MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

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The MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup feature enables a router to dynamically build backup tunnels and to dynamically create one-hop primary tunnels on all interfaces that have been configured with Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnels.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup" section on page 32.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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

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Prerequisites for MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

- Configure TE on the routers.

Restrictions for MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

- You cannot enable primary one-hop autotunnels and backup autotunnels on a router that is also configured with stateful switchover (SSO) redundancy. This restriction does not prevent an MPLS TE tunnel that is automatically configured via TE AutoTunnel from being successfully recovered on a midpoint router along the LSP's path if that router experiences an SSO switchover.

Information About MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

To configure autotunnel, you need to understand the following concepts:

Overview of MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup has the following features:

- Backup autotunnel—Enables a router to dynamically build backup tunnels.
- Primary one-hop autotunnel—Enables a router to dynamically create one-hop primary tunnels on all interfaces that have been configured with MPLS TE tunnels.

If no backup tunnels exist, the following types of backup tunnels are created:

- Next hop (NHOP)
- Next-next hop (NNHOP)

The MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup feature has the following benefits:

- Backup tunnels are built automatically, eliminating the need for users to preconfigure each backup tunnel and then assign the backup tunnel to the protected interface.
- The dynamic creation of one-hop primary tunnels eliminates the need to configure an MPLS TE tunnel with the Fast Reroute (FRR) option for the tunnel to be protected.
- Protection is expanded; FRR does not protect IP traffic that is not using the TE tunnel or Label Distribution Protocol (LDP) labels that are not using the TE tunnel.

MPLS Traffic Engineering

MPLS is an Internet Engineering Task Force (IETF)-specified framework that provides for the efficient designation, routing, forwarding, and switching of traffic flows through the network.

TE is the process of adjusting bandwidth allocations to ensure that enough bandwidth is left for high-priority traffic.

In MPLS TE, the upstream router creates a network tunnel for a particular traffic stream, then sets the bandwidth available for that tunnel.

Backup AutoTunnels

Without MPLS backup autotunnels, to protect a label-switched path (LSP) you had to do the following:

- Preconfigure each backup tunnel.
- Assign the backup tunnels to the protected interfaces.

An LSP requests backup protection from Resource Reservation Protocol (RSVP) FRR in the following situations:

- Receipt of the first RSVP Resv message
- Receipt of an RSVP path message with the protection attribute after the LSP has been established without the protection attribute
- Detection that a Record Route Object (RRO) changed

If there was no backup tunnel protecting the interface used by the LSP, the LSP remained unprotected.

Backup autotunnels enable a router to dynamically build backup tunnels when they are needed. This prevents you from having to build MPLS TE tunnels statically.

Backup tunnels may not be available for the following reasons:

- Static backup tunnels are not configured.
- Static backup tunnels are configured, but cannot protect the LSP. The backup tunnel may not have enough available bandwidth, the tunnel may protect a different pool, or the tunnel may be down.

If a backup tunnel is not available, the following two backup tunnels are created dynamically:

- NHOP—Protects against link failure
- NNHOP—Protects against node failure

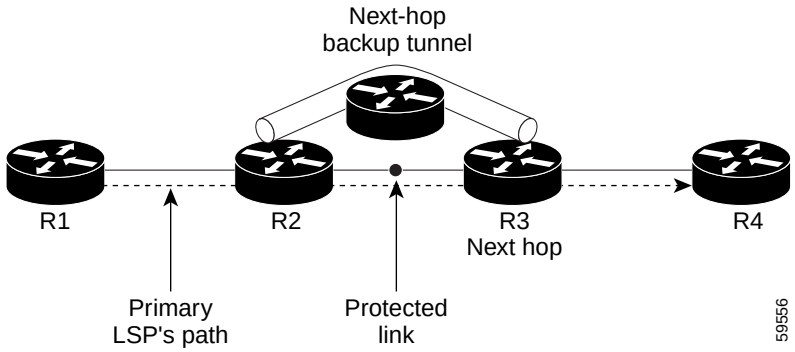
Note At the penultimate hop, only an NHOP backup tunnel is created.

Note If two LSPs share the same output interface and NHOP, three (not four) backup tunnels are created. They share an NHOP backup tunnel.

Link Protection

Backup tunnels that bypass only a single link of the LSP's path provide link protection. They protect LSPs if a link along their path fails by rerouting the LSP's traffic to the next hop (bypassing the failed link). These are referred to as NHOP backup tunnels because they terminate at the LSP's next hop beyond the point of failure. Figure 1 illustrates an NHOP backup tunnel.

Figure 1 Next-Hop Backup Tunnel

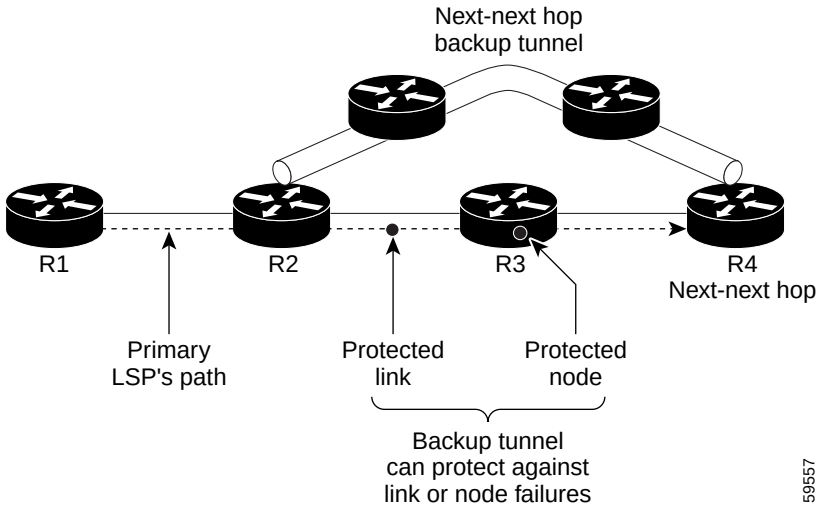


Node Protection

Backup tunnels that bypass next-hop nodes along LSP paths are called NNHOP backup tunnels because they terminate at the node following the next-hop node of the LSPs, thereby bypassing the next-hop node. They protect LSPs by enabling the node upstream of a link or node failure to reroute the LSPs and their traffic around the failure to the next-hop node. NNHOP backup tunnels also provide protection from link failures because they bypass the failed link and the node.

