



# MPLS High Availability Overview

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This document provides an overview of the Multiprotocol Label Switching (MPLS) high availability (HA) features. MPLS HA provides full nonstop forwarding (NSF) and stateful switchover (SSO) capability to the MPLS Label Distribution Protocol (LDP) and MPLS Virtual Private Networks (VPNs) features.

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## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Restrictions for MPLS High Availability

For information about supported hardware, see the following documents:

- For Cisco IOS Release 12.2(25)S, see the Cross-Platform Release Notes for Cisco IOS Release 12.2S.
- For Cisco IOS Release 12.2SB, see the Cross-Platform Release Notes for Cisco IOS Release 12.2SB.
- For Cisco IOS Release 12.2(33)SRA, see the Release Notes for Cisco IOS Release 12.2SR for the Cisco 7600 Series Routers.
- For Cisco IOS Release 12.2(33)SXH, see the [Release Notes for Cisco IOS Release 12.2SX on the Catalyst 6500 Series MSFC](#)



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## Information About MPLS High Availability

- [MPLS High Availability Overview, page 2](#)
- [MPLS High Availability Features, page 2](#)
- [MPLS High Availability Infrastructure Changes, page 4](#)
- [MPLS Applications That Coexist with SSO, page 5](#)

## MPLS High Availability Overview

MPLS HA features provide SSO and NSF capability to the MPLS Label Distribution Protocol (LDP) and MPLS Virtual Private Network (VPN) features. MPLS HA includes the following new features:

- [NSF SSO—MPLS VPN, page 3](#)
- [NSF SSO - MPLS LDP and LDP Graceful Restart, page 3](#)
- [NSF SSO Any Transport over MPLS and Graceful Restart, page 4](#)

In addition, the MIBs for MPLS VPNs and MPLS LDP have been enhanced to work in the MPLS HA environment.

The following features have been changed or created to work in the MPLS HA environment:

- [MPLS High Availability Infrastructure Changes, page 4](#)
- [Cisco Express Forwarding Scalability Enhancements, page 4](#)

The following features perform normally in an NSF/SSO environment. They can exist with SSO and NSF but do not have the ability to keep duplicate information in a backup Route Processor (RP) on the Cisco 7500 series router and in a backup Performance Routing Engine2 (PRE2) on the Cisco 10000 series router.

- [MPLS Traffic Engineering, page 5](#)
- [MPLS Quality of Service Applications, page 5](#)
- [IPv6 over MPLS, page 6](#) (not supported on the Cisco 10000 series router)
- [MPLS Label Switching Router MIB, page 6](#)
- [MPLS TE MIB, page 6](#)
- [MPLS Enhancements to Interfaces MIB, page 7](#)

The following sections explain these features in more detail.

## MPLS High Availability Features

The following MPLS HA features have the ability to continue forwarding data following an RP switchover on the Cisco 7500 series router or PRE2 switchover on the Cisco 10000 series router:

- MPLS Label Distribution Protocol (LDP)
- MPLS Virtual Private Networks (VPNs)
- Any Transport over MPLS (AToM)

**Note**

In Cisco IOS Release 12.2(28)SB, AToM is not enabled for high availability on the Cisco 10000 series router. However, AToM coexists with SSO. This means that AToM functions normally in an SSO environment but because state information is not maintained on the standby RP, a switchover can partially disrupt operations

When you enable MPLS HA, you get the benefit of allowing an RP on the Cisco 7500 series router or PRE2 on the Cisco 10000 series router to recover from disruption in service without losing its LDP bindings, MPLS forwarding state, and VPN prefix information.

- [NSF SSO—MPLS VPN, page 3](#)
- [NSF SSO - MPLS LDP and LDP Graceful Restart, page 3](#)
- [NSF SSO Any Transport over MPLS and Graceful Restart, page 4](#)

## NSF SSO—MPLS VPN

The MPLS High Availability feature allows a router to recover from a disruption in service without losing its VPN prefix information. The MPLS High Availability feature works with the BGP Graceful Restart mechanisms defined in the Graceful Restart Internet Engineering Task Force (IETF) specifications and in the Cisco Nonstop Forwarding feature module. The BGP Graceful Restart feature supports the VPNv4 VRFs, which allows the routers running BGP Graceful Restart to preserve VPN prefix information when a router restarts.

For information about configuring the MPLS High Availability feature, see the following feature module: NSF/SSO—MPLS VPN.

- [NSF SSO MPLS VPN MIB, page 3](#)

### NSF SSO MPLS VPN MIB

The MPLS High Availability feature works with the MPLS VPN MIB. For information about configuring the MPLS VPN MIB, see the following feature module: MPLS VPN: SNMP MIB Support.

## NSF SSO - MPLS LDP and LDP Graceful Restart

MPLS LDP uses SSO, NSF, and Graceful Restart to allow an RP on the Cisco 7500 series router or PRE2 on the Cisco 10000 series router to recover from disruption in the LDP components of the control plane service without losing its MPLS forwarding state. The NSF/SSO--MPLS LDP and LDP Graceful Restart feature works with LDP sessions between directly connected peers as well as with peers that are not directly connected (targeted sessions).

