



MPLS Traffic Engineering Fast Reroute — Link Protection

This feature module describes the Fast Reroute (FRR) link protection feature of MPLS traffic engineering. It includes information on the benefits of the new feature, supported platforms, and related documents.

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Feature Overview

Regular MPLS traffic engineering automatically establishes and maintains label-switched paths (LSPs) across the backbone using Resource ReSerVation Protocol (RSVP). The path used by a given LSP at any point in time is based upon the LSP resource requirements and available network resources such as bandwidth.

Available resources are flooded via extensions to a link-state based Interior Gateway Protocol (IGP), such as IS-IS or OSPF.

Paths for LSPs are calculated at the LSP headend. Under failure conditions, the headend determines a new route for the LSP. Recovery at the headend provides for the optimal use of resources. However, due to messaging delays, the headend cannot recover as fast as possible by making a repair at the point of failure.

Fast Reroute provides link protection to LSPs. This enables all traffic carried by LSPs that traverse a failed link to be rerouted around the failure. The reroute decision is completely controlled locally by the router interfacing the failed link. The headend of the tunnel is also notified of the link failure through the IGP or through RSVP; the headend then attempts to establish a new LSP that bypasses the failure.

- Increased Reliability for IP Services—MPLS traffic engineering with Fast Reroute uses fail over times that match the capabilities of SONET link restoration. This leverages a very high degree of resiliency for IP traffic that flows over a service provider's backbone, leading to more robust IP services and higher end-customer satisfaction.
- High Scalability Solution—The Fast Reroute feature uses the highest degree of scalability by supporting the mapping of all primary tunnels that traverse a link onto a single backup tunnel. This capability bounds the growth of backup tunnels to the number of links in the backbone rather than the number of TE tunnels that run across the backbone.

Restrictions

The Fast Reroute link protection feature works only on

- Packet over SONET (POS) links (SDH in the European standard)
- Links that use MPLS global label allocation (GLA)

Related Features and Technologies

This Fast Reroute feature is related to the IS-IS, OSPF, RSVP, and MPLS (formerly referred to as Tag Switching) features, which are described separately in the publications listed in the following section, "Related Documents".

Related Documents

- "Configuring Integrated IS-IS" in Cisco IOS Release 12.1 *IP and IP Routing Configuration Guide*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/ip_c/ipcprt2/1cdisis.htm
- "Integrated IS-IS Commands" in Cisco IOS Release 12.1 *IP and IP Routing Command Reference*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/ip_r/iprprt2/1rdisis.htm
- "Configuring OSPF" in Cisco IOS Release 12.1 *IP and IP Routing Configuration Guide*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/ip_c/ipcprt2/1cdospf.htm
- "OSPF Commands" in Cisco IOS Release 12.1 *IP and IP Routing Command Reference*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/ip_r/iprprt2/1rdospf.htm
- "Configuring RSVP" in Cisco IOS Release 12.1 *Quality of Service Solutions Configuration Guide*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/qos_c/qcprt5/qcdrsvp.htm
- IP RSVP commands section in Cisco IOS Release 12.1 *Quality of Service Solutions Command Reference*,
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/qos_r/qrdcmd2.htm
- Cisco IOS Release 12.1(3)T *MPLS Traffic Engineering and Enhancements*.
<http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t3/traffeng.htm>
- "Multiprotocol Label Switching" in Cisco IOS Release 12.1 *Switching Services Configuration Guide*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/switch_c/xcprt4
- Section containing MPLS commands in Cisco IOS Release 12.1 *Switching Services Command Reference*.
http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/switch_r/xrdscmd3.htm

Supported Platforms

This feature is supported on POS links connecting Cisco 12000 Series devices.