Figure 2 illustrates an NNHOP backup tunnel.

Figure 2 Next-Next Hop Backup Tunnel



Explicit Paths

Explicit paths are used to create backup autotunnels as follows:

- NHOP excludes the protected link's IP address.
- NNHOP excludes the NHOP router ID.
- The explicit-path name is _auto-tunnel_tunnel*xxx*, where *xxx* matches the dynamically created backup tunnel ID.
- The interface used for the **ip unnumbered** command defaults to Loopback0. You can configure this to use a different interface.

Range for Backup AutoTunnels

The tunnel range for backup autotunnels is configurable. By default, the last 100 TE tunnel IDs are used; that is 65,436 to 65,535. Autotunnels detect tunnel IDs that are being used. IDs are allocated starting with the lowest number.

Foe example, if you configure a tunnel range 1000 to 1100 and statically configured TE tunnel are in that range, routers do not use those IDs. If those static tunnels are removed, the MPLS TE dynamic tunnel software can use those IDs.

Primary AutoTunnels

The MPLS Traffic Engineering AutoTunnel Primary and Backup feature enables a router to dynamically create one-hop primary tunnels on all interfaces that have been configured with MPLS traffic. The tunnels are created with zero bandwidth. The constraint-based shortest path first (CSPF) is the same as the shortest path first (SPF) when using zero bandwidth, so the router's choice of the autorouted one-hop primary tunnel is the same as if there were no tunnel. Because it is a one-hop tunnel, the encapsulation is tag-implicit (that is, there is no tag header).

Explicit Paths

Explicit paths are used to create autotunnels as follows:

- The explicit path is dynamically created.
- The explicit path includes the IP address for the interface connected to the next hop.
- The explicit-path name is _auto-tunnel_tunnel*xxx*, where *xxx* matches the dynamically created one-hop tunnel ID.
- Interfaces used for the **ip unnumbered** command default to Loopback0. You can configure this to use a different interface.

Range for AutoTunnels

The tunnel range is configurable. By default, the last 100 TE tunnel IDs are used; that is 65,436 to 65,535. Autotunnels detect tunnel IDs that are being used. IDs are allocated starting with the lowest number.

For example, if you configure a tunnel range 100 to 200 and statically configured TE tunnels are in that range, routers do not use those IDs. If those static tunnels are removed, the IDs become available for use by the MPLS TE dynamic tunnel software.

Label-Based Forwarding

Routers receive a packet, determine where it needs to go by examining some fields in the packet, and send it to the appropriate output device. A label is a short, fixed-length identifier that is used to forward packets. A label switching device normally replaces the label in a packet with a new value before forwarding the packet to the next hop. For this reason, the forwarding algorithm is called label swapping. A label switching device, referred to as a label switch router (LSR), runs standard IP control protocols (that is, routing protocols, RSVP, and so forth) to determine where to forward packets.

Protection and Why It Is Important

This section describes the following:

Delivery of Packets During a Failure

Backup tunnels that terminate at the NNHOP protect both the downstream link and node. This provides protection for link and node failures.

Multiple Backup Tunnels Protecting the Same Interface

- Redundancy—If one backup tunnel is down, other backup tunnels protect LSPs.
- Increased backup capacity—If the protected interface is a high-capacity link and no single backup path exists with an equal capacity, multiple backup tunnels can protect that one high-capacity link. The LSPs using this link will fail over to different backup tunnels, allowing all of the LSPs to have adequate bandwidth protection during failure (rerouting). If bandwidth protection is not desired, the router spreads LSPs across all available backup tunnels (that is, there is load balancing across backup tunnels).

Scalability

A backup tunnel can protect multiple LSPs. Furthermore, a backup tunnel can protect multiple interfaces. This is called many-to-one (N:1) protection. N:1 protection has significant scalability advantages over one-to-one (1:1) protection, where a separate backup tunnel must be used for each LSP needing protection.

An example of N:1 protection is that when one backup tunnel protects 5000 LSPs, each router along the backup path maintains one additional tunnel.

An example of 1:1 protection is that when 5000 backup tunnels protect 5000 LSPs, each router along the backup path must maintain state for an additional 5000 tunnels.

RSVP Hello

RSVP Hello allows a router to detect when its neighbor has gone down but its interface to that neighbor is still operational. When Layer 2 link protocols are unable to detect that the neighbor is unreachable, Hellos provide the detection mechanism; this allows the router to switch LSPs onto its backup tunnels and avoid packet loss.

How to Configure MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

This sections contains the following procedures:

- Establishing MPLS Backup AutoTunnels to Protect Fast Reroutable TE LSPs, page 7 (required)
- Establishing One-Hop Tunnels to All Neighbors, page 8 (required)

Establishing MPLS Backup AutoTunnels to Protect Fast Reroutable TE LSPs

To establish an MPLS backup autotunnel to protect fast reroutable TE LSPs, perform the following steps.

Note Only Steps 1 through 3 are required. If you perform additional steps, you can perform them in any order after Step 3.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng auto-tunnel backup**
4. **mpls traffic-eng auto-tunnel backup nhop-only**
5. **mpls traffic-eng auto-tunnel backup tunnel-num** [**min** *num*] [**max** *num*]
6. **mpls traffic-eng auto-tunnel backup timers removal unused** *sec*
7. **mpls traffic-eng auto-tunnel backup config unnumbered-interface** *interface*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**mpls traffic-eng auto-tunnel backup** **Example:** `Router(config)# mpls traffic-eng auto-tunnel backup`	Automatically builds NHOP and NNHOP backup tunnels.

