

	Command or Action	Purpose
Step 5	Use the <b>commit</b> or <b>end</b> command.	<p><b>commit</b>—Saves the configuration changes and remains within the configuration session.</p> <p><b>end</b>—Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

### Related Topics

[IGP Auto-configuration, on page 13](#)

[Configuring LDP Auto-Configuration: Example, on page 52](#)

## Configuring LDP Nonstop Routing

Perform this task to configure LDP NSR.



### Note

By default, NSR is globally-enabled on all LDP sessions except AToM.

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **nsr**
4. Use the **commit** or **end** command.
5. **show mpls ldp nsr statistics**
6. **show mpls ldp nsr summary**
7. **show mpls ldp nsr pending**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <code>mpls ldp</code>	Enters the MPLS LDP configuration mode.
<b>Step 3</b>	<b>nsr</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <code>nsr</code>	Enables LDP nonstop routing.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>
<b>Step 5</b>	<b>show mpls ldp nsr statistics</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>show mpls ldp nsr statistics</code>	Displays MPLS LDP NSR statistics.
<b>Step 6</b>	<b>show mpls ldp nsr summary</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>show mpls ldp nsr summary</code>	Displays MPLS LDP NSR summarized information.
<b>Step 7</b>	<b>show mpls ldp nsr pending</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>show mpls ldp nsr pending</code>	Displays MPLS LDP NSR pending information.

### Related Topics

[LDP Nonstop Routing, on page 14](#)

## Configuring LDP Downstream on Demand mode

### SUMMARY STEPS

1. **configure**
2. **mpls ldp**
3. **downstream-on-demand**
4. Use the **commit** or **end** command.

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <b>configure</b>	Enters global configuration mode.
<b>Step 2</b>	<b>mpls ldp</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# <b>mpls ldp</b>	Enters MPLS LDP configuration mode.
<b>Step 3</b>	<b>downstream-on-demand</b>  <b>Example:</b> RP/0/0/CPU0:router(config-ldp)# <b>downstream-on-demand with access-list</b>	Enters downstream on demand label advertisement mode. The ACL contains the list of peer IDs that are configured for downstream-on-demand mode. When the ACL is changed or configured, the list of established neighbor is traversed.
<b>Step 4</b>	Use the <b>commit</b> or <b>end</b> command.	<b>commit</b> —Saves the configuration changes and remains within the configuration session. <b>end</b> —Prompts user to take one of these actions: <ul style="list-style-type: none"> <li>• <b>Yes</b>— Saves configuration changes and exits the configuration session.</li> <li>• <b>No</b>—Exits the configuration session without committing the configuration changes.</li> <li>• <b>Cancel</b>—Remains in the configuration session, without committing the configuration changes.</li> </ul>

Command or Action	Purpose
-------------------	---------

### Related Topics

[Downstream on Demand](#), on page 16

## Configuration Examples for Implementing MPLS LDP

These configuration examples are provided to implement LDP:

### Configuring LDP with Graceful Restart: Example

The example shows how to enable LDP with graceful restart on the POS interface 0/2/0/0.

```
mpls ldp
 graceful-restart
 interface pos0/2/0/0
 !
```

### Configuring LDP Discovery: Example

The example shows how to configure LDP discovery parameters.

```
mpls ldp
 router-id 192.168.70.1
 discovery hello holdtime 15
 discovery hello interval 5
 !

show mpls ldp parameters
show mpls ldp discovery
```

### Configuring LDP Link: Example

The example shows how to configure LDP link parameters.

```
mpls ldp
 interface pos 0/1/0/0
 !
 !

show mpls ldp discovery
```

### Related Topics

[Configuring LDP Discovery Over a Link](#), on page 18

[LDP Control Plane](#), on page 3



## Configuring LDP Discovery for Targeted Hellos: Example

The examples show how to configure LDP Discovery to accept targeted hello messages.