For information about configuring the NSF/SSO MPLS LDP and LDP Graceful Restart feature, see the following feature module: *NSF/SSO—MPLS LDP and LDP Graceful Restart*.

- [NSF SSO MPLS LDP MIB, page 3](#)

### NSF SSO MPLS LDP MIB

The MPLS LDP MIB with the IETF Version 8 Upgrade is supported with NSF/SSO MPLS LDP and LDP Graceful Restart. For information about configuring the MPLS LDP MIB, see the following feature module: MPLS Label Distribution Protocol MIB Version 8 Upgrade.

## NSF SSO Any Transport over MPLS and Graceful Restart

AToM uses SSO, NSF, and Graceful Restart to allow an RP to recover from disruption in the LDP components of the control plane service without losing its MPLS forwarding state.

**Note**

In Cisco IOS Release 12.2(28)SB, AToM is not enabled for high availability on the Cisco 10000 series router. However, AToM coexists with SSO. This means that AToM functions normally in an SSO environment but because state information is not maintained on the standby RP, a switchover can partially disrupt operations.

For information about configuring AToM NSF/SSO Support and Graceful Restart, see [NSF/SSO: Any Transport over MPLS and Graceful Restart](#).

## MPLS High Availability Infrastructure Changes

The MPLS control plane software has been enhanced to work in an HA environment. The changes made the control plane software more modular, which helps MPLS support newer applications. Some of the control plane software changes made MPLS more scalable and flexible. See the [Cisco Express Forwarding Scalability Enhancements, page 4](#) for more information.

Changes to the MPLS Forwarding Infrastructure (MFI) and the Cisco Express Forwarding component introduced new commands and changed other existing commands.

MFI replaced the Label Forwarding Information Base (LFIB) and is responsible for managing MPLS data structures used for forwarding. For information about the MPLS command changes related to the MFI, see the following document: [MPLS High Availability: Command Changes](#).

**Note**

The MFI and LFIB do not coexist in the same image. Users must use MFI starting with Cisco IOS Release 12.2(25)S and later releases.

MPLS High Availability introduces the MPLS IP Rewrite Manager (IPRM), which manages the interactions between Cisco Express Forwarding, the IP Label Distribution Modules (LDMs), and the MFI. MPLS IPRM is enabled by default. You do not need to configure or customize the IPRM. See the [Feature Information for MPLS High Availability Overview, page 8](#) for show and debug commands related to IPRM.

- [Cisco Express Forwarding Scalability Enhancements, page 4](#)

## Cisco Express Forwarding Scalability Enhancements

Cisco Express Forwarding provides a forwarding path and maintains a complete forwarding and adjacency table for both the software and hardware forwarding engines.

With MPLS High Availability, Cisco Express Forwarding supports new features and new hardware. The Cisco Express Forwarding improvements enable Cisco Express Forwarding to work with the MPLS HA applications and the MFI infrastructure. Cisco Express Forwarding improvements increase scalability, which are outlined in the table below.

**Table 1** Cisco Express Forwarding Scalability Enhancements

| For the Cisco 7500 Series Router  | For the Cisco 10000 Series Router         |
|---|---|
| Up to 512,000 prefixes  | Up to 1 million prefixes                  |
| Up to 128,000 adjacencies   | Up to 1 million adjacencies               |
| 4000 VPNs   | 4000 VPNs                                 |
| Arbitrary prefix path counts from the Routing Information Base (RIB)        | Arbitrary prefix path counts from the RIB |
| 16 paths per prefix for forwarding  | 8 paths per prefix for forwarding         |
| 64 Cisco Express Forwarding instances (such as line cards or redundant RPs) | NA  |

Cisco Express Forwarding makes the following enhancements:

- Improves memory use
- Reduces large peak memory use
- Reduces route convergence times for the Cisco 7500 series router.

For information about the Cisco Express Forwarding command changes, see Cisco Express Forwarding: Command Changes.

## MPLS Applications That Coexist with SSO

The following sections list the MPLS features that maintain, either partially or completely, undisturbed operation through an RP switchover on the Cisco 7500 series router or PRE2 switchover on the Cisco 10000 series router.

- [MPLS Traffic Engineering, page 5](#)
- [MPLSQualityofServiceApplications, page 5](#)
- [IPv6 over MPLS, page 6](#)
- [MPLS Label Switching Router MIB, page 6](#)
- [MPLS TE MIB, page 6](#)
- [MPLS Enhancements to Interfaces MIB, page 7](#)

### MPLS Traffic Engineering

The MPLS Traffic Engineering (TE) features work with the new Cisco Express Forwarding and MFI modules. TE is SSO coexistent, which means it maintains, either partially or completely, undisturbed operation through an RP switchover on the Cisco 7500 series router or PRE2 switchover on the Cisco 10000 series router. No additional capabilities have been introduced with MPLS High Availability. The **debug mpls traffic-eng lsd-client** command is introduced with the MPLS High Availability features.