	Command or Action	Purpose
Step 4	**mpls traffic-eng auto-tunnel backup nhop-only** **Example:** `Router(config)# mpls traffic-eng auto-tunnel backup nhop-only`	Enables the creation of dynamic NHOP backup tunnels.
Step 5	**mpls traffic-eng auto-tunnel backup tunnel-num** [**min** *num*] [**max** *num*] **Example:** `Router(config)# mpls traffic-eng auto-tunnel backup tunnel-num min 1000 max 1100`	Configures the range of tunnel interface numbers for backup autotunnels.
Step 6	**mpls traffic-eng auto-tunnel backup timers removal unused** *sec* **Example:** `Router(config)# mpls traffic-eng auto-tunnel backup timers removal unused 50`	Configures how frequently a timer will scan backup autotunnels and remove tunnels that are not being used.
Step 7	**mpls traffic-eng auto-tunnel backup config unnumbered-interface** *interface* **Example:** `Router(config)# mpls traffic-eng auto-tunnel backup config unnumbered-interface ethernet1/0`	Enables IP processing on the specified interface without an explicit address.

Establishing One-Hop Tunnels to All Neighbors

To establish one-hop tunnels to all neighbors, perform the following steps.

Note Only Steps 1 through 3 are required. If you perform additional steps, you can perform them in any order after Step 3.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng auto-tunnel primary onehop**
4. **mpls traffic-eng auto-tunnel primary tunnel-num** [**min** *num*] [**max** *num*]
5. **mpls traffic-eng auto-tunnel primary timers removal rerouted** *sec*
6. **mpls traffic-eng auto-tunnel primary config unnumbered** *interface*
7. **mpls traffic-eng auto-tunnel primary config mpls ip**
8. **clear mpls traffic-eng auto-tunnel primary**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**mpls traffic-eng auto-tunnel primary onehop** **Example:** `Router(config)# mpls traffic-eng auto-tunnel primary onehop`	Automatically creates primary tunnels to all next hops.
Step 4	**mpls traffic-eng auto-tunnel primary tunnel-num** [**min** *num*] [**max** *num*] **Example:** `Router(config)# mpls traffic-eng auto-tunnel primary tunnel-num min 2000 max 2100`	Configures the range of tunnel interface numbers for primary autotunnels.
Step 5	**mpls traffic-eng auto-tunnel primary timers removal rerouted** *sec* **Example:** `Router(config)# mpls traffic-eng auto-tunnel primary timers removal rerouted 400`	Configures how many seconds after a failure primary autotunnels will be removed.
Step 6	**mpls traffic-eng auto-tunnel primary config unnumbered** *interface* **Example:** `Router(config)# mpls traffic-eng auto-tunnel primary config unnumbered ethernet1/0`	Enables IP processing on the specified interface without an explicit address.
Step 7	**mpls traffic-eng auto-tunnel primary config mpls ip** **Example:** `Router(config)# mpls traffic-eng auto-tunnel primary config mpls ip`	Enables LDP on primary autotunnels.
Step 8	**clear mpls traffic-eng auto-tunnel primary** **Example:** `Router(config)# clear mpls traffic-eng auto-tunnel primary`	Removes all primary autotunnels and re-creates them.

Configuration Examples for MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

This section contains the following configuration examples:

Establishing MPLS Backup AutoTunnels to Protect Fast Reroutable TE LSPs: Example

Note This example does not include the **mpls traffic-eng auto-tunnel backup nhop-only** command because AutoTunnel would not be able to create any backup tunnels.

To determine if there are any backup tunnels, enter the **show ip rsvp fast-reroute** command. This example shows that there is a static configured primary tunnel and no backup tunnels. For a description of the command output fields, refer to the "show ip rsvp fast-reroute" section on page 30.

```
Router(config)# show ip rsvp fast-reroute

Primary     Protect   BW         Backup
Tunnel      I/F       BPS:Type   Tunnel:Label  State  Level   Type
------      -------   -------    ------------  ------ -----   ----
R3-PRP_t0   PO3/1     0:G        None          None   None
```

The following command causes AutoTunnel to automatically configure NHOP and NNHOP backup tunnels:

```
Router(config)# mpls traffic-eng auto-tunnel backup
```

As illustrated in the **show ip interface brief** command output, AutoTunnel created two backup tunnels that have tunnel IDs 65436 and 65437:

```
Router# show ip interface brief

Interface              IP-Address      OK? Method Status                Protocol
POS2/0                 10.0.0.14       YES NVRAM  down                  down
POS2/1                 10.0.0.49       YES NVRAM  up                    up
POS2/2                 10.0.0.45       YES NVRAM  up                    up
POS2/3                 10.0.0.57       YES NVRAM  administratively down  down
POS3/0                 10.0.0.18       YES NVRAM  down                  down
POS3/1                 10.0.0.33       YES NVRAM  up                    up
POS3/2                 unassigned      YES NVRAM  administratively down  down
POS3/3                 unassigned      YES NVRAM  administratively down  down
GigabitEthernet4/0     10.0.0.37       YES NVRAM  up                    up
GigabitEthernet4/1     unassigned      YES NVRAM  administratively down  down
GigabitEthernet4/2     unassigned      YES NVRAM  administratively down  down
Loopback0              10.0.3.1        YES NVRAM  up                    up
Tunnel0                10.0.3.1        YES unset  up                    up
Tunnel65436            10.0.3.1        YES unset  up                    up
Tunnel65437            10.0.3.1        YES unset  up                    up
Ethernet0              10.3.38.3       YES NVRAM  up                    up
Ethernet1              unassigned      YES NVRAM  administratively down  down
R3-PRP#
```

The following command prevents AutoTunnel from creating NNHOP backup tunnels:

```
Router# mpls traffic-eng auto-tunnel backup nhop-only
```