Supported RFCs

RFCs

- RFC 2205, *Resource ReSerVation Protocol (RSVP)*
- RFC 1142, *IS-IS*
- RFC 1195, *Use of OSI IS-IS for Routing in TCP/IP and Dual Environments*
- RFC 2328, *OSPF version 2*
- RFC 2370, *The OSPF Opaque LSA Option*
- RFC 2702, *Requirements for Traffic Engineering Over MPLS*

Prerequisites

Your network must support both the following Cisco IOS features before you can enable Fast Reroute link protection:

- IP Cisco Express Forwarding (CEF)
- Multiprotocol Label Switching

At the same time, the network must support at least one of the following protocols:

- Intermediate System-to-Intermediate System (IS-IS)
- Open Shortest Path First (OSPF)

Configuration Tasks

You configure Fast Reroute link protection in three overall tasks:

- Configure Fast Reroute protection for a particular link
- Configure a backup tunnel around the protected link
- Configure the protected link to use the backup tunnel

Before or after entering these commands, you must enable the MPLS traffic-engineering tunnel capability globally on the router. The command to do that is **mpls traffic-eng tunnels**.

Configure Fast Reroute protection for a particular link

To configure a primary tunnel and assign it for Fast Reroute protection, perform the following steps:

	Command	Purpose
Step 1	Router(config)# interface Tunnel1	Creates a tunnel interface and enters interface configuration mode.
Step 2	Router(config-if)# ip unnumbered loopback0	Gives the tunnel interface an IP address. An MPLS traffic engineering tunnel interface should be unnumbered since it represents a unidirectional link.
Step 3	Router(config-if)# tunnel destination A.B.C.D	Specifies the IP address of the device at the far end of the tunnel.
Step 4	Router(config-if)# tunnel mode mpls traffic-eng	Sets the tunnel's encapsulation mode to MPLS traffic engineering.
Step 5	Router(config-if)# tunnel mpls traffic-eng autoroute announce	Causes the IGP to use the tunnel in its enhanced SPF calculation.
Step 6	Router(config-if)# tunnel mpls traffic-eng priority 0 0	Configures setup and reservation priorities of the tunnel.
Step 7	Router(config-if)# tunnel mpls traffic-eng bandwidth 100	Configures the tunnel's bandwidth (in kilobits).
Step 8	Router(config-if)# tunnel mpls traffic-eng path-option 1 explicit identifier 1	Directs the tunnel to use an explicit path.
Step 9	Router(config-if)# tunnel mpls traffic-eng fast-reroute	Enables the tunnel to use a backup tunnel in the event of a link failure. (Establishing the backup tunnel is accomplished by the following two tables' commands.)

Configure a backup tunnel around the protected link

To configure a backup tunnel around the protected link, perform the following steps:

	Command	Purpose
Step 1	Router(config)# interface Tunnel1000	Creates a tunnel interface and enters interface configuration mode.
Step 2	Router(config-if)# ip unnumbered loopback0	Gives the tunnel interface an IP address. An MPLS traffic engineering tunnel interface should be unnumbered since it represents a unidirectional link.
Step 3	Router(config-if)# tunnel destination A.B.C.D	Specifies the IP address of the device at the far end of the tunnel.
Step 4	Router(config-if)# tunnel mode mpls traffic-eng	Sets encapsulation mode of the tunnel to MPLS traffic engineering.
Step 5	Router(config-if)# tunnel mpls traffic-eng priority 0 0	Configures setup and reservation priorities of the tunnel.
Step 6	Router(config-if)# tunnel mpls traffic-eng path-option 1 explicit identifier 2	Directs the tunnel to use an explicit path.

Configure the protected link to use the backup tunnel

To configure the protected link to use the backup tunnel, perform the following steps:

	Command	Purpose
Step 1	Router(config)# interface interface-id	Moves configuration to the physical interface level, directing subsequent configuration commands to the specific physical interface identified by the <i>interface-id</i> . (In this release it is a POS interface.)
Step 2	Router(config-if)# ip address A.B.C.D E.F.G.H	Sets a primary IP address for this interface and a mask for the associated IP subnet.
Step 3	Router(config-if)# mpls traffic-eng tunnels	Enables the MPLS traffic engineering tunnel feature on this physical interface.
Step 4	Router(config-if)# mpls traffic-eng backup-path Tunnel1000	Configures the interface to use the backup tunnel in the event of a detected failure on the interface.
Step 5	Router(config-if)# pos ais-shut	Enables the alarm signal-line (AIS-L) to be sent when the POS interface is placed in administrative shutdown state.

