

MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

The Static IPv6 Routes over MPLS TE IPv4 Tunnels feature helps to statically enable IPv6 tunneling over Multiprotocol Label Switching (MPLS) traffic engineering (TE) IPv4 tunnels on edge devices. This feature provides a simple and cost-effective method to leverage an existing MPLS IPv4 backbone to integrate IPv6 services over service provider core backbones.

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Prerequisites for MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

- The MPLS TE feature must be enabled by using the **mpls traffic-eng** command. This command is disabled by default.
- A TE tunnel must be configured.

Restrictions for MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

- Native TE IPv6 tunnels are not supported.
- TE IPv4 tunnel exposure to IPv6 Interior Gateway Protocol (IGP) through IPv6 forwarding adjacency or through autoroute announcement is not supported.
- Static IPv6 routes over TE IPv4 primary autotunnels or autotunnel meshes are not supported.
- Nonstandard Facilities (NSF), stateful switchover (SSO), and Cisco In-Service Software Upgrade (ISSU) high availability requirements are applicable only for dual Route Processor (RP) platforms.
- The TE IPv4 tunnel destination cannot be announced to IPv6 routing.
- TE IPv4 tunnels cannot be announced to IPv6 topologies.
- The tunnel interface needs both IPv4 and IPv6 addresses to forward IPv6 traffic under the tunnel interface. This is because tunnel interface adjacencies are sourced by the adjacency point-to-point manager, which only expects IPv4 to be enabled on the interface before the adjacency point-to-point manager sources the adjacencies.
- If the Static IPv6 Routes over MPLS TE IPv4 Tunnels feature is enabled, TE tunnel statistics will show both MPLS and IPv6 statistics because both IPv6 and MPLS adjacencies are created and used.
- Both the provider-edge-to-customer-edge (PE-to-CE) interface and the CE core-facing interface need IPv6 addresses.
- MPLS and interface statistics on the tunnel egress interface are not supported.
- IPv6 policy-based routing on MPLS TE IPv4 tunnels is not supported.
- Unequal load balancing of IPv6 static routes over multiple TE IPv4 tunnels is not supported.
- TE IPv4 tunnel autobandwidth is not supported.
- IPv6 multicast traffic over TE IPv4 point-to-multipoint tunnel is not supported.
- Generalized MPLS (GMPLS) is not supported.

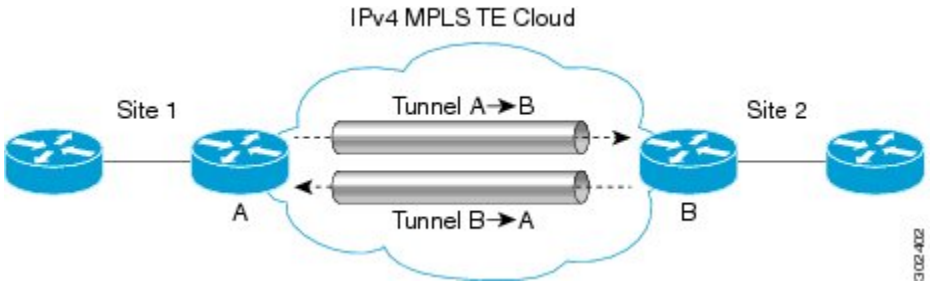
Information About MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

Overview of Static IPv6 Routes over MPLS TE IPv4 Tunnels

The Static IPv6 Routes over MPLS TE IPv4 Tunnels feature manually specifies an MPLS TE IPv4 tunnel as an egress interface for IPv6 routes. Communication is established between remote IPv6 domains by using standard IPv6 tunneling mechanism.

The figure below shows two IPv4-aware and IPv6-aware sites, Site 1 and Site 2, which are connected over an MPLS TE IPv4 core. MPLS TE tunnels are set up across the core between endpoints A and B. IPv6 prefixes from Site 1 are routed onto MPLS TE tunnels through edge device A and vice versa, and IPv6 prefixes from Site 2 are routed onto MPLS TE tunnels through edge device B.

Figure 1: Static IPv6 Route over MPLS TE IPv4 Tunnels



To carry IPv4 and IPv6 traffic on a single MPLS TE IPv4 tunnel, the MPLS Forwarding Infrastructure (MFI) is enhanced at the tunnel ingress and egress endpoints to differentiate between the two types of traffic.

How to Configure MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

Assigning an IPv6 Address to an MPLS TE IPv4 Tunnel

To enable a static IPv6 route over an MPLS TE IPv4 tunnel, first configure a TE IPv4 tunnel, and then assign an IPv6 address or IPv6 unnumbered loopback interface to the TE IPv4 tunnel. The steps for these tasks are listed below.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface tunnel** *interface-number*
4. **ip unnumbered loopback** *interface-number*
5. **ipv6 address** *ipv6-address/prefix-length*
6. **end**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface tunnel** *interface-number* **Example:** `Device(config)# interface tunnel 2`	Configures a tunnel interface and enters interface configuration mode.
Step 4	**ip unnumbered loopback** *interface-number* **Example:** `Device(config-if)# ip unnumbered loopback 0`	Enables IP processing on an interface without assigning an explicit IP address to the interface.
Step 5	**ipv6 address** *ipv6-address/prefix-length* **Example:** `Device(config-if)# ipv6 address 2001:DB8:2222:7272::72/64`	Configures an IPv6 address based on an IPv6 general prefix and enables IPv6 processing on an interface.
Step 6	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

What to do next

After assigning an IPv6 address to a TE IPv4 tunnel, configure the IPv6 route by using the IPv4 tunnel as the egress interface.