The “Type” field in the following **show ip rsvp fast-reroute** command shows that there is only an NHOP tunnel:

```
Router# show ip rsvp fast-reroute

Primary    Protect  BW Backup
Tunnel     I/F      BPS:Type  Tunnel:Label  State  Level   Type
------     -------  --------  ------------- ------ ------- ----
R3-PRP_t0  PO3/1    0:G       Tu65436:24    Ready  any-unl Nhop
```

The following command changes the minimum and maximum tunnel interface numbers to 1000 and 1100, respectively:

```
Router# mpls traffic-eng auto-tunnel backup tunnel-num min 1000 max 1100
```

You can verify the ID numbers and autotunnel backup range ID by entering the **show ip rsvp fast-reroute** and **show ip interface brief** commands. In this example, only one backup tunnel is protecting the primary tunnel:

```
Router# show ip rsvp fast-reroute

Primary                  Protect BW         Backup
Tunnel                   I/F     BPS:Type   Tunnel:Label  State  Level   Type
------                   ------- --------   ------------- ------ -----   ------
R3-PRP_t0                PO3/1   0:G        Tu1000:24     Ready  any-unl Nhop

Router# show ip interface brief

Interface            IP-Address    OK?  Method  Status                  Protocol
POS2/0               10.0.0.14     YES  NVRAM   down                    down
POS2/1               10.0.0.49     YES  NVRAM   up                      up
POS2/2               10.0.0.45     YES  NVRAM   up                      up
POS2/3               10.0.0.57     YES  NVRAM   administratively down   down
POS3/0               10.0.0.18     YES  NVRAM   down                    down
POS3/1               10.0.0.33     YES  NVRAM   up                      up
POS3/2               unassigned    YES  NVRAM   administratively down   down
POS3/3               unassigned    YES  NVRAM   administratively down   down
GigabitEthernet4/0   10.0.0.37     YES  NVRAM   up                      up
GigabitEthernet4/1   unassigned    YES  NVRAM   administratively down   down
GigabitEthernet4/2   unassigned    YES  NVRAM   administratively down   down
Loopback0            10.0.3.1      YES  NVRAM   up                      up
Tunnel0              10.0.3.1      YES  unset   up                      up
Tunnel65436          10.0.3.1      YES  unset   up                      up
Ethernet0            10.3.38.3     YES  NVRAM   up                      up
Ethernet1            unassigned    YES  NVRAM   administratively down   down
```

The default tunnel range for autotunnel backup tunnels is 65,436 through 65,535. The following **show ip rsvp fast-reroute** command changes the tunnel range IDs:

```
Router# show ip rsvp fast-reroute

Primary     Protect  BW         Backup
Tunnel       I/F     BPS:Type   Tunnel:Label   State   Level    Type
------      -------  --------   ------------- ------   -----    ------
R3-PRP_t0   PO3/1    0:G        Tu1001:0       Ready   any-unl  N-Nhop
```

The results are shown in the **show ip interface brief** command:

```
Router# show ip interface
Router# show ip interface brief

Interface              UP-Address   OK?  Method  Status                Protocol
POS2/0                 10.0.0.14    YES  NVRAM   down                  down
POS2/1                 10.0.0.49    YES  NVRAM   up                    up
POS2/2                 10.0.0.45    YES  NVRAM   up                    up
POS2/3                 10.0.0.57    YES  NVRAM   up                    up
POS3/0                 10.0.0.18    YES  NVRAM   up                    up
POS3/1                 10.0.0.33    YES  NVRAM   up                    up
POS3/2                 unassigned   YES  NVRAM   administratively down  down
POS3/3                 unassigned   YES  NVRAM   administratively down  down
Loopback0              10.0.3.1     YES  NVRAM   up                    up
Tunnel0                10.0.3.1     YES  unset   up                    up
Tunnel1000             10.0.3.1     YES  unset   up                    up
Tunnel1001             10.0.3.1     YES  unset   up                    up
Ethernet0              10.3.38.3     YES  NVRAM   up                    up
Ethernet1              unassigned   YES  NVRAM   administratively down  down
```

The following **mpls traffic-eng auto-tunnel backup timers removal unused** command specifies that a timer will scan backup autotunnels every 50 seconds and the timer will remove tunnels that are not being used:

```
Router(config)# mpls traffic-eng auto-tunnel backup timers removal unused 50
```

The following **mpls traffic-eng auto-tunnel backup config unnumbered-interface** command enables IP processing on interface POS3/1:

```
Router(config)# mpls traffic-eng auto-tunnel backup config unnumbered-interface POS3/1
```

To verify that IP processing is enabled on POS3/1, enter the **show interfaces tunnel** command:

```
Router# show interfaces tunnel 1001

Tunnel1001 is up, line protocol is up
  Hardware is Tunnel
  Interface is unnumbered.  Using address of POS3/1 (10.0.0.33)
  MTU 1514 bytes, BW 9 Kbit, DLY 500000 usec, rely 255/255, load 1/255
  Encapsulation TUNNEL, loopback not set
  Keepalive not set
  Tunnel source 10.0.0.0, destination 10.0.5.1
  Tunnel protocol/transport Label Switching, sequencing disabled
  Key disabled
  Checksumming of packets disabled
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Establishing One-Hop Tunnels to Neighbors: Example

For AutoTunnel to automatically create primary tunnels to all next hops, you must enter the following command:

```
Router(config)# mpls traffic-eng auto-tunnel primary onehop
```

In this example there are four primary tunnels and no backup tunnels. To verify that configuration, enter the **show ip rsvp fast-reroute** command and the **show ip interface brief** command:

```
Router# show ip rsvp fast-reroute

Primary                  Protect BW         Backup
Tunnel                   I/F     BPS:Type   Tunnel:Label  State  Level   Type
------                   ------- --------   ------------- ------ -----   ------
R3-PRP_t65337            PO2/2   0:G        None          None   None
R3-PRP_t65338            PO3/1   0:G        None          None   None
R3-PRP_t65339            Gi4/0   0:G        None          None   None
R3-PRP_t65336            PO2/1   0:G        None          None   None

