MPLS High Availability: Overview

This document provides an overview of the Multiprotocol Label Switching (MPLS) High Availability (HA) features introduced in Cisco IOS Release 12.2(25)S. MPLS HA provides full Stateful Switchover (SSO) and Nonstop Forwarding (NSF) capability to the MPLS Label Distribution Protocol (LDP) and MPLS Virtual Private Networks (VPNs) features.

Feature History for MPLS High Availability: Overview

Release	Modification
Cisco IOS Release 12.2(25)S	This feature was introduced.
Cisco IOS Release 12.2(27)SBA	This feature was integrated into Cisco IOS Release 12.2(27)SBA.
Supported Platforms	
Cisco 7500 Series routers	

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Contents

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Information About MPLS High Availability

This section covers the following topics:

What is MPLS HA?

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:

- MPLS VPN: SSO/NSF Support
- MPLS LDP: SSO/NSF Support and Graceful Restart

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:

- CEF Scalability Enhancements

The following features perform normally in an SSO/NSF environment. The can exist with SSO and NSF but do not have the ability to keep duplicate information in a backup RP.

- MPLS Traffic Engineering
- MPLS Quality of Service Applications
- IPv6 over MPLS
- IPv6 over MPLS
- MPLS Label Switching Router MIB
- MPLS TE MIB
- MPLS Enhancements to Interfaces MIB

The following sections explains these features in more detail.

New MPLS HA Features

Cisco IOS Release 12.2(25)S introduces HA for the MPLS environment. The following features now have the ability to continue forwarding data following a route processor (RP) switchover:

- MPLS Label Distribution Protocol (LDP)
- MPLS Virtual Private Networks (VPNs)

When you enable MPLS HA, you get the benefit of allowing an RP to recover from disruption in service without losing its LDP bindings, MPLS forwarding state, and VPN prefix information.

MPLS VPN: SSO/NSF Support

MPLS VPN: SSO/NSF support allows a router to recover from a disruption in service without losing its VPN prefix information. MPLS VPN: SSO/NSF support 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. BGP Graceful Restart 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 MPLS VPN: SSO/NSF support, see the following feature module: *MPLS VPN: SSO/NSF Support.*

MPLS VPN MIB: SSO/NSF Support

MPLS VPN: SSO/NSF support works with the MPLS VPN MIB. For information about configuring the MPLS VPN MIB, see the following feature module: *MPLS VPN: SNMP MIB Support.*

MPLS LDP: SSO/NSF Support and Graceful Restart

MPLS LDP 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. MPLS LDP: SSO/NSF Support and Graceful Restart works with LDP sessions between directly connected peers as well as with peers that are not directly connected (targeted sessions).

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

MPLS LDP MIB: SSO/NSF Support

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

MPLS HA 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 CEF Scalability Enhancements for more information.

Changes to the MPLS Forwarding Infrastructure (MFI) and the Cisco Express Forwarding (CEF) 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 the MFI with this release.

A new module, called the MPLS IP Rewrite Manager, has also been introduced.

The MPLS IP Rewrite Manager (IPRM) manages the interactions between CEF, the IP Label Distribution Modules (LDMs), and the MFI. IPRM works with the other features that make up MPLS HA. MPLS IPRM is enabled by default. You do not need to configure or customize the IPRM. See the Command Reference section for show and debug commands related to IPRM.

CEF Scalability Enhancements

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

CEF has been updated to support new features and new hardware. The CEF improvements enable CEF to work with the MPLS HA applications and the MFI infrastructure. CEF scalability has been enhanced to support the following:

- Up to 512K prefixes
- Up to 128K adjacencies
- 4K VPNs
- Arbitrary prefix path counts from the routing information base (RIB)
- 16 paths per prefix for forwarding
- 64 CEF instances (such as line cards or redundant RPs)

Further, the following improvements have been made to CEF:

- Improved memory use
- Reduced large peak memory use
- Reduced route convergence times

For information about the CEF command changes, see the following document:

Cisco Express Forwarding: Command Changes

MPLS Applications That Are SSO Coexistent

The following sections list the MPLS features that maintain, either partially or completely, undisturbed operation through an RP switchover.