	Command	Purpose
Step 6	Router(config-if)# pos report lrdi	Permits selected SONET alarms to be logged to the console for a POS interface.
Step 7	Router(config-if)# ip rsvp bandwidth 2480000 2480000	Enables RSVP on this interface, and limits the amount of bandwidth RSVP can reserve on this interface. For a description of IP RSVP command syntax, see the <i>Cisco IOS Quality of Service Command Reference</i> . [http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/qos_r/qrdcmd2.htm]

Verifying Fast Reroute for MPLS Traffic Engineering

Verify whether MPLS traffic engineering Fast Reroute link protection has been enabled.

Enter the **show mpls traffic-eng fast-reroute database** command.

```
router# show mpls traffic-eng fast-reroute database 12.0.0.0
```

The sample display output is as follows:

```
Tunnel head fast reroute information:
Prefix      Tunnel In-label Out intf/labelFRR intf/labelStatus
12.0.0.0/16Tu111 Tun hd PO0/0:UntaggedTu4000:16 ready
12.0.0.0/16Tu449 Tun hd PO0/0:UntaggedTu4000:736 ready
12.0.0.0/16Tu314 Tun hd PO0/0:UntaggedTu4000:757 ready
12.0.0.0/16Tu313 Tun hd PO0/0:UntaggedTu4000:756 ready
```

Configuration Examples

This section provides the following configuration examples:

- Configuring a Primary Tunnel and Assigning It for Fast Reroute Link Protection
- Configuring a Backup Tunnel Around the Protected Link
- Configuring the Protected Link to Use the Backup Tunnel

Configuring a Primary Tunnel and Assigning It for Fast Reroute

Enter the following commands to configure a primary tunnel (at the headend) and to assign it for Fast Reroute link protection:

```
interface Tunnel1
ip unnumbered loopback0
tunnel destination 25.1.1.1
tunnel mode mpls traffic-eng
tunnel mpls traffic-eng autoroute announce
tunnel mode mpls traffic-eng priority 0 0
tunnel mpls traffic-eng bandwidth 100
tunnel mpls traffic-eng path-option 1 explicit identifier 1
tunnel mpls traffic-eng fast-reroute
```

Configuring a Backup Tunnel Around the Protected Link



Note

Although you can route normal traffic on a backup tunnel, it is recommended that you do not (that is, do not use the autoroute or static routing functionality to direct traffic to the backup tunnel).

Enter the following commands to configure a backup tunnel around the protected link:

```
interface Tunnel1000
ip unnumbered loopback0
tunnel destination 27.2.2.2
tunnel mode mpls traffic-eng
tunnel mpls traffic-eng priority 0 0
tunnel mpls traffic-eng path-option 1 explicit identifier 2
```

Configuring the Protected Link to Use the Backup Tunnel

Enter the following commands to configure the protected link to use the backup tunnel:

```
interface POS5/0
ip address 160.2.2.1 255.255.255.0
mpls traffic-eng tunnels
mpls traffic-eng backup-path Tunnel1000
pos ais-shut
pos report lrldi
ip rsvp bandwidth 2480000 2480000
```

Command Reference

This section documents the four new commands associated with the Fast Reroute feature. Other commands used with this feature are documented in the Cisco IOS Release 12.1(3)T *MPLS Traffic Engineering and Enhancements* feature module
[<http://www.cisco.com/univercd/cc/td/doc/product/software/ios121/121newft/121t/121t3/traffeng.htm>]

- **mpls traffic-eng backup-path Tunnel**
- **show mpls traffic-eng fast-reroute database**
- **show mpls traffic-eng fast-reroute log reroutes**
- **tunnel mpls traffic-eng fast-reroute**

mpls traffic-eng backup-path Tunnel

To configure the physical interface to use a backup tunnel in the event of a detected failure on that physical interface, use the **mpls traffic-eng backup-path Tunnel** interface-mode command.