Router# show ip interface brief

Interface              IP-Address    OK?  Method Status                Protocol
POS2/0                 10.0.0.14     YES  NVRAM  down                  down
POS2/1                 10.0.0.49     YES  NVRAM  up                    up
POS2/2                 10.0.0.45     YES  NVRAM  up                    up
POS2/3                 10.0.0.57     YES  NVRAM  administratively down  down
POS3/0                 10.0.0.18     YES  NVRAM  down                  down
POS3/1                 10.0.0.33     YES  NVRAM  up                    up
POS3/2                 unassigned    YES  NVRAM  administratively down  down
POS3/3                 unassigned    YES  NVRAM  administratively down  down
GigabitEthernet4/0     10.0.0.37     YES  NVRAM  up                    up
GigabitEthernet4/1     unassigned    YES  NVRAM  administratively down  down
GigabitEthernet4/2     unassigned    YES  NVRAM  administratively down  down
Loopback0              10.0.3.1      YES  NVRAM  up                    up
Tunnel0                10.0.3.1      YES  unset  administratively down  down
Tunnel65336            10.0.3.1      YES  unset  up                    up
Tunnel65337            10.0.3.1      YES  unset  up                    up
Tunnel65338            10.0.3.1      YES  unset  up                    up
Tunnel65339            10.0.3.1      YES  unset  up                    up
Ethernet0              10.3.38.3     YES  NVRAM  up                    up
Ethernet1              unassigned    YES  NVRAM  administratively down  down
R3-PRP#
```

The default tunnel range for primary autotunnels is 65,336 through 65,435. The following **mpls traffic-eng auto-tunnel primary tunnel-num** command changes the range to 2000 through 2100:

```
Router(config)# mpls traffic-eng auto-tunnel primary tunnel-num min 2000 max 2100
```

The following sample output from the **show ip rsvp fast-reroute** command and the **show ip interface brief** command shows that the tunnel IDs are 2000, 2001, 2002, and 2003:

```
Router# show ip rsvp fast-reroute

Primary                  Protect BW         Backup
Tunnel                   I/F     BPS:Type   Tunnel:Label  State  Level   Type
------                   ------- --------   ------------- ------ -----   ------
R3-PRP_t2001             PO2/2   0:G        None          None   None
R3-PRP_t2002             PO3/1   0:G        None          None   None
R3-PRP_t2003             Gi4/0   0:G        None          None   None
R3-PRP_t2000             PO2/1   0:G        None          None   None
```

```
Router# show ip interface brief

Interface              IP-Address      OK? Method Status                Protocol
POS2/0                 10.0.0.14       YES NVRAM  down                  down
POS2/1                 10.0.0.49       YES NVRAM  up                    up
POS2/2                 10.0.0.45       YES NVRAM  up                    up
POS2/3                 10.0.0.57       YES NVRAM  administratively down down
POS3/0                 10.0.0.18       YES NVRAM  down                  down
POS3/1                 10.0.0.33       YES NVRAM  up                    up
POS3/2                 unassigned      YES NVRAM  administratively down down
POS3/3                 unassigned      YES NVRAM  administratively down down
GigabitEthernet4/0     10.0.0.37       YES NVRAM  up                    up
GigabitEthernet4/1     unassigned      YES NVRAM  administratively down down
GigabitEthernet4/2     unassigned      YES NVRAM  administratively down down
Loopback0              10.0.3.1        YES NVRAM  up                    up
Tunnel0                10.0.3.1        YES unset  administratively down down
Tunnel2000             10.0.3.1        YES unset  up                    up
Tunnel2001             10.0.3.1        YES unset  up                    up
Tunnel2002             10.0.3.1        YES unset  up                    up
Tunnel2003             10.0.3.1        YES unset  up                    up
Ethernet0              10.3.38.3 '     YES NVRAM  up                    up
Ethernet1              unassigned      YES NVRAM  administratively down down
```

The following **mpls traffic-eng auto-tunnel primary timers** command specifies that a timer will scan backup autotunnels every 50 seconds and remove tunnels that are not being used:

```
Router(config)# mpls traffic-eng auto-tunnel primary timers removal rerouted 50
```

The following **mpls traffic-eng auto-tunnel primary config unnumbered** command enables IP processing on interface POS3/1:

```
Router(config)# mpls traffic-eng auto-tunnel primary config unnumbered POS3/1
```

To specify that AutoTunnel remove all primary autotunnels and re-create them, enter the following command:

```
Router(config)# clear mpls traffic-eng auto-tunnel primary
```

Additional References

The following sections provide references related to the MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup feature.

Related Documents

Related Topic	Document Title
Backup tunnels	*MPLS Traffic Engineering (TE) Link and Node Protection, with RSVP Hellos Support*, Release 12.2(33)S
Link protection	• *Cisco IOS IP Switching Command Reference*, Release 12.4T • *Cisco IOS IP Switching Command Reference*, Release 12.2 SR • *Cisco IOS IP Switching Command Reference*, Release 12.2SB • *Cisco IOS IP Switching Configuration Guide*, Release 12.4
MPLS traffic engineering	• *Cisco IOS IP Switching Command Reference*, Release 12.4T • *Cisco IOS IP Switching Command Reference*, Release 12.2 SR • *Cisco IOS IP Switching Command Reference*, Release 12.2SB • *Cisco IOS IP Switching Configuration Guide*, Release 12.4 • *MPLS Diff-Serv-aware Traffic Engineering (DS-TE) over ATM*, Release 12.2(8)T

Standards

Standards	Title
No new or modified standards are supported by this release and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this release and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
No new or modified RFCs are supported by this release and support for existing RFCs has not been modified by this feature.	—

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.	http://www.cisco.com/techsupport

Command Reference

This section documents only commands that are new or modified.

- **clear mpls traffic-eng auto-tunnel primary**
- **mpls traffic-eng auto-tunnel backup**
- **mpls traffic-eng auto-tunnel backup config**
- **mpls traffic-eng auto-tunnel backup nhop-only**
- **mpls traffic-eng auto-tunnel backup timers**
- **mpls traffic-eng auto-tunnel backup tunnel-num**
- **mpls traffic-eng auto-tunnel primary config**
- **mpls traffic-eng auto-tunnel primary config mpls ip**
- **mpls traffic-eng auto-tunnel primary onehop**
- **mpls traffic-eng auto-tunnel primary timers**
- **mpls traffic-eng auto-tunnel primary tunnel-num**
- **show ip rsvp fast-reroute**

clear mpls traffic-eng auto-tunnel primary

To remove all the primary autotunnels and re-create them, use the **clear mpls traffic-eng auto-tunnel primary** command in global configuration mode.

clear mpls traffic-eng auto-tunnel primary

Syntax Description

This command has no arguments or keywords.

Command Default

None

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example removes all primary autotunnels and re-creates them:

```
Router# clear mpls traffic-eng auto-tunnel primary
```

Related Commands

Command	Description
show ip rsvp fast-reroute	Displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection.

mpls traffic-eng auto-tunnel backup

To automatically build next-hop (NHOP) and next-next hop (NNHOP) backup tunnels, use the **mpls traffic-eng auto-tunnel backup** command in global configuration mode. To delete the NHOP and NNHOP backup tunnels, use the **no** form of this command.

mpls traffic-eng auto-tunnel backup

no mpls traffic-eng auto-tunnel backup

Syntax Description

This command has no arguments or keywords.

Command Default

None

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

The **no** form of this command deletes both NHOP and NNHOP backup tunnels that were configured using either the **mpls traffic-eng auto-tunnel backup** command or the **mpls traffic-eng auto-tunnel backup nhop-only** command.

Examples

The following example automatically builds NHOP and NNHOP backup tunnels:

```
Router# mpls traffic-eng auto-tunnel backup
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel backup config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel backup nhop-only	Enables the creation of only dynamic next-hop backup tunnels.
mpls traffic-eng auto-tunnel backup timers	Configures how frequently a timer will scan backup autotunnels and remove tunnels that are not being used.
mpls traffic-eng auto-tunnel backup tunnel-num	Configures the range of tunnel interface numbers for backup autotunnels.

mpls traffic-eng auto-tunnel backup config

To enable IP processing without an explicit address, use the **mpls traffic-eng auto-tunnel backup config** command in global configuration mode. To disable IP processing without an explicit address, use the **no** form of this command.

mpls traffic-eng auto-tunnel backup config unnumbered-interface *interface*

no mpls traffic-eng auto-tunnel backup config unnumbered-interface *interface*

Syntax Description

unnumbered-interface *interface*	Interface on which IP processing will be enabled without an explicit address. Default: Loopback0.

Command Default

None

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example enables IP processing on an Ethernet interface without an explicit address:

```
Router# mpls traffic-eng auto-tunnel backup config unnumbered-interface ethernet1/0
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel backup	Automatically builds NHOP and NNHOP backup tunnels.
mpls traffic-eng auto-tunnel backup nhop-only	Enables the creation of only dynamic next-hop backup tunnels.
mpls traffic-eng auto-tunnel backup timers	Configures how frequently a timer will scan backup autotunnels and remove tunnels that are not currently being used.
mpls traffic-eng auto-tunnel backup tunnel-num	Configures the range of tunnel interface numbers for backup autotunnels.

mpls traffic-eng auto-tunnel backup nhop-only

To automatically build next-hop (NHOP) backup tunnels, use the **mpls traffic-eng auto-tunnel backup nhop-only** command in global configuration mode. To delete the NHOP backup tunnels, use the **no** form of this command.

mpls traffic-eng auto-tunnel backup nhop-only

no mpls traffic-eng auto-tunnel backup nhop-only

Syntax Description

This command has no arguments or keywords.

Command Default

The dynamically created backup tunnel uses Loopback0.

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

This command permits the creation of only NHOP backup tunnels; next-next hop (NNHOP) backup tunnels are not created. The **no** form of this command deletes only the NHOP backup tunnels; NNHOP backup tunnels are not deleted.

Examples

The following example enables the creation of only dynamic NHOP backup tunnels:

```
Router# mpls traffic-eng auto-tunnel backup nhop-only
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel backup	Automatically builds NHOP and NNHOP backup tunnels.
mpls traffic-eng auto-tunnel backup config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel backup timers	Configures how frequently a timer will scan backup autotunnels and remove tunnels that are not being used.
mpls traffic-eng auto-tunnel backup tunnel-num	Configures the range of tunnel interface numbers for backup autotunnels.

mpls traffic-eng auto-tunnel backup timers

To configure how frequently a timer will scan backup autotunnels and remove tunnels that are not being used, use the **mpls traffic-eng auto-tunnel backup timers** command in global configuration mode. To disable this configuration, use the **no** form of this command.

mpls traffic-eng auto-tunnel backup timers removal unused [*sec*]

no mpls traffic-eng auto-tunnel backup timers removal unused [*sec*]

Syntax Description

removal unused *sec*	Configures how frequently (in seconds) a timer will scan the backup autotunnels and remove tunnels that are not being used. Valid values are 0 to 604,800.

Command Default

The timer scans backup autotunnels and removes tunnels that are not being used every 3600 seconds (60 minutes).