MPLS Traffic Engineering

The MPLS Traffic Engineering (TE) application has been enhanced to work with the new CEF and MFI modules. TE is SSO coexistent, which means it maintains, either partially or completely, undisturbed operation through an RP switchover. No additional capabilities have been introduced in this release. One new command has been added: **debug mpls traffic-eng lsd-client**.

MPLS Quality of Service Applications

Cisco IOS MPLS supports the IETF DiffServ architecture by enabling the Quality of Service (QoS) functions to act on the MPLS packets.

Category	Related MPLS QoS Features
Traffic classification	Access Control List matching
Traffic marking	DiffServ Code Point (DSCP) MPLS Experimental (EXP) field
Congestion management	Low-Latency Queuing (LLQ) Class-Based Weighted Fair Queuing (CBWFQ)
Congestion avoidance	Weighted Random Early Detection (WRED)
Traffic conditioning	Shaping and Policing

IPv6 over MPLS

The IPv6 over MPLS application has been updated to work with the new CEF and MFI modules. IPv6 over MPLS is SSO coexistent, which means it maintains, either partially or completely, undisturbed operation through an RP switchover. No additional capabilities have been introduced in this release. Command changes are documented in the following feature module:

Cisco IOS IPv6 Command Reference

MPLS Label Switching Router MIB

The MPLS Label Switching Router (LSR) MIB has been updated to work 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 following document:

MPLS Label Switching Router MIB.

MPLS TE MIB

The MPLS TE MIB has been updated to work in the MPLS HA environment. For information about the MPLS TE MIB, see the following document:

MPLS Traffic Engineering (TE) MIB

Note After an RP switchover, the value of mplsTunnelCreationTime in the TE MIB does not correctly reflect the time when the tunnel was created. After an RP switchover, the tunnel gets a new timestamp.

MPLS Enhancements to Interfaces MIB

The MPLS Enhancements to Interfaces MIB has been updated to work in the MPLS HA environment. For information about the MPLS Enhancements to Interfaces MIB, see the following document:

MPLS Enhancements to Interfaces MIB

Supported Hardware for MPLS HA

The hardware listed in the following paragraphs is supported for this release.

Supported Platform

Cisco 7500 series routers

Supported Port Adapters

- PA-2FE-TX, PA-2FE-FX
- PA-A3-OC3-MM, PA-A3-OC3-SMI, PA-A3-OC3-SML
- PA-POS-OC3-MM, PA-POS-OC3-SMI, PA-POS-OC3-SML
- PA-MC-T3, PA-MC-2T3+
- PA-MC-STM1-MM, PA-MC-STM1-SMI
- PA-MC_8E1/120, MC-4E1, MC-2E1, MC-8T1, MC-4T1, MC-2T1 [potent family]
- PA-MC-8TE1+ [kumo lite]
- PA-MC-8E1IMA
- PA-MC-E3
- PA-4T+ and/or PA-8T-232, PA-8T-V35, PA-8T-X21
- PA-2H, PA-H
- GEIP+
- PA-FE-TX, PA-FE-FX
- PA-4E, PA-8E

Supported RSPs

- RSP4
- RSP4+
- RSP8

Supported VIPs

- VIP2-50
- VIP4-50
- VIP4-80

Additional References

For additional information related to MPLS High Availability, refer to the following documents:

Related Documents

Related Topic	Document Title
MPLS HA for VPNS	*MPLS VPN: SSO/NSF Support*
MPLS HA for LDP	*MPLS LDP: SSO/NSF Support and Graceful Restart*
MPLS HA: Command Changes	*MPLS High Availability: Command Changes*
Stateful Switchover	*Stateful Switchover*
MPLS Label Distribution Protocol	*MPLS Label Distribution Protocol (LDP)*
Cisco Nonstop Forwarding	*Cisco Nonstop Forwarding*

Standards

Standards	Title
None	—

MIBs

MIBs	MIBs Link
None.	To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

RFCs

RFCs	Title
None.	

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, tools, and lots more. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

Command Reference

This section documents new and modified commands only.

- **clear mpls counters**
- **clear mpls ip iprm counters**
- **debug mpls traffic-eng lsd-client**
- **debug mpls ip iprm**
- **debug mpls ip iprm cef**
- **debug mpls ip iprm events**
- **debug mpls ip iprm ldm**
- **debug mpls ip iprm mfi**
- **show mpls ip iprm counters**
- **show mpls ip iprm ldm**

clear mpls counters

To clear the Multiprotocol Label Switching (MPLS) forwarding table counters, use the **clear mpls counters** command in EXEC mode.

clear mpls counters

Syntax Description

This command has no arguments or keywords.