Configuring a Static IPv6 Route by Specifying an MPLS TE IPv4 Tunnel as the Egress Interface

To route IPv6 traffic over a TE IPv4 tunnel, specify the IPv4 tunnel as the egress interface.

Before you begin

Before configuring an IPv6 route by using a TE IPv4 tunnel as the egress interface, assign an IPv6 address to the TE IPv4 tunnel. For more information, see the "Assigning an IPv6 Address to an MPLS TE IPv4 Tunnel" section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 route** *ipv6-address/prefix-length interface-type interface-number*
4. **end**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 route** *ipv6-address/prefix-length interface-type interface-number* **Example:** `Device(config)# ipv6 route 2001:DB8:2222:7272::72/64 tunnel 2`	Implements static IPv6 routes. **Note** Using the **ipv6 route** command, specify the same tunnel *interface-number* on which the TE IPv4 tunnel is configured using the steps described in the "Assigning an IPv6 Address to an MPLS TE IPv4 Tunnel" section.
Step 4	**end** **Example:** `Device(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Verifying IPv6 Routing over a TE IPv4 Tunnel

The IPv6 routing component is responsible for processing the static IPv6 route configuration and updating the IPv6 Routing Information Base (RIB). You can use the commands listed below in any order to verify the IPv6 routing configuration.

SUMMARY STEPS

1. **enable**
2. **show ipv6 route**
3. **show ipv6 cef** *interface-type interface-number*
4. **exit**

DETAILED STEPS

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **show ipv6 route**

Example:

```
Device# show ipv6 route
```

Displays contents of the IPv6 routing table.

Step 3 **show ipv6 cef** *interface-type interface-number*

Example:

```
Device# show ipv6 cef tunnel 2
```

Display entries in the IPv6 Forwarding Information Base (FIB).

Step 4 **exit**

Example:

```
Device# exit
```

Exits privileged EXEC mode.

Displaying IPv6 Statistics over a TE IPv4 Tunnel

When the Static IPv6 Routes over MPLS TE IPv4 Tunnels feature is enabled, the TE IPv4 tunnel can carry both IPv4 and IPv6 traffic. You can display the statistics for IPv6 traffic going over the TE tunnel by using the commands described in this task. These commands can be used in any order. The statistics are displayed on a per-interface, per-protocol basis.



Note MPLS and interface statistics will be counted twice due to the presence of two midchain adjacencies in the tunnel. You can subtract IPv6 link adjacency statistics (obtained from the **show adjacency link ipv6** command) from the interface IPv6 statistics (obtained from the **show interface accounting** command) to arrive at accurate statistics.

SUMMARY STEPS

1. **enable**
2. **show mpls forwarding-table** [*ipv6-address*/*prefix-length*]
3. **show interfaces accounting**
4. **show interface** [*interface-type interface-number*] **stats**
5. **show adjacency**
6. **exit**

DETAILED STEPS

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **show mpls forwarding-table** [*ipv6-address*/*prefix-length*]

Example:

```
Device# show mpls forwarding-table
```

Displays the contents of MPLS Label FIB (LFIB).

Step 3 **show interfaces accounting**

Example:

```
Device# show interfaces accounting
```

Displays the number of packets of each protocol type that have been sent through all configured interfaces.

Step 4 **show interface** [*interface-type interface-number*] **stats**

Example:

```
Device# show interface stats
```

Displays numbers of packets that were process switched, fast switched, and distributed switched.

Step 5 **show adjacency**

Example:

```
Device# show adjacency
```

Displays information about the Cisco Express Forwarding adjacency table or the hardware Layer 3-switching adjacency table.

Step 6 **exit**

Example:

```
Device# exit
```

Exits privileged EXEC mode.

Troubleshooting IPv6 Routing over a TE IPv4 Tunnel

You can use the following commands for troubleshooting:

- **debug ipv6 cef**—Dsplays debug messages for Cisco Express Forwarding for IPv6.

- **debug ipv6 routing**—Displays debug messages for IPv6 routing table updates and route cache updates.
- **debug mpls traffic-eng**—Displays debug messages for MPLS traffic engineering activities.

Configuration Examples for MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

Example: Assigning an IPv6 Address to an MPLS TE IPv4 Tunnel

```
Device> enable
Device# configure terminal
Device(config)# interface tunnel 1
Device(config-if)# ip unnumbered loopback 0
Device(config-if)# ipv6 address 2001:DB8::/32
Device(config-if)# end
```

Example: Configuring a Static IPv6 Route by Specifying an MPLS TE IPv4 Tunnel as an Egress Interface

```
Device> enable
Device# configure terminal
Device(config)# ipv6 route 2001:DB8::/32 tunnel 1
Device(config)# end
```

Additional References for MPLS TE - Bundled Interface Support

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
MPLS traffic engineering commands	Cisco IOS Multiprotocol Label Switching Command Reference
IPv6 commands	Cisco IOS IPv6 Command Reference

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

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

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

Table 1: Feature Information for MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels

Feature Name	Releases	Feature Information
MPLS Traffic Engineering Static IPv6 Routes over MPLS TE IPv4 Tunnels	15.2(4)S	The Static IPv6 Routes over MPLS TE IPv4 Tunnels feature helps to statically enable IPv6 tunneling over Multiprotocol Label Switching (MPLS) traffic engineering (TE) IPv4 tunnels through edge devices. This feature provides a simple and cost-effective method to leverage an existing MPLS IPv4 backbone to integrate IPv6 services over service provider core backbones.