### Active (tunnel head)

```
mpls ldp
router-id 192.168.70.1
interface tunnel-te 12001
!
!
```

### Passive (tunnel tail)

```
mpls ldp
router-id 192.168.70.2
discovery targeted-hello accept
!
```

### Related Topics

[Configuring LDP Discovery for Active Targeted Hellos, on page 20](#)

[Configuring LDP Discovery for Passive Targeted Hellos, on page 22](#)

[LDP Control Plane, on page 3](#)

## Configuring Label Advertisement (Outbound Filtering): Example

The example shows how to configure LDP label advertisement control.

```
mpls ldp
label
  advertise
    disable
    for pfx_acl_1 to peer_acl_1
    for pfx_acl_2 to peer_acl_2
    for pfx_acl_3
    interface POS 0/1/0/0
    interface POS 0/2/0/0
  !
!
!
ipv4 access-list pfx_acl_1
  10 permit ip host 1.0.0.0 any
!
ipv4 access-list pfx_acl_2
  10 permit ip host 2.0.0.0 any
!
ipv4 access-list peer_acl_1
  10 permit ip host 1.1.1.1 any
  20 permit ip host 1.1.1.2 any
!
ipv4 access-list peer_acl_2
  10 permit ip host 2.2.2.2 any
!

show mpls ldp binding
```

**Related Topics**

[Configuring Label Advertisement Control \(Outbound Filtering\), on page 23](#)  
[Label Advertisement Control \(Outbound Filtering\), on page 10](#)

## Configuring LDP Neighbors: Example

The example shows how to disable label advertisement.

```
mpls ldp
  router-id 192.168.70.1
  neighbor 1.1.1.1 password encrypted 110A1016141E
  neighbor 2.2.2.2 implicit-withdraw
!
```

**Related Topics**

[Setting Up LDP Neighbors, on page 25](#)

## Configuring LDP Forwarding: Example

The example shows how to configure LDP forwarding.

```
mpls ldp
  explicit-null
!

show mpls ldp forwarding
show mpls forwarding
```

**Related Topics**

[Setting Up LDP Forwarding, on page 27](#)  
[LDP Forwarding, on page 5](#)

## Configuring LDP Nonstop Forwarding with Graceful Restart: Example

The example shows how to configure LDP nonstop forwarding with graceful restart.

```
mpls ldp
log
graceful-restart
!
  graceful-restart
  graceful-restart forwarding state-holdtime 180
  graceful-restart reconnect-timeout 15
  interface pos0/1/0/0
!

show mpls ldp graceful-restart
show mpls ldp neighbor gr
show mpls ldp forwarding
show mpls forwarding
```

**Related Topics**

- [Setting Up LDP NSF Using Graceful Restart, on page 29](#)
- [LDP Graceful Restart, on page 6](#)
- [Phases in Graceful Restart, on page 8](#)
- [Recovery with Graceful-Restart, on page 9](#)

## Configuring Label Acceptance (Inbound Filtering): Example

The example shows how to configure inbound label filtering.

```
mpls ldp
 label
 accept
  for pfx_acl_2 from 192.168.2.2
 !
 !
 !
```

**Related Topics**

- [Configuring Label Acceptance Control \(Inbound Filtering\), on page 31](#)
- [Label Acceptance Control \(Inbound Filtering\), on page 10](#)

## Configuring Local Label Allocation Control: Example

The example shows how to configure local label allocation control.

```
mpls ldp
 label
 allocate for pfx_acl_1
 !
 !
```

**Related Topics**

- [Configuring Local Label Allocation Control, on page 33](#)
- [Local Label Allocation Control, on page 11](#)

## Configuring LDP Session Protection: Example

The example shows how to configure session protection.

```
mpls ldp
 session protection for peer_acl_1 duration
 60
 !
```

**Related Topics**

- [Configuring Session Protection, on page 34](#)
- [Session Protection, on page 11](#)

## Configuring LDP IGP Synchronization—OSPF: Example

The example shows how to configure LDP IGP synchronization for OSPF.

```
router ospf 100
mpls ldp sync
!
mpls ldp
  igp sync delay 30
!
```

### Related Topics

[Configuring LDP IGP Synchronization: OSPF, on page 35](#)  
[IGP Synchronization, on page 12](#)