mpls traffic-eng backup-path Tunnel*interface*

Syntax Description	<i>interface</i>	String that identifies the tunnel interface being created and configured. This string is appended to the word Tunnel with no intervening space.
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Defaults	No default behavior or values.
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Command Modes	Interface
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Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following example shows you how to specify the traffic engineering backup tunnel with the identifier “1000”:

```
Router(config_if)# mpls traffic-eng backup-path Tunnel1000
```

Related Commands	Command	Description
	show mpls traffic-eng fast-reroute database	Displays information about existing Fast Reroute configurations.
	tunnel mpls traffic-eng fast-reroute	Enables an MPLS traffic engineering tunnel to use a backup tunnel in the event of a link failure (provided that a backup tunnel exists).

show mpls traffic-eng fast-reroute database

To display the contents of the Fast Reroute database, use the **show mpls traffic-eng fast-reroute database EXEC** command.

```
show mpls traffic-eng fast-reroute database
  [{network [mask | masklength]
  | labels low label [-high label] |
  interface ifname [ backup-interface ifname ] |
  backup-interface ifname}]
  [state {active | ready | partial}]
  [role {head | middle}]
  [detail]
```

Syntax Description		
<i>network</i>		IP address of the destination network. This functions as the prefix of the Fast Reroute rewrite.
<i>mask</i>		Bit combination indicating the portion of the IP address that is being used for the subnet address.
<i>masklength</i>		Number of bits in mask of destination.
labels		Shows only database entries that possess in-labels assigned by this router (local labels). You specify either a starting value or a range of values.
<i>low label</i>		Starting label value or lowest value in the range.
<i>- high label</i>		Highest label value in the range.
interface		Shows only database entries related to the primary outgoing interface.
<i>ifname</i>		Name of the primary outgoing interface.
backup-interface		Shows only database entries related to the backup outgoing interface.
<i>ifname</i>		Name of the backup outgoing interface.
state		Shows entries that match one of four possible states: partial, complete, ready, or active.
partial		State before the FRR rewrite has been fully created; its backup routing information is still incomplete.
complete		State after the FRR rewrite has been assembled: it is either ready or active.
ready		The FRR rewrite has been created, but has not yet been moved into the forwarding database.
active		The FRR rewrite has been put into the forwarding database (where it can be placed onto appropriate incoming packets).
role		Shows entries associated either with the tunnel head or tunnel midpoint.
head		Entry associated with tunnel head.
middle		Entry associated with tunnel midpoint.
detail		Shows long-form information: LFIB-FRR total number of clusters, groups and items (defined in Table 2 on page 13) in addition to the short-form information of prefix, label and state.

show mpls traffic-eng fast-reroute database

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following example shows output from the **show mpls traffic-eng fast-reroute database** command at a tunnel head link.

```
router# show mpls traffic-eng fast-reroute database 12.0.0.0
Tunnel head fast reroute information:
Prefix      Tunnel  In-label  Out intf/labelFRR intf/labelStatus
12.0.0.0/16Tu111 Tun hd   PO0/0:UntaggedTu4000:16 ready
12.0.0.0/16Tu449 Tun hd   PO0/0:UntaggedTu4000:736 ready
12.0.0.0/16Tu314 Tun hd   PO0/0:UntaggedTu4000:757 ready
12.0.0.0/16Tu313 Tun hd   PO0/0:UntaggedTu4000:756 ready
```

Table 1 Description of fields in show MPLS traffic-eng fast-reroute database

Field	Description
Prefix	Address to which packets with this label are going.
Tunnel	Tunnel's identifying number.
In Label	Label advertised to other routers to signify a particular prefix. The value "Tunnel head" occurs when no such label has been advertised.
Out intf/ label	Out interface—short name of the physical interface through which traffic goes to the protected link. Out label: —At a tunnel head, this is the label advertised by the tunnel destination device. The value "Untagged" occurs when no such label has been advertised. —At tunnel midpoints, this is the label selected by the next hop device. The "Pop Tag" value occurs when the next hop is the tunnel's final hop.
FRR intf/ label	Fast Reroute interface—the backup tunnel interface. Fast Reroute label —At a tunnel head, this is the label selected by the tunnel tail to indicate the destination network. The value "Untagged" occurs when no such label has been advertised. —At tunnel midpoints, this has the same value as the Out Label.
Status	State of the rewrite: partial, ready, or active. (These terms are defined above, in the Syntax Description section).