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example shows that a timer will scan backup autotunnels every 80 seconds and remove tunnels that are not being used:

```
Router# mpls traffic-eng auto-tunnel backup timers removal unused 80
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel backup	Automatically builds NHOP and NNHOP backup tunnels.
mpls traffic-eng auto-tunnel backup config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel backup nhop-only	Enables the creation of only dynamic next-hop backup tunnels.
mpls traffic-eng auto-tunnel backup tunnel-num	Configures the range of tunnel interface numbers for backup autotunnels.

mpls traffic-eng auto-tunnel backup tunnel-num

To configure the range of tunnel interface numbers for backup autotunnels, use the **mpls traffic-eng auto-tunnel backup tunnel-num** command in global configuration mode. To disable this configuration, use the **no** form of this command.

mpls traffic-eng auto-tunnel backup tunnel-num [**min** *num*] [**max** *num*]

no mpls traffic-eng auto-tunnel backup tunnel-num [**min** *num*] [**max** *num*]

Syntax Description

min *num*	(Optional) Minimum number of the backup tunnels. Valid values are from 0 to 65535. Default: 65436.
max *num*	(Optional) Maximum number of the backup tunnels. Valid values are from 0 to 65535. Default: 65535.

Command Default

None

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example configures the range of backup autotunnel numbers to be between 1000 and 1100:

```
Router# mpls traffic-eng auto-tunnel backup tunnel-num min 1000 max 1100
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel backup	Automatically builds NHOP and NNHOP backup tunnels.
mpls traffic-eng auto-tunnel backup config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel backup nhop-only	Enables the creation of only dynamic next-hop backup tunnels.
mpls traffic-eng auto-tunnel backup timers	Configures how frequently a timer will scan backup autotunnels and remove tunnels that are not being used.

mpls traffic-eng auto-tunnel primary config

To enable IP processing without an explicit address, use the **mpls traffic-eng auto-tunnel primary config** command in global configuration mode. To disable this capability, use the **no** form of this command.

mpls traffic-eng auto-tunnel primary config unnumbered *interface*

no mpls traffic-eng auto-tunnel primary config unnumbered *interface*

Syntax Description

unnumbered *interface*	Interface on which IP processing will be enabled without an explicit address.

Command Default

Loopback0

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example enables IP processing on an Ethernet interface:

```
Router# mpls traffic-eng auto-tunnel primary config unnumbered ethernet1/0
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel primary config mpls ip	Enables LDP on primary autotunnels.
mpls traffic-eng auto-tunnel primary onehop	Automatically creates primary tunnels to all next-hops.
mpls traffic-eng auto-tunnel primary timers	Configures how many seconds after a failure primary autotunnels are removed.
mpls traffic-eng auto-tunnel primary tunnel-num	Configures the range of tunnel interface numbers for primary autotunnels.
show ip rsvp fast-reroute	Displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection.

mpls traffic-eng auto-tunnel primary config mpls ip

To enable Label Distribution Protocol (LDP) on primary autotunnels, use the **mpls traffic-eng auto-tunnel primary config mpls ip** command in global configuration mode. To disable LDP on primary autotunnels, use the **no** form of this command.

mpls traffic-eng auto-tunnel primary config mpls ip

no mpls traffic-eng auto-tunnel primary config mpls ip

Syntax Description

This command has no arguments or keywords.

Command Default

LDP is not enabled.

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example enables LDP on primary autotunnels:

```
Router# mpls traffic-eng auto-tunnel primary config mpls ip
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel primary config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel primary onehop	Automatically creates primary tunnels to all next hops.
mpls traffic-eng auto-tunnel primary timers	Configures how many seconds after a failure primary autotunnels are removed.
mpls traffic-eng auto-tunnel primary tunnel-num	Configures the range of tunnel interface numbers for primary autotunnels.
show ip rsvp fast-reroute	Displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection.

mpls traffic-eng auto-tunnel primary onehop

To automatically create primary tunnels to all next hops, use the **mpls traffic-eng auto-tunnel primary onehop** command in global configuration mode. To disable the automatic creation of primary tunnels to all next hops, use the **no** form of this command.

mpls traffic-eng auto-tunnel primary onehop

no mpls traffic-eng auto-tunnel primary onehop

Syntax Description

This command has no arguments or keywords.

Command Default

The dynamically created one-hop tunnels use Loopback0.

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example automatically creates primary tunnels to all next hops:

```
Router# mpls traffic-eng auto-tunnel primary onehop
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel primary config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel primary onehop	Enables LDP on primary autotunnels.
mpls traffic-eng auto-tunnel primary timers	Configures how many seconds after a failure primary autotunnels are removed.
mpls traffic-eng auto-tunnel primary tunnel-num	Configures the range of tunnel interface numbers for primary autotunnels.
show ip rsvp fast-reroute	Displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection.

mpls traffic-eng auto-tunnel primary timers

To configure how many seconds after a failure primary autotunnels are removed, use the **mpls traffic-eng auto-tunnel primary timers** command in global configuration mode. To disable this configuration, use the **no** form of this command.

mpls traffic-eng auto-tunnel primary timers removal rerouted *sec*

no mpls traffic-eng auto-tunnel primary timers removal rerouted *sec*

Syntax Description

removal rerouted *sec*	Number of seconds after a failure that primary autotunnels are removed. Valid values are 30 to 604,800. Default: 0.

Command Default

None

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example shows that primary autotunnels are removed 100 seconds after a failure:

```
Router# mpls traffic-eng auto-tunnel primary timers removal rerouted 100
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel primary config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel primary tunnel-num	Enables LDP on primary autotunnels.
mpls traffic-eng auto-tunnel primary onehop	Automatically creates primary tunnels to all next hops.
mpls traffic-eng auto-tunnel primary tunnel-num	Configures the range of tunnel interface numbers for primary autotunnels.
show ip rsvp fast-reroute	Displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection.

mpls traffic-eng auto-tunnel primary tunnel-num

To configure the range of tunnel interface numbers for primary autotunnels, use the **mpls traffic-eng auto-tunnel primary tunnel-num** command in global configuration mode. To disable this configuration, use the **no** form of this command.

mpls traffic-eng auto-tunnel primary tunnel-num [**min** *num*] [**max** *num*]

no mpls traffic-eng auto-tunnel primary tunnel-num [**min** *num*] [**max** *num*]

Syntax Description

min *num*	(Optional) Minimum number of the primary tunnels. Valid values are from 0 to 65535. Default: 65436.
max *num*	(Optional) Maximum number of the primary tunnels. The **max** number is the minimum number plus 99. Valid values are from 0 to 65535.