Defaults

Checkpoint information resides on the active and standby route processor.

Command Modes

EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command clears the MPLS forwarding table counters.

Examples

The command in the following example clears the MPLS forwarding table counters. The first **show mpls forwarding-table** command shows that 590 label-switched bytes exist in the forwarding table. After the **clear mpls counters** command clears the counters, the second **show mpls forwarding-table** command shows that the number of label-switched bytes is 0.

```
Router# show mpls forwarding-table

Local  Outgoing      Prefix           Bytes Label   Outgoing   Next Hop
Label  Label or VC   or Tunnel Id     Switched      interface
20     30            17.17.17.17      590           Et3/0      140.0.0.2

Router# clear mpls counters

Clear "show mpls forwarding-table" counters [confirm]
mpls forward counters cleared

Router# show mpls forwarding-table

Local  Outgoing      Prefix           Bytes Label   Outgoing   Next Hop
Label  Label or VC   or Tunnel Id     Switched      interface
20     30            17.17.17.17      0             Et3/0      140.0.0.2
```

Related Commands

Command	Description
show mpls forwarding-table	Displays the contents of the MPLS forwarding information base.

clear mpls ip iprm counters

To clear the IP Rewrite Manager (IPRM) counters, use the **clear mpls ip iprm counters** command in privileged EXEC mode.

clear mpls ip iprm counters

Syntax Description

This command has no arguments or keywords.

Defaults

No default behavior or values

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command sets IPRM counters to zero.

Examples

The command in the following example clears the IPRM counters:

```
Router# clear mpls ip iprm counters

Clear iprm counters [confirm]
```

Related Commands

Command	Description
show mpls ip iprm counters	Displays the IPRM counters.

debug mpls traffic-eng lsd-client

To display the Application Programming Interface (API) messages sent to the Label Switching Database (LSD) from the Traffic Engineering (TE) client, use the **debug mpls traffic-eng lsd-client** command in privileged EXEC mode. To disable the display of these messages, use the **no** form of this command.

debug mpls traffic-eng lsd-client

no debug mpls traffic-eng lsd-client

Syntax Description

This command has no arguments or keywords.

Defaults

Debugging is not enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Examples

The following messages are displayed when TE is enabled globally:

```
00:10:23: TE-LSD-CLIENT: register with LSD OK; conn_id = 23, recov time = 60000 s
00:10:23: TE-LSD-CLIENT: LSD is now up
```

The following messages are displayed when TE is disabled globally:

```
00:09:50: TE-LSD-CLIENT: unregister LSD client; result = OK; conn_id 23
```

The following messages are displayed when TE is enabled on specific interfaces:

```
00:10:23: TE-LSD-CLIENT: enabled TE LSD client on Ethernet1/0; status = OK
00:10:23: TE-LSD-CLIENT: enabled TE LSD client on Serial2/0; status = OK
00:10:23: TE-LSD-CLIENT: enabled TE LSD client on Serial3/0; status = OK
```

The following messages are displayed when TE is disabled on specific interfaces:

```
00:09:50: TE-LSD-CLIENT: disabled TE LSD client on Ethernet1/0; status = OK
00:09:50: TE-LSD-CLIENT: disabled TE LSD client on Serial2/0; status = OK
00:09:50: TE-LSD-CLIENT: disabled TE LSD client on Serial3/0; status = OK
```

The following messages are displayed when labels are allocated on tunnel midpoints and tunnel midpoint rewrites are created:

```
00:14:04: TE-LSD-CLIENT: label alloc OK; label = 16, conn_id = 23
00:14:04: TE-LSD-CLIENT: Create TE mid rewrite for 100.100.100.100 1 [5], Result: OK
00:14:04:          In: Serial3/0, 16 Out: Serial2/0, 3
```

The following messages are displayed when labels are freed on tunnel midpoints and tunnel midpoints are deleted:

```
00:13:13: TE-LSD-CLIENT: Delete TE mid rewrite for iou-100_t1, Result: OK
00:13:13: In: Serial3/0, 16 Out: Serial2/0, 1
00:13:13: TE-LSD-CLIENT: free label 16 result =  OK; conn_id = 23
```