### MPLSQualityofServiceApplications

Cisco IOS MPLS supports the IETF DiffServ architecture by enabling the quality of service (QoS) functions listed in the table below to act on the MPLS packets.

**Table 2**      **MPLS QoS Support**

| Category               | Related MPLS QoS Features  |
|------------------------|--|
| Traffic classification | Access Control List matching   |
| Traffic marking        | Differentiated services code point (DSCP)<br>MPLS Experimental (EXP) field |
| Congestion management  | Low latency queueing (LLQ)<br>Class-based weighted fair queueing (CBWFQ)   |
| Congestion avoidance   | Weighted Random Early Detection (WRED)                                     |
| Traffic conditioning   | Shaping and policing   |

## IPv6 over MPLS

The IPv6 over MPLS application works with the new Cisco Express Forwarding and MFI modules. IPv6 over MPLS is SSO coexistent, which means it maintains, either partially or completely, undisturbed operation through an RP switchover.


**Note**

The Cisco 10000 series router does not support the IPv6 over MPLS application.

Command changes are documented in the Cisco IOS IPv6 Command Reference.

## MPLS Label Switching Router MIB

The MPLS Label Switching Router (LSR) MIB works in the MPLS HA environment. Two indexes in the LSR MIB were changed to provide well-defined and ordered values:

- mplsXCIndex
- mplsOutSegmentIndex

This benefits the MPLS LSR MIB in the following ways:

- The MIB walk-through has a consistent and logical order.
- The same index values are maintained after a switchover.

For information about the MPLS LSR MIB, see the MPLS Label Switching Router MIB.

## MPLS TE MIB

The MPLS TE MIB works in the MPLS HA environment. For information about the MPLS TE MIB, see the MPLS Traffic Engineering (TE) MIB.

**Note**

After an RP switchover on the Cisco 7500 series router or PRE2 switchover on the Cisco 10000 series router, the value of `mplsTunnelCreationTime` in the TE MIB does not correctly reflect the time when the tunnel was created. After an RP or PRE2 switchover, the tunnel gets a new time stamp.

## MPLS Enhancements to Interfaces MIB

The MPLS Enhancements to Interfaces MIB works in the MPLS HA environment. For information about the MPLS Enhancements to Interfaces MIB, see the MPLS Enhancements to Interfaces MIB.

## Additional References

The following sections provide references related to the MPLS High Availability feature.

### Related Documents

| Related Topic                 | Document Title  |
|-------------------------------|---|
| MPLS VPNs Non Stop Forwarding | NSF/SSO—MPLS VPN  |
| MPLS LDP Non Stop Forwarding  | <i>NSF/SSO—MPLS LDP and LDP Graceful Restart</i>  |
| AToM Non Stop Forwarding      | NSF/SSO: Any Transport over MPLS and Graceful Restart   |
| Cisco Express Forwarding      | Cisco Express Forwarding: Command Changes   |
| MIBs                          | <ul style="list-style-type: none"> <li>MPLS VPN: SNMP MIB Support</li> <li>MPLS Label Distribution Protocol MIB Version 8 Upgrade</li> <li>MPLS Label Switching Router MIB</li> <li>MPLS Enhancements to Interfaces MIB</li> <li>MPLS Traffic Engineering (TE) MIB</li> </ul> |
| NSF/SSO                       | Cisco Nonstop Forwarding<br>MPLS High Availability: Command Changes   |

### Standards

| Standard                             | Title  |
|--------------------------------------|--|
| draft-ietf-mpls-bgp-mpls-restart.txt | Graceful Restart Mechanism for BGP with MPLS |
| draft-ietf-mpls-idr-restart.txt      | Graceful Restart Mechanism for BGP           |

**MIBs**

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

**RFCs**

| RFC      | Title   |
|----------|---|
| RFC 3478 | Graceful Restart Mechanism for Label Distribution |

**Technical Assistance**

| Description   | Link  |
|---|---|
| The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register on Cisco.com. | <a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a> |

## Feature Information for MPLS High Availability Overview

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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**Table 3**      **Feature Information for MPLS High Availability: Overview**

| Feature Name                     | Releases  | Feature Information   |
|----------------------------------|---|---|
| MPLS High Availability: Overview | 12.2(25)S 12.2(28)SB<br>12.2(33)SRA 12.2(33)SXH | <p>This feature provides an overview of the Multiprotocol Label Switching (MPLS) high availability (HA) features.</p> <p>In 12.2(25)S, this feature was introduced on the Cisco 7500 series router.</p> <p>In 12.2(28)SB, support was added for the Cisco 10000.</p> <p>In 12.2(33)SRA, support was added for the Cisco 7600 series routers.</p> <p>In 12.2(33)SXH, this feature was integrated into Cisco IOS Release 12.2(33)SXH.</p> |

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