Command Default

None

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example shows that the primary tunnel numbers can be between 2000 and 2100:

```
Router# mpls traffic-eng auto-tunnel primary tunnel-num min 2000 max 2100
```

Related Commands

Command	Description
mpls traffic-eng auto-tunnel primary config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel primary config mpls ip	Enables LDP on primary autotunnels.
mpls traffic-eng auto-tunnel primary onehop	Automatically creates primary tunnels to all next hops.
mpls traffic-eng auto-tunnel primary timers	Configures how many seconds after a failure primary autotunnels are removed.
show ip rsvp fast-reroute	Displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection.

show ip rsvp fast-reroute

To display information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection, use the **show ip rsvp fast-reroute** command in privileged EXEC mode.

show ip rsvp fast-reroute

Syntax Description

This command has no arguments or keywords.

Command Default

None

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(27)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example displays information about fast reroutable primary tunnels and their corresponding backup tunnels that provide protection:

```
Router# show ip rsvp fast-reroute

Primary                 Protect BW         Backup
Tunnel                  I/F     BPS:Type   Tunnel:Label  State  Level  Type
------                  ------- --------   ------------- ------ -----  ---
GSR1---R2---_t65336     PO1/0   0:G        Tu1002:0      Ready  any-unl Nhop
GSR1---R2---_t65338     PO4/0   0:G        Tu1004:0      Ready  any-unl Nhop
```

Table 1 describes the significant fields shown in the display.

Table 1 show ip rsvp fast-reroute Field Descriptions

Field	Description
Primary Tunnel	Hostname and tunnel ID.
Protect I/F	Interface that is being protected.
BW BPS:Type	Bandwidth bits per second and pool from which bandwidth comes. Valid values are G, global pool; S, subpool.
Backup Tunnel:Label	Backup tunnel ID and label.
State	Status of protection. Valid values are Ready and Active.
Level	Level of bandwidth. Valid values are any and unl (unlimited).
Type	Type of backup tunnel: Nhop (next hop) or NNhop (next-next hop).

Related Commands

Command	Description
mpls traffic-eng auto-tunnel primary config	Enables IP processing without an explicit address.
mpls traffic-eng auto-tunnel primary config mpls ip	Enables LDP on primary autotunnels.
mpls traffic-eng auto-tunnel primary onehop	Automatically creates primary tunnels to all next-hops.
mpls traffic-eng auto-tunnel primary timers	Configures how many seconds after a failure primary autotunnels are removed.
mpls traffic-eng auto-tunnel primary tunnel-num	Configures the range of tunnel interface numbers for primary autotunnels.

Feature Information for MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

Table 2 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note Table 2 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 2 Feature Information for MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup

Feature Name	Releases	Feature Configuration Information
MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup	12.0(27)S 12.2(33)SRA 12.2(33)SXH	MPLS Traffic Engineering (TE)—AutoTunnel Primary and Backup enables a router to dynamically build backup tunnels and to dynamically create one-hop primary tunnels on all interfaces that have been configured with MPLS TE tunnels. In 12.0(27)S, this feature was introduced. In12.2(33)SRA, this feature was integrated. Support for 12.2(33)SXH was added.

Glossary

backup tunnel—An MPLS traffic engineering tunnel used to protect other (primary) tunnel's traffic when a link or node failure occurs.

egress router—A router at the edge of the network where packets are leaving.

Fast Reroute—Fast Reroute (FRR) is a mechanism for protecting MPLS traffic engineering (TE) LSPs from link and node failure by locally repairing the LSPs at the point of failure, allowing data to continue to flow on them while their headend routers attempt to establish end-to-end LSPs to replace them. FRR locally repairs the protected LSPs by rerouting them over backup tunnels that bypass failed links or nodes.

hop—Passage of a data packet between two network nodes (for example, between two routers).

interface—A network connection.

IP address—A 32-bit address assigned to hosts using TCP/IP. An IP address belongs to one of five classes (A, B, C, D, or E) and is written as four octets separated by periods (dotted decimal format). Each address consists of a network number, an optional subnetwork number, and a host number. The network and subnetwork numbers together are used for routing, and the host number is used to address an individual host within the network or subnetwork. A subnet mask is used to extract network and subnetwork information from the IP address.

IP explicit path—A list of IP addresses, each representing a node or link in the explicit path.

LDP—Label Distribution Protocol. A standard protocol between MPLS-enabled routers to negotiate the labels (addresses) used to forward packets.

link—Point-to-point connection between adjacent nodes.

LSP—label-switched path. A path that is followed by a labeled packet over several hops, starting at an ingress LSR and ending at an egress LSR.

LSR—label switch router. A Layer 3 router that forwards a packet based on the value of a label encapsulated in the packet.

MPLS—Multiprotocol Label Switching. A method for forwarding packets (frames) through a network. It enables routers at the edge of a network to apply labels to packets. ATM switches or existing routers in the network core can switch packets according to the labels with minimal lookup overhead.

node—Endpoint of a network connection or a junction common to two or more lines in a network. Nodes can be interconnected by links, and serve as control points in the network.

penultimate router—The second-to-last router; that is, the router that is immediately before the egress router.

primary tunnel—An MPLS tunnel whose LSP can be fast rerouted if there is a failure.

router—A network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information.

router ID—Something by which a router originating a packet can be uniquely distinguished from all other routers. For example, an IP address from one of the router's interfaces.

scalability—An indicator showing how quickly some measure of resource usage increases as a network gets larger.

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.

tunnel—A secure communication path between two peers, such as two routers. A traffic engineering tunnel is a label-switched tunnel that is used for traffic engineering. Such a tunnel is set up through means other than normal Layer 3 routing; it is used to direct traffic over a path different from the one that Layer 3 routing could cause the tunnel to take.

Note See *Internetworking Terms and Acronyms* for terms not included in this glossary.