The following messages are displayed when tunnel headend rewrites are created:

```
00:09:10: TE-LSD-CLIENT: Create TE he rewrite for iou-100_t1, Result = OK
00:09:10: tun_inst: 7  Out: Serial3/0, 16  Dest: 13.0.0.2
ps_flags: 0x60003
```

The following messages are displayed when tunnel headend rewrites are deleted:

```
00:09:15: TE-LSD-CLIENT: Delete TE he rewrite for iou-100_t1, Result: OK
00:09:15: tun_inst: 7  Out: Serial3/0, 16  ps_flags: 0x60003
```

debug mpls ip iprm

To display debugging information for the Multiprotocol Label Switching (MPLS) IP Rewrite Manager (IPRM), use the **debug mpls ip iprm** command in privileged EXEC mode. To disable the display of this information, use the **no** form of this command.

debug mpls ip iprm

no debug mpls ip iprm

Syntax Description

This command has no arguments or keywords.

Defaults

Debugging is not enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command displays all output related to IPRM.

Examples

The command in the following example displays all IPRM debugging for the global routing table:

```
Router# debug mpls ip iprm

IPRM debugging is on for global routing table

  iprm: prefix deleted: 144.0.0.44/32(glbl)
  iprm: delete mfi rewrite: 144.0.0.44/32(glbl)
  ...
  iprm: discover prefix labels: 144.0.0.44/32(glbl); recurs tree change; ctxt 0x38002
  iprm: get mfi rewrite 144.0.0.44/32(glbl) obtained: 0 fpis/0 mois
  iprm: announce prefix local labels: lcatm; trans #80; 144.0.0.44/32(glbl); 0 labels;
flags 0x0
  iprm: update mfi rewrite: 144.0.0.44/32(glbl); prefix label info
  iprm: omit rewrite create: 144.0.0.44/32(glbl)
  iprm: discover prefix labels: 144.0.0.44/32(glbl); recurs tree change; ctxt 0x38000
  iprm: get mfi rewrite 144.0.0.44/32(glbl) obtained: 0 fpis/0 mois
  iprm: announce prefix local labels: lcatm; trans #81; 144.0.0.44/32(glbl); 0 labels;
flags 0x0
  iprm: get path labels: 144.0.0.44/32(glbl); nh 59.0.0.55(glbl), Et4/0/1; trans #81;
recurs tree change
  iprm: ldm get path labels: 144.0.0.44/32(glbl), ldp; flags 0x8000
  iprm: announce prefix local labels: ldp; trans #81; 144.0.0.44/32(glbl); 1 label; flags
0x0
  iprm:    lab 21, ltbl 0
  iprm: announce path labels: ldp; trans #81; 144.0.0.44/32(glbl); 0 labels; flags 0x0
```

```
iprm:    path: nh 59.0.0.55(glbl), Et4/0/1
iprm: update mfi rewrite: 144.0.0.44/32(glbl); prefix label info
iprm:    lcl lab 21, ltbl 0, ldp
iprm:    path lab -, nh 59.0.0.55(glbl), Et4/0/1; ldp
iprm: create mfi rewrite 144.0.0.44/32(glbl) passed: 2 fpis/1 mois
iprm:    fpi[0] IV4, owner IPRM; 144.0.0.44/32; glbl
iprm:    fpi[1] LBL, owner LDP; 21, ltbl 0
iprm:    moi[0] PKT, flags 0x8; lab label-no-label; nh 59.0.0.55; nh if Et4/0/1 (nsf)
```

Table 1 describes the significant fields shown in the display. The field descriptions also apply to the output of following debug commands:

- **debug mpls ip iprm cef**
- **debug mpls ip iprm events**
- **debug mpls ip iprm ldm**
- **debug mpls ip iprm mfi**