## Configuring LDP IGP Synchronization—ISIS: Example

The example shows how to configure LDP IGP synchronization.

```
router isis 100
  interface POS 0/2/0/0
  address-family ipv4 unicast
  mpls ldp sync
  !
  !
  !
mpls ldp
  igp sync delay 30
!
```

### Related Topics

[Configuring LDP IGP Synchronization: ISIS, on page 36](#)  
[IGP Synchronization, on page 12](#)

## Configuring LDP Auto-Configuration: Example

The example shows how to configure the IGP auto-configuration feature globally for a specific OSPF interface ID.

```
router ospf 100
  mpls ldp auto-config
  area 0
  interface pos 1/1/1/1
```

The example shows how to configure the IGP auto-configuration feature on a given area for a given OSPF interface ID.

```
router ospf 100
  area 0
  mpls ldp auto-config
  interface pos 1/1/1/1
```

**Related Topics**

[Enabling LDP Auto-Configuration for a Specified OSPF Instance, on page 40](#)

[Enabling LDP Auto-Configuration in an Area for a Specified OSPF Instance, on page 42](#)

[Disabling LDP Auto-Configuration, on page 44](#)

[IGP Auto-configuration, on page 13](#)

**Configure IP LDP Fast Reroute Loop Free Alternate: Examples**

This example shows how to configure LFA FRR with default tie-break configuration:

```
router isis TEST
net 49.0001.0000.0000.0001.00
address-family ipv4 unicast
metric-style wide

interface GigabitEthernet0/6/0/13
point-to-point
address-family ipv4 unicast
fast-reroute per-prefix
# primary path GigabitEthernet0/6/0/13 will exclude the interface
# GigabitEthernet0/6/0/33 in LFA backup path computation.
fast-reroute per-prefix exclude interface GigabitEthernet0/6/0/33
!
interface GigabitEthernet0/6/0/23
point-to-point
address-family ipv4 unicast
!
interface GigabitEthernet0/6/0/24
point-to-point
address-family ipv4 unicast
!
interface GigabitEthernet0/6/0/33
point-to-point
address-family ipv4 unicast
!
```

This example shows how to configure TE tunnel as LFA backup:

```
router isis TEST
net 49.0001.0000.0000.0001.00
address-family ipv4 unicast
metric-style wide

interface GigabitEthernet0/6/0/13
point-to-point
address-family ipv4 unicast
fast-reroute per-prefix
# primary path GigabitEthernet0/6/0/13 will exclude the interface
# GigabitEthernet0/6/0/33 in LFA backup path computation. TE tunnel 1001
# is using the link GigabitEthernet0/6/0/33.
fast-reroute per-prefix exclude interface GigabitEthernet0/6/0/33
fast-reroute per-prefix lfa-candidate interface tunnel-te1001
!
interface GigabitEthernet0/6/0/33
point-to-point
address-family ipv4 unicast
!
```

This example shows how to configure LFA FRR with configurable tie-break configuration:

```

router isis TEST
net 49.0001.0000.0000.0001.00
address-family ipv4 unicast
metric-style wide
fast-reroute per-prefix tiebreaker ?
downstream          Prefer backup path via downstream node
lc-disjoint         Prefer line card disjoint backup path
lowest-backup-metric Prefer backup path with lowest total metric
node-protecting     Prefer node protecting backup path
primary-path        Prefer backup path from ECMP set
secondary-path      Prefer non-ECMP backup path

fast-reroute per-prefix tiebreaker lc-disjoint index ?
<1-255> Index
fast-reroute per-prefix tiebreaker lc-disjoint index 10