The following example shows output from the **show mpls traffic-eng fast-reroute database** command with the **labels** argument specified at a midpoint link:

```
Router# show mpls traffic-eng fast-reroute database labels 250 - 255
Tunnel head fast reroute information:
Prefix Tunnel      In-label Out intf/label   FRR intf/label   Status

LSP midpoint frr information:
LSP identifier      In-label Out intf/label   FRR intf/label   Status
10.110.0.10 229 [7334] 255 P00/0:694 Tu4000:694 active
10.110.0.10 228 [7332] 254 P00/0:693 Tu4000:693 active
10.110.0.10 227 [7331] 253 P00/0:692 Tu4000:692 active
10.110.0.10 226 [7334] 252 P00/0:691 Tu4000:691 active
10.110.0.10 225 [7333] 251 P00/0:690 Tu4000:690 active
10.110.0.10 224 [7329] 250 P00/0:689 Tu4000:689 active
```

The following example shows output from the **show mpls traffic-eng fast-reroute database** command with the **detail** argument included at a tunnel head link:

```
Router# show mpls traffic-eng fast-reroute database 12.0.0.0. detail
LFIB FRR Database Summary:
  Total Clusters:      2
  Total Groups:        2
  Total Items:         789
Link 10:PO5/0 (Down, 1 group)
  Group 51:PO5/0->Tu4000 (Up, 779 members)
    Prefix 12.0.0.0/16, Tu313, active
      Input label Tun hd, Output label P00/0:773, FRR label Tu4000:773
    Prefix 12.0.0.0/16, Tu392, active
      Input label Tun hd, Output label P00/0:775, FRR label Tu4000:775
    Prefix 12.0.0.0/16, Tu111, active
      Input label Tun hd, Output label P00/0:16, FRR label Tu4000:16
    Prefix 12.0.0.0/16, Tu394, active
      Input label Tun hd, Output label P00/0:774, FRR label Tu4000:774
```

Table 2 Description of fields when detail keyword is used with show MPLS traffic-eng fast-reroute database

Field	Description
Total Clusters	A cluster is the physical interface upon which Fast Reroute link protection has been enabled.
Total Groups	A group is a database record that associates the link-protected physical interface with a backup tunnel. A cluster (physical interface) therefore can have one or more groups. For example, the cluster Ethernet4/0/1 is protected by backup Tunnel1 and backup Tunnel2, and so has two groups.
Total Items	An item is a database record that associates a rewrite with a group. A group therefore can have one or more items.

■ show mpls traffic-eng fast-reroute database

Field	Description
Link 10:PO5/0 (Down, 1 group)	This describes a cluster (physical interface): <ul style="list-style-type: none"> • "10" is the interface's unique IOS-assigned ID number. • ":" is followed by the interface's short name. • Parentheses contain the operating state of the interface (Up or Down) and the number of groups associated with it.
Group 51:PO5/0->Tu4000 (Up, 779 members)	This describes a group: <ul style="list-style-type: none"> • "51" is the ID number of the backup interface. • ":" is followed by the group's physical interface short name. • "->" is followed by the backup tunnel interface short name. • Parentheses contain the operating state of the tunnel interface (Up or Down) and the number of items—also called “members”—associated with it.

Related Commands

Command	Description
show mpls traffic-eng fast-reroute log reroutes	Displays contents of Fast Reroute event log.

show mpls traffic-eng fast-reroute log reroutes

To display the contents of the Fast Reroute event log, use the **show mpls traffic-eng fast-reroute log reroutes EXEC** command.

```
show mpls traffic-eng fast-reroute log reroutes
```

Syntax Description This command has no arguments or keywords.

Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following example shows output from the **show mpls traffic-eng fast-reroute log reroutes** command.

```
router# show mpls traffic-eng fast-reroute log reroutes
When      Interface Event  Rewrites Duration CPU msecs Suspend Errors
00:27:39 P00/0   Down  1079   30 msec 30      0      0
00:27:35 P00/0   Up    1079   40 msec 40      0      0
```

Table 3 Description of Display Fields in show mpls traffic-eng fast-reroute log reroutes

Display Field	Description
When	Indicates how long ago the logged event occurred (before this line was displayed on your screen). Displayed as hours, minutes, seconds.
Interface	The physical or tunnel interface where the logged event occurred.
Event	The change to Up or Down by the affected interface.
Rewrites	Total number of reroutes accomplished because of this event.
Duration	Time elapsed during the rerouting process.
CPU msecs	CPU time spent processing those reroutes. (This is less than or equal to the Duration value).
Suspend	Number of times that reroute processing for this event was interrupted to let the CPU handle other tasks.
Errors	Number of unsuccessful reroute attempts.

Related Commands	Command	Description
	show mpls traffic-eng fast-reroute database	Displays contents of Fast Reroute database.

tunnel mpls traffic-eng fast-reroute

To enable an MPLS traffic engineering tunnel to use an established backup tunnel in the event of a link failure, use the **tunnel mpls traffic-eng fast-reroute** interface configuration command.

tunnel mpls traffic-eng fast-reroute

Syntax Description This command has no arguments or keywords.

Defaults No default behavior or values.

Command Modes Interface

Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following example enables an MPLS traffic engineering tunnel to use an existing backup tunnel if a link fails:

```
Router(config_if)# tunnel mpls traffic-eng fast-reroute
```

Related Commands	Command	Description
	mpls traffic-eng backup-path Tunnel	Configures the physical interface to use a backup tunnel in the event of a detected failure on the interface.

Debug Commands

This section documents debugging commands used with the MPLS traffic engineering Fast Reroute link protection feature.

- **debug ip rsvp fast-reroute**
- **debug mpls lfib fast-reroute database**
- **debug mpls lfib fast-reroute events**
- **debug mpls lfib fast-reroute reroutes**

debug ip rsvp fast-reroute

Use the **debug ip rsvp fast-reroute** EXEC command to observe RSVP events associated with Fast Reroute. To disable debugging, use the **no** form of this command.

[no] debug ip rsvp fast-reroute

Syntax Description This command has no arguments or keywords.

Defaults Disabled

Command Modes EXEC

Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following command tells you about RSVP events associated with Fast Reroute:

```
Router# debug ip rsvp fast-reroute
```

Related Commands	Command	Description
	show mpls traffic-eng fast-reroute log reroutes	Displays contents of the Fast Reroute event log.

debug mpls lfib fast-reroute database

Use the **debug mpls lfib fast-reroute database EXEC** command to print information about changes to the Fast Reroute database. Use the [no] form of this command to disable the debugging output.

[no] debug mpls lfib fast-reroute database

Syntax Description This command has no arguments or keywords.

Defaults Disabled

Command Modes EXEC

Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following example displays steps in Fast Reroute processing:

```
Router# debug mpls lfib fast-reroute database

LFIB-FRR:Clear headend FRR info for Tunnell
LFIB-FRR:FRR info for Tunnell changed
LFIB-FRR:update headend FRR info for 10.8.0.1/32
LFIB-FRR:item B13D94 [Tu1] (group PO0/0->Tu4000):destroying entry for 10.8.0.1/32... [514
left]
LFIB-FRR:item B13D94 [Tu1]:removed from name tree
LFIB-FRR:item B13D94 [Tu1]:removed from group PO0/0->Tu4000 tree
%LINK-5-CHANGED:Interface Tunnell1, changed state to administratively down
LFIB-FRR:Clear headend FRR info for Tunnell
LFIB-FRR:FRR info for Tunnell changed
LFIB-FRR:Clear headend FRR info for Tunnell
LFIB-FRR:FRR info for Tunnell changed
LFIB-FRR:Set headend FRR info for Tunnell {main=PO0/0,backup=Tu4000,label=18}
LFIB-FRR:FRR info for Tunnell changed
%SYS-5-CONFIG_I:Configured from console by console
LFIB-FRR:update headend FRR info for 10.8.0.1/32
LFIB-FRR:item B13D94 [Tu1]:inserted in name tree
LFIB-FRR:item B13D94 [Tu1]:inserted in group PO0/0->Tu4000 tree
LFIB-FRR:item B13D94 [Tu1] (group PO0/0->Tu4000):full entry created for 10.8.0.1/32
[total 515]
LFIB-FRR:update headend FRR info for 10.8.0.1/32
LFIB-FRR:item B13D94 [Tu1] (group PO0/0->Tu4000):updating entry for 10.8.0.1/32...
LFIB-FRR:item B13D94 [Tu1] (group PO0/0->Tu4000):... updated
%LINK-3-UPDOWN:Interface Tunnell1, changed state to up
LFIB-FRR:update headend FRR info for 10.43.0.0/16
LFIB-FRR:item B04C2C [Tu486]:inserted in name tree
LFIB-FRR:item B04C2C [Tu486]:inserted in group PO0/0->Tu4000 tree
LFIB-FRR:item B04C2C [Tu486] (group PO0/0->Tu4000):full entry created for 10.43.0.0/16
[total 516]
LFIB-FRR:update headend FRR info for 10.43.0.0/16
LFIB-FRR:item B04BB4 [Tu481]:inserted in name tree
```