Table 1 debug mpls ip iprm Field Descriptions

Field	Description
discover prefix labels	The prefix labels that the IP LDM discovered.
announce prefix local labels announce path labels	IP LDMs pass prefix incoming (local) and outgoing (path) labels to IPRM by announcing the labels.
mfi rewrite	The information required by MPLS Forwarding Infrastructure (MFI) to create forwarding data structures for an MPLS forwarding equivalence class (FEC). For IP over MPLS a prefix is an MPLS FEC. An MFI rewrite includes a set of forwarding path identifier (FPI) and MPLS output information (MOI) elements.
fpi	Forwarding path identifier, which is required to locate MPLS forwarding information for a FEC. IP over MPLS deals with several types of FPIs, including IPv4 (IV4), IPv6 (IV6), and label (LBL) FPIs.
moi	MPLS output information. For IP over MPLS, there is a MOI for each prefix path. The MOI includes the next hop (nh), outgoing interface (nh if), and outgoing label. IP over MPLS handles several types of MOIs, including packet (PKT) and ATM (ATM).
get/create/update MFI rewrite	The process IPRM uses to read (get) or update (create/update) an MFI rewrite.
recurs tree change	Recursion tree change. Cisco Express Forwarding (CEF) notifies IPRM when the recursion tree (see below) for a prefix changes. IPRM responds by performing label discovery (see above).
recursion tree	A prefix known to CEF can have one or more paths (routes). Each is either a terminal path with a next hop and an outgoing interface or a recursive path with a next hop and no outgoing interface. The next hop for a recursive path typically matches a prefix known to CEF. That prefix also has one or more paths. The IP recursion tree for prefix P is a tree rooted at P's CEF entry with one of more path descendants. Terminal paths are leaf nodes in P's recursion tree and recursive paths are nonleaf nodes, each of which points to the CEF entry for its next hop.

Table 1 debug mpls ip iprm Field Descriptions (continued)

Field	Description
glbl	The global (default) routing table.
ctxt	Context. Information used by IPRM when it performs label discovery.
flags	Information passed between IPRM and other components.
trans #	Transaction number used to identify an ongoing label discovery.
ltbl	Label table.
nsf	Non-stop forwarding.

Related Commands

Command	Description
debug mpls ip iprm cef	Displays debugging information for interactions between CEF and the IPRM.
debug mpls ip iprm events	Displays events related to the MPLS IPRM.
debug mpls ip iprm ldm	Displays debugging information for interactions between the LDMs and the MPLS IPRM.
debug mpls ip iprm mfi	Displays debugging information for interactions between the MFI and the MPLS IPRM.

debug mpls ip iprm cef

To display debugging information for interactions between Cisco Express Forwarding (CEF) and the Multiprotocol Label Switching (MPLS) IP Rewrite Manager (IPRM), use the **debug mpls ip iprm cef** command in privileged EXEC mode. To disable the display of these events, use the **no** form of this command.

debug mpls ip iprm cef [**table** {**all** | *table-id*} | **vrf** *vrf-name* | **acl** *acl-name* | **prefix-list** *prefix-list-name*]

no debug mpls ip iprm cef

Syntax Description

table	(Optional) Displays the debugging information for one or more routing tables.
all	Displays debugging information for all routing tables.
table-id	The ID of the routing table for which you want to display debugging information. Table 0 is the default or global routing table.
vrf	(Optional) Displays debugging information for the VPN Routing and Forwarding (VRF) instance you specify.
vrf-name	The name of the VRF instance. You can find VRF names with the **show ip vrf** command.
acl	(Optional) Displays debugging information for the access control list (ACL) you specify.
acl-name	The name of the ACL. You can find ACL names with the **show ip access-list** command.
prefix-list	(Optional) Displays debugging information for the prefix list you specify.
prefix-list-name	The name of the prefix list. You can find prefix list names with the **show ip prefix-list** command.

Defaults

Debugging is not enabled. If you do not supply an optional keyword, all the debugging events are displayed.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command limits the debug output to the IPRM interactions with CEF.

Examples

In the following example, IPRM events related to CEF are displayed:

```
Router# debug mpls ip iprm cef

IPRM CEF interaction debugging is on for global routing table
iprm: prefix deleted: 144.0.0.44/32(glbl)
  iprm: discover prefix labels: 144.0.0.44/32(glbl); recurs tree change; ctxt 0x38002
  iprm: announce prefix local labels: lcatm; trans #94; 144.0.0.44/32(glbl); 0 labels;
flags 0x0
  ...
  iprm: discover prefix labels: 144.0.0.44/32(glbl); recurs tree change; ctxt 0x38000
  iprm: announce prefix local labels: lcatm; trans #97; 144.0.0.44/32(glbl); 0 labels;
flags 0x0
  iprm: get path labels: 144.0.0.44/32(glbl); nh 59.0.0.55(glbl), Et4/0/1; trans #97;
recurs tree change
  iprm: announce prefix local labels: ldp; trans #97; 144.0.0.44/32(glbl); 1 label; flags
0x0
  iprm:    lab 21, ltbl 0
  iprm: announce path labels: ldp; trans #97; 144.0.0.44/32(glbl); 0 labels; flags 0x0
  iprm:    path: nh 59.0.0.55(glbl), Et4/0/1
```

See Table 1 (debug mpls ip iprm Field Descriptions) for an explanation of the fields displayed in the output.