```

Sample configuration:

```

router isis TEST
net 49.0001.0000.0000.0001.00
address-family ipv4 unicast
metric-style wide
fast-reroute per-prefix tiebreaker downstream index 60
fast-reroute per-prefix tiebreaker lc-disjoint index 10
fast-reroute per-prefix tiebreaker lowest-backup-metric index 40
fast-reroute per-prefix tiebreaker node-protecting index 30
fast-reroute per-prefix tiebreaker primary-path index 20
fast-reroute per-prefix tiebreaker secondary-path index 50
!
interface GigabitEthernet0/6/0/13
point-to-point
address-family ipv4 unicast
fast-reroute per-prefix
!
interface GigabitEthernet0/1/0/13
point-to-point
address-family ipv4 unicast
fast-reroute per-prefix
!
interface GigabitEthernet0/3/0/0.1
point-to-point
address-family ipv4 unicast
!
interface GigabitEthernet0/3/0/0.2
point-to-point
address-family ipv4 unicast

```

### Related Topics

[IP LDP Fast Reroute Loop Free Alternate, on page 14](#)

## Verify IP LDP Fast Reroute Loop Free Alternate: Example

The following examples show how to verify the IP LDP FRR LFA feature on the router. The following example shows how to verify ISIS FRR output:

```

RP/0/0/CPU0:router#show isis fast-reroute summary
IS-IS 1 IPv4 Unicast FRR summary

```

	Critical Priority	High Priority	Medium Priority	Low Priority	Total
Prefixes reachable in L1					
All paths protected	0	0	4	1008	1012
Some paths protected	0	0	0	0	0
Unprotected	0	0	0	0	0
Protection coverage	0.00%	0.00%	100.00%	100.00%	100.00%

```

Prefixes reachable in L2
  All paths protected      0          0          1          0          1
  Some paths protected    0          0          0          0          0
  Unprotected             0          0          0          0          0
  Protection coverage     0.00%     0.00%     100.00%    0.00%     100.00%

```

The following example shows how to verify the IGP route 211.1.1.1/24 in ISIS Fast Reroute output:

```

RP/0/0/CPU0:router#show isis fast-reroute 211.1.1.1/24

L1 211.1.1.1/24 [40/115]
   via 12.0.0.2, GigabitEthernet0/6/0/13, NORTH
   FRR backup via 14.0.2.2, GigabitEthernet0/6/0/0.3, SOUTH

RP/0/0/CPU0:router#show isis fast-reroute 211.1.1.1/24 detail

L1 211.1.1.1/24 [40/115] low priority
   via 12.0.0.2, GigabitEthernet0/6/0/13, NORTH
   FRR backup via 14.0.2.2, GigabitEthernet0/6/0/0.3, SOUTH
   P: No, TM: 130, LC: No, NP: Yes, D: Yes
   src srl.00-00, 173.1.1.2
   L2 adv [40] native, propagated

```

The following example shows how to verify the IGP route 211.1.1.1/24 in RIB output:

```

RP/0/0/CPU0:router#show route 211.1.1.1/24

Routing entry for 211.1.1.0/24
  Known via "isis 1", distance 115, metric 40, type level-1
  Installed Nov 27 10:22:20.311 for 1d08h
  Routing Descriptor Blocks
    12.0.0.2, from 173.1.1.2, via GigabitEthernet0/6/0/13, Protected
    Route metric is 40
    14.0.2.2, from 173.1.1.2, via GigabitEthernet0/6/0/0.3, Backup
    Route metric is 0
  No advertising protos.