debug mpls lfib fast-reroute database

```

LFIB-FRR:item B04BB4 [Tu481]:inserted in group P00/0->Tu4000 tree
LFIB-FRR:item B04BB4 [Tu481] (group P00/0->Tu4000):full entry created for 10.43.0.0/16
[total 517]
LFIB-FRR:update headend FRR info for 10.2.0.0/16
LFIB-FRR:item B04B3C [Tu486]:inserted in name tree
LFIB-FRR:item B04B3C [Tu486]:inserted in group P00/0->Tu4000 tree
LFIB-FRR:item B04B3C [Tu486] (group P00/0->Tu4000):full entry created for 10.2.0.0/16
[total 518]
LFIB-FRR:update headend FRR info for 10.2.0.0/16
LFIB-FRR:item B04AC4 [Tu481]:inserted in name tree
LFIB-FRR:item B04AC4 [Tu481]:inserted in group P00/0->Tu4000 tree

```

Related Commands

Command	Description
debug mpls traffic-eng tunnels fast-reroute events	Prints information about Fast Reroute events.
debug mpls traffic-eng tunnels fast-reroute reroutes	Print information about the rerouting of traffic from link-protected interfaces to backup tunnels.

debug mpls lfib fast-reroute events

Use the **debug mpls lfib fast-reroute events EXEC** command to print information about Fast Reroute events. Use the [no] form of this command to disable the debugging output.

[no] debug mpls lfib fast-reroute events

Syntax Description This command has no arguments or keywords.

Defaults Disabled

Command Modes EXEC

Command History	Release	Modification
	12.0(10)ST	This command was introduced.

Examples The following example reports on the rerouting of traffic to a backup tunnel because of a change of state at a link-protected physical interface.

```
Router# debug mpls lfib fast-reroute events
```

```
LFIB-FRR:enqueued interface DOWN event for P00/0 (Up)
LFIB-FRR:discarded interface DOWN event for P00/0 (Up)
LFIB-FRR:processing interface DOWN event for P00/0 (Up)
LFIB-FRR:group P00/0->Tu4000:output if fixup:Backup(Tu4000) -> Backup(Tu4000)
```



Note

The state given in parentheses reflects what the FRR database currently understands to be the state of the physical interface. This may or may not be the same as the event state reported earlier on that same display line.

Related Commands	Command	Description
	debug mpls traffic-eng tunnels fast-reroute database	Prints information about changes to the Fast Reroute database.
	debug mpls traffic-eng tunnels fast-reroute reroutes	Print information about the rerouting of traffic from link-protected interfaces to backup tunnels.

debug mpls lfib fast-reroute reroutes

Use the **debug mpls lfib fast-reroute reroutes** EXEC command to print information about the rerouting of protected LFIB entries between the primary and backup outgoing interfaces. Use the [no] form of this command to disable the debugging output.

[no] debug mpls lfib fast-reroute reroutes



Note

The output of this command increases in proportion to the number of tunnels that utilize Fast Reroute.