Related Commands

Command	Description
debug mpls ip iprm events	Displays events related to the MPLS IPRM.
debug mpls ip iprm ldm	Displays debugging information for interactions between the IP Label Distribution Modules (LDMs) and the MPLS IPRM.
debug mpls ip iprm mfi	Displays debugging information for interactions between the MPLS Forwarding Infrastructure (MFI) and the MPLS IPRM.

debug mpls ip iprm events

To display events related to the Multiprotocol Label Switching (MPLS) IP Rewrite Manager (IPRM), use the **debug mpls ip iprm events** command in privileged EXEC mode. To disable the display of these events, use the **no** form of this command.

debug mpls ip iprm events

no debug mpls ip iprm events

Syntax Description

This command has no keywords or arguments.

Defaults

Debugging is not enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Examples

See the command page for **debug mpls ip iprm** for sample command output. See Table 1 (debug mpls ip iprm Field Descriptions) for an explanation of the fields displayed in the output.

Related Commands

Command	Description
debug mpls ip iprm cef	Displays debugging information for interactions between Cisco Express Forwarding (CEF) and the IPRM.
debug mpls ip iprm ldm	Displays debugging information for interactions between the Label Distribution Modules (LDMs) and the MPLS IPRM.
debug mpls ip iprm mfi	Displays debugging information for interactions between the MPLS Forwarding Infrastructure (MFI) and the MPLS IPRM.

debug mpls ip iprm ldm

To display debugging information for interactions between the IP Label Distribution Modules (LDMs) and the Multiprotocol Label Switching (MPLS) IP Rewrite Manager (IPRM), use the **debug mpls ip iprm ldm** command in privileged EXEC mode. To disable the display of this information, use the **no** form of this command.

debug mpls ip iprm ldm [**bgp** | **lcatm** | **ldp** | **vpnv4** | **6pe** | **table** {**all** | *table-id*} | **vrf** *vrf-name* | **acl** *acl-name* | **prefix-list** *prefix-list-name*]

no debug mpls ip iprm ldm

Syntax Description

bgp	(Optional) Displays Border Gateway Protocol (BGP) events.
lcatm	(Optional) Displays Label Controlled ATM (LC-ATM) events.
ldp	(Optional) Displays Label Distribution Protocol (LDP) events.
vpnv4	(Optional) Displays Virtual Private Network (VPNv4) events.
6pe	(Optional) Displays IPv6 over MPLS events.
table	(Optional) Displays debugging information for one or more routing tables.
all	Displays debugging information for all routing tables.
table-id	Specifies the routing table for which you want to display debugging information. Table 0 is the default or global routing table.
vrf	(Optional) Displays debugging information for the VPN Routing and Forwarding (VRF) instance you specify.
vrf-name	The name of the VRF instance. You can find VRF names with the **show ip vrf** command.
acl	(Optional) Displays debugging information for the access control list (ACL) you specify.
acl-name	The name of the ACL. You can find ACL names with the **show ip access-list** command.
prefix-list	(Optional) Displays debugging information for the prefix list you specify.
prefix-list-name	The name of the prefix list. You can find prefix list names with the **show ip prefix-list** command.

Defaults

Debugging is not enabled. If you do not supply an optional keyword, all the debugging events are displayed.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Examples

See the command page for **debug mpls ip iprm** for sample command output. See Table 1 (debug mpls ip iprm Field Descriptions) for an explanation of the fields displayed in the output.