```

The following example shows how to verify the IGP route 211.1.1.1/24 in FIB output:

```

RP/0/0/CPU0:router#show cef 211.1.1.1/24
211.1.1.0/24, version 0, internal 0x40040001 (ptr 0x9d9e1a68) [1], 0x0 \
(0x9ce0ec40), 0x4500 (0x9e2c69e4)
  Updated Nov 27 10:22:29.825
  remote adjacency to GigabitEthernet0/6/0/13
  Prefix Len 24, traffic index 0, precedence routine (0)
  via 12.0.0.2, GigabitEthernet0/6/0/13, 0 dependencies, weight 0, class 0, \
protected [flags 0x400]
    path-idx 0, bkup-idx 1 [0x9e5b71b4 0x0]
    next hop 12.0.0.2
    local label 16080          labels imposed {16082}
    via 14.0.2.2, GigabitEthernet0/6/0/0.3, 3 dependencies, weight 0, class 0, \
backup [flags 0x300]
    path-idx 1
    next hop 14.0.2.2
    remote adjacency
    local label 16080          labels imposed {16079}

RP/0/0/CPU0:router#show cef 211.1.1.1/24 detail
211.1.1.0/24, version 0, internal 0x40040001 (ptr 0x9d9e1a68) [1], 0x0 \
(0x9ce0ec40), 0x4500 (0x9e2c69e4)
  Updated Nov 27 10:22:29.825
  remote adjacency to GigabitEthernet0/6/0/13
  Prefix Len 24, traffic index 0, precedence routine (0)
  gateway array (0x9cc622f0) reference count 1158, flags 0x28000d00, source lsd \
(2),
    [387 type 5 flags 0x101001 (0x9df32398) ext 0x0 (0x0)]
  LW-LDI[type=5, refc=3, ptr=0x9ce0ec40, sh-ldi=0x9df32398]
  via 12.0.0.2, GigabitEthernet0/6/0/13, 0 dependencies, weight 0, class 0, \

```

```

protected [flags 0x400]
  path-idx 0, bkup-idx 1 [0x9e5b71b4 0x0]
  next hop 12.0.0.2
    local label 16080      labels imposed {16082}
  via 14.0.2.2, GigabitEthernet0/6/0/0.3, 3 dependencies, weight 0, class 0, \
backup [flags 0x300]
  path-idx 1
  next hop 14.0.2.2
  remote adjacency
  local label 16080      labels imposed {16079}

Load distribution: 0 (refcount 387)

Hash OK Interface Address
0 Y GigabitEthernet0/6/0/13 remote

```

The following example shows how to verify the IGP route 211.1.1.1/24 in MPLS LDP output:

```

RP/0/0/CPU0:router#show mpls ldp forwarding 211.1.1.1/24

Prefix          Label  Label  Outgoing  Next Hop          GR Stale
-----          -
211.1.1.0/24   16080  16082  Gi0/6/0/13  12.0.0.2          Y N
                16079  16079  Gi0/6/0/0.3  14.0.2.2 (!)     Y N

RP/0/0/CPU0:router#show mpls ldp forwarding 211.1.1.1/24 detail

Prefix          Label  Label  Outgoing  Next Hop          GR Stale
-----          -
211.1.1.0/24   16080  16082  Gi0/6/0/13  12.0.0.2          Y N
                [ Protected; path-id 1 backup-path-id 33;
                peer 20.20.20.20:0 ]
                16079  Gi0/6/0/0.3  14.0.2.2 (!)     Y N
                [ Backup; path-id 33; peer 40.40.40.40:0 ]
Routing update   : Nov 27 10:22:19.560 (1d08h ago)
Forwarding update: Nov 27 10:22:29.060 (1d08h ago)

```

### Related Topics

[IP LDP Fast Reroute Loop Free Alternate](#), on page 14

## Additional References

For additional information related to Implementing MPLS Label Distribution Protocol, refer to the following references:

### Related Documents

Related Topic	Document Title
LDP Commands	<i>MPLS Label Distribution Protocol Commands</i> module in <i>Cisco IOS XR MPLS Command Reference for the Cisco XR 12000 Series Router</i> .



**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
—	To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: <a href="http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml">http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml</a>

**RFCs**

RFCs Note	Title
<b>Not all supported RFCs are listed.</b>	
RFC 3031	<i>Multiprotocol Label Switching Architecture</i>
RFC 3036	<i>LDP Specification</i>
RFC 3037	<i>LDP Applicability</i>
RFC 3478	<i>Graceful Restart Mechanism for Label Distribution Protocol</i>
RFC 3815	<i>Definitions of Managed Objects for MPLS LDP</i>
RFC 5036	<i>Label Distribution and Management Downstream on Demand Label Advertisement</i>
RFC 5286	<i>Basic Specification for IP Fast Reroute: Loop-Free Alternates</i>

**Technical Assistance**

Description	Link
The Cisco Technical Support 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>