Syntax Description

This command has no arguments or keywords.

Defaults

Disabled

Command Modes

EXEC

Command History

Release	Modification
12.0(10)ST	This command was introduced.

Examples

The following example reports the results of reroute attempts.

```
Router# debug mpls lfib fast-reroute reroutes
```

```
LFIB-FRR:item B0E844 [Tu139]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0E8BC [Tu138]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0E934 [Tu387]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0E9AC [Tu137]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0EA24 [Tu136]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0EA9C [Tu135]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0EB14 [Tu384]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0EB8C [Tu134]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0EC04 [Tu133]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
LFIB-FRR:item B0EC7C [Tu132]:output if fixup, Main(P00/0) -> Backup(Tu4000), succeeded
```

Related Commands

Command	Description
debug mpls traffic-eng tunnels fast-reroute database	Prints information about changes to the Fast Reroute database.
debug mpls traffic-eng tunnels fast-reroute events	Prints information about Fast Reroute events.

Glossary

Backup LSP—An LSP that may be used by the Fast Reroute procedure to temporarily repair one or more protected LSPs when a failure occurs. A backup LSP can be used to repair a protected LSP only if the backup LSP's destination is a router along the downstream path of the protected LSP.

Backup tunnel—An IOS tunnel (software tunnelling interface) associated with a backup LSP. (This represents a temporary route to take in the event of a failure.)

CCO—Cisco Connection Online. The public web location of Cisco user documentation.

FIB—Forwarding Information Base (switching).

FRR—Fast Reroute. The local forwarding of outbound traffic through an alternative traffic engineering tunnel when a link on the original tunnel fails.

Group ID—Two numerals enclosed in curly-braces, where each numeral is a unique, Cisco IOS-assigned ID for, respectively, the physical and backup interfaces of a link-protected Fast-Reroute-enabled tunnel. For example, {10,13} is the Group ID for physical interface 10 and backup tunnel interface 13.

Headend—The router that originates and maintains a given LSP. This is the first router in the LSP's path.

IS-IS—Intermediate System to Intermediate System. Link-state hierarchical routing protocol that calls for intermediate system (IS) routers to exchange routing information based on a single metric, to determine network topology.

LFIB—Label Forwarding Information Base (Switching).

Link protection—Rerouting an LSP through a backup tunnel around a failed, "protected" link.

LSP—Label-Switched Path. Creation of an n-hop LSP requires that static label switching state be installed at a sequence of router hops, R0...Rn, in order to transport packets from R0 to Rn using label switching. (This represents an end-to-end tunnel on which data normally flows.)

Midpoint—A transit router for a given LSP.

MPLS—MultiProtocol Label Switching. Packet-forwarding technology, used in the network core, that applies data link layer labels to tell switching nodes how to forward data, resulting in faster and more scalable forwarding than network layer routing normally can do.

MPLS Global Label Allocation (GLA)—Using one label space for all interfaces in the router. For example, label 100 coming in one interface is treated the same as label 100 coming in a different interface.

OSPF—Open Shortest Past First. A link-state, hierarchical Interior Gateway Protocol routing algorithm, derived from the IS-IS protocol. OSPF features include least-cost routing, multipath routing, and load balancing.

Protected LSP—An LSP that is eligible for fast repair using the Fast Reroute feature.

Rewrite—An MPLS information block appended to the header of a packet for routing it through a traffic-engineering tunnel. The rewrite stores much of the tunnel's forwarding state (output information).

RSVP—Resource ReSerVation Protocol. An IETF protocol used for signalling requests (setting up reservations) for internet services by a customer before that customer is permitted to transmit data over that portion of the network.

SPF—Shortest Path First. A routing algorithm that iterates on length-of-path to determine a shortest-path spanning tree. Commonly used in link-state routing algorithms. Sometimes called Dijkstra's algorithm.

Tailend—The router upon which an LSP is terminated. This is the last router in the LSP's path.

TE—Traffic Engineering. The techniques and processes used to cause routed traffic to travel through the network on a path other than the one that would have been chosen if standard routing methods had been used.