Related Commands

Command	Description
debug mpls ip iprm cef	Displays debugging information for interactions between Cisco Express Forwarding (CEF) and the MPLS IP Rewrite Manager (IPRM).
debug mpls ip iprm events	Displays debugging information about events related to the MPLS IPRM.
debug mpls ip iprm mfi	Displays debugging information for interactions between the MPLS Forwarding Infrastructure (MFI) and the MPLS IPRM.

debug mpls ip iprm mfi

To display debugging information for interactions between the Multiprotocol Label Switching (MPLS) Forwarding Infrastructure (MFI) and the MPLS IP Rewrite Manager (IPRM), use the **debug mpls ip iprm mfi** command in privileged EXEC mode. To disable the display of this information, use the **no** form of this command.

debug mpls ip iprm mfi [**table** {**all** | *table-id*} | **vrf** *vrf-name* | **acl** *acl-name* | **prefix-list** *prefix-list-name*]

no debug mpls ip iprm mfi

Syntax Description

table	(Optional) Displays debugging information for one or more routing tables.
all	Displays debugging information for all routing tables.
table-id	Displays debugging information for the routing table you specify. Table 0 is the default or global routing table.
vrf	(Optional) Displays debugging information for the VPN Routing and Forwarding (VRF) instance you specify.
vrf-name	The name of the VRF instance. You can find VRF names with the **show ip vrf** command.
acl	(Optional) Displays debugging information for the access control list (ACL) you specify.
acl-name	The name of the ACL. You can find ACL names with the **show ip access-list** command.
prefix-list	(Optional) Displays debugging information for the prefix list you specify.
prefix-list-name	The name of the prefix list. You can find prefix list names with the **show ip prefix-list** command.

Defaults

Debugging is not enabled. If you enable debugging but do not supply an optional keyword, all the debugging events are displayed.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Examples

The command in the following example displays MFI events:

```
Router# debug mpls ip iprm mfi

IPRM MFI interaction debugging is on for global routing table
iprm: delete mfi rewrite: 144.0.0.44/32(glbl)
```

```
...
iprm: get mfi rewrite 144.0.0.44/32(glbl) obtained: 0 fpis/0 mois
iprm: update mfi rewrite: 144.0.0.44/32(glbl); prefix label info
iprm: omit rewrite create: 144.0.0.44/32(glbl)
...
iprm: get mfi rewrite 144.0.0.44/32(glbl) obtained: 0 fpis/0 mois
iprm: update mfi rewrite: 144.0.0.44/32(glbl); prefix label info
iprm:    lcl lab 21, ltbl 0, ldp
iprm:    path lab -, nh 59.0.0.55(glbl), Et4/0/1; ldp
iprm: create mfi rewrite 144.0.0.44/32(glbl) passed: 2 fpis/1 mois
iprm:    fpi[0] IV4, owner IPRM; 144.0.0.44/32; glbl
iprm:    fpi[1] LBL, owner LDP; 21, ltbl 0
iprm:    moi[0] PKT, flags 0x8; lab label-no-label; nh 59.0.0.55; nh if Et4/0/1 (nsf)
```

See Table 1 (debug mpls ip iprm Field Descriptions) for an explanation of the fields displayed in the output.

Related Commands

Command	Description
debug mpls ip iprm cef	Displays debugging information for interactions between Cisco Express Forwarding (CEF) and the MPLS IP Rewrite Manager (IPRM).
debug mpls ip iprm events	Displays events related to the MPLS IPRM.
debug mpls ip iprm ldm	Displays debugging information for interactions between the IP Label Distribution Modules (LDMs) and the MPLS IPRM.

show mpls ip iprm counters

To display the number of occurrences of various Multiprotocol Label Switching (MPLS) IP Rewrite Manager (IPRM) events, use the **show mpls ip iprm counters** command in privileged EXEC mode.

show mpls ip iprm counters

Syntax Description

This command has no arguments or keywords.

Defaults

No default behaviors or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command reports the occurrences of IPRM events.

Examples

The command in the following example displays the events that the IPRM logs:

```
router# show mpls ip iprm counters

  CEF Tree Changes Processed/Ignored:           91/12
  CEF Deletes Processed/Ignored:                12/2
  Label Discoveries:                            74
  Rewrite Create Successes/Failures:            60/0
  Rewrite Gets/Deletes:                         82/0
  Label Announcements: Info/Local/Path:         6/119/80
  Walks: Recursion Tree/CEF Full/CEF interface: 78/2/0
```

Table 2 describes the significant fields shown in the display.

Table 2 show mpls ip iprm counters Command Field Descriptions

Field	Description
CEF Tree Changes Processed/Ignored	Processed—The number of Cisco Express Forwarding (CEF) tree change announcements that IPRM processed. Ignored—The number of CEF tree change announcements that IPRM ignored. Typically, IPRM processes tree change announcements only for prefixes in a routing table.
CEF Deletes Processed/Ignored	Processed—The number of CEF delete entry announcements that IPRM processed. Ignored—The number of CEF delete entry announcements that IPRM ignored. Typically, IPRM processes delete entry announcements only for prefixes in a routing table.
Label Discoveries	The number of label discoveries performed by IPRM. Label discovery is the process by which IPRM obtains prefix labels from the IP Label Distribution Modules (LDMs).
Rewrite Create Successes/Failures	Successes—The number of times IPRM successfully updated the MPLS forwarding information. Failures—The number of times IPRM attempted to update the MPLS forwarding information and failed.
Rewrite Gets/Deletes	Gets—The number of times IPRM retrieved forwarding information from the MPLS forwarding infrastructure. Deletes—The number of times IPRM removed prefix forwarding information from the MPLS forwarding infrastructure.
Label Announcements: Info/Local/Path	Info—The number of times an IP label distribution module informed IPRM that label information for a prefix changed. Local—The number of times an IP label distribution module specified local labels for a prefix. Path—The number of times an IP LDM specified outgoing labels for a prefix route.
Walks: Recursion Tree/CEF Full/CEF interface	Recursion Tree—The number of times IPRM requested CEF to walk the recursion (path) tree for a prefix. CEF Full—The number of times IPRM requested CEF to walk a CEF table and notify IPRM about each prefix. CEF interface—The number of times IPRM requested CEF to walk a CEF table and notify IPRM about each prefix with a path that uses a specific interface.

Related Commands

Command	Description
show mpls ip iprm ldm	Displays information about the IP LDMs that have registered with the IPRM.
clear mpls ip iprm counters	Clears the IPRM counters.

show mpls ip iprm ldm

To display information about the IP Label Distribution Modules (LDMs) that have registered with the IP Rewrite Manager (IPRM), use the **show mpls ip iprm ldm** command in privileged EXEC mode.

show mpls ip iprm ldm [**table** {**all** | *table-id*} | **vrf** *vrf-name*] [**ipv4** | **ipv6**]

Syntax Description

table	(Optional) Displays the LDMs for one or more routing tables.
all	Displays the LDMs for all routing tables.
table-id	Displays the LDMs for the routing table you specify. Table 0 is the default or global routing table.
vrf	(Optional) Displays the LDMs for the VPN Routing and Forwarding (VRF) instance you specify.
vrf-name	The name of the VRF instance. You can find VRF names with the **show ip vrf** command.
ipv4	(Optional) Displays IPv4 LDMs.
ipv6	(Optional) Displays IPv6 LDMs.

Defaults

If you do not specify any keywords or parameters, the command displays the LDMs for the global routing table (the default).

Command Modes

Privileged EXEC

Command History

Release	Modification
12.2(25)S	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.

Usage Guidelines

This command displays the IP LDMs registered with IPRM.

Examples

The command in the following example displays the LDMs for the global routing tables. It shows that two LDMs (lcatm and ldp) are registered for the ipv4 global routing table, and that one LDM (bgp ipv6) is registered for the ipv6 global routing table.

```
router# show mpls ip iprm ldm

  table (glbl;ipv4); ldms: 2
    lcatm, ldp
  table (glbl;ipv6); ldms: 1
    bgp ipv6
```

The command in the following example displays all of the LDMs registered with IPRM. The output shows the following:

- The LDMs called lcatm and ldp have registered with IPRM for the ipv4 global table.
- The LDM called bgp ipv6 is registered for the IPv6 global table.
- The LDM called bgp vpnv4 is registered for all IPv4 vrf routing tables.

```
router# show mpls ip iprm ldm table all

  table (glbl;ipv4); ldms: 2
    lcatm, ldp
  table (glbl;ipv6); ldms: 1
    bgp ipv6
  table (all-tbls;ipv4); ldms: 1
    bgp vpnv4
```

The command in the following example displays the LDMs registered for the IPv6 routing tables.

```
router# show mpls ip iprm ldm ipv6

  table (glbl;ipv6); ldms: 1
    bgp ipv6
```

Related Commands

Command	Description
show mpls ip iprm counters	Displays the number of occurrences of various IPRM events.