Configuring MPLS–Transport Profile

This chapter describes the MPLS–Transport Profile and procedures to configure MPLS–Transport Profile.

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Understanding Multiprotocol Label Switching Transport Profile

Multiprotocol Label Switching Transport Profile (MPLS–TP) is a carrier–grade packet transport technology that enables service providers to move from Synchronous Optical Networking (SONET) and Synchronous Digital Hierarchy (SDH) time–division multiplexing (TDM) to packet switching. MPLS–TP enables MPLS to be deployed in a transport network to support packet transport services with a similar degree of predictability to that found in existing transport networks.

The goal of MPLS–TP is to provide connection–oriented transport for packet and TDM services over optical networks leveraging the widely deployed MPLS technology. Operations, Administration, and Maintenance (OAM) and resiliency features are defined and implemented in MPLS–TP to ensure the capabilities needed for carrier–grade packet transport networks—scalable operations, high availability, performance monitoring and multidomain support.

MPLS–TP defines a profile of MPLS targeted at transport applications and networks. This profile specifies the MPLS characteristics and extensions required to meet the transport requirements.

Note MPLS–TP supports only point–to–point Layer 2 VPN service in this release. The point–to–point Layer 2 VPN service is called Virtual Private Wire Service (VPWS). MPLS–TP supports only static pseudowires in this release.

Key Features

The key features of MPLS–TP are as follows:

- Connection–oriented.
- Carries Layer 3 and Layer 2 services.
- Runs over IEEE Ethernet PHYs, OTN, WDM and so on.
- Static and bidirectional label-switched path (LSP) provisioning.
- OAM functions similar to those available in traditional optical transport networks such as SONET or SDH are provided. These OAM functions belong to the MPLS–TP data plane and are independent from the control plane.
- Fault propagation through Bidirectional Fault Detection (BFD), Link Down Indication (LDI), and Lockout Request (LKR) messages.
- 1:1 revertive path protection.
- IP–less provisioning of tunnels.
- Network provisioning through CTC.
- Traffic switchover time from working LSP to protect LSP and vice versa is up to 50 milliseconds.

Planes in MPLS–TP

The three planes in MPLS–TP perform the following functions:

Plane	Functions
Control plane through CTC	• Constraint-based path computation • Primary and backup LSPs definition • Auto-discovery of existing tunnels • Fault management
Data plane	Forwards data packets
Management plane	Configuration

The control plane is decoupled from the data plane such that the failures in the control plane do not affect the data plane and vice versa.

Restrictions

The following restrictions apply to MPLS–TP:

- Penultimate hop popping is not supported. Only ultimate hop popping is supported, because the label mappings are configured at the MPLS–TP end points.
- MPLS–TP link numbers are not configured on the interfaces for which Multiprotocol Label Switching Traffic Engineering (MPLS-TE) is enabled and vice versa.
- IPv6 addressing is not supported.

Understanding MPLS–TP Operations, Administration, and Maintenance

Several Operations, Administration, and Maintenance (OAM) protocols and messages support the provisioning and maintenance of MPLS–TP tunnels and bidirectional LSPs. The OAM messages are used for fault management, connection verification, continuity check, and other functions. The timers can be configured for each OAM message.

The following OAM messages are forwarded along the specified LSP:

- OAM fault management—Link Down Indication (LDI) and Lockout Request (LKR) messages
- OAM connection verification—ping and traceroute messages
- OAM continuity check—Bidirectional Fault Detection (BFD) messages. min_tx and min_rx are 4 milliseconds.

The following messages are forwarded along the specified pseudowire:

- Static pseudowire OAM messages
- Pseudowire ping and traceroute messages
- Pseudowire BFD messages. min_tx and min_rx are 50 milliseconds.

LDI and LKR Messages

The LDI messages are generated at midpoint nodes when a link failure is detected. The LKR messages are sent from a midpoint node to the reachable endpoint when an interface is administratively shut. When a **lockout** command is configured on either the working or the protect LSP, an LDI message is sent from the local endpoint to the remote endpoint.

LSP Ping and Trace Messages

For MPLS–TP connectivity verification, **ping mpls tp** and **trace mpls tp** commands can be used to specify that the echo requests must be sent along the working LSP or the protect LSP, or the locked out working or protect LSP.

BFD Messages

BFD sessions running on MPLS-TP LSPs can be configured. These sessions run on both the working LSP and the protect LSP. BFD provides continuity check for MPLS–TP LSPs to detect forwarding failures between two adjacent routers. When BFD is enabled on an MPLS–TP tunnel interface, the MPLS–TP client creates separate BFD sessions for working and protect LSPs. A single set of BFD timers is configured on the tunnel that applies to both the working and protect LSPs.

Multiprotocol Label Switching Transport Profile Configuration Procedures

The following procedures can be performed using Cisco IOS commands to configure MPLS–TP:

- DLP-J95 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using Cisco IOS Commands, on page 5
- DLP-J103 Specify Static Label Range Using Cisco IOS Commands, on page 9
- DLP-J97 Create and Configure BFD Templates Using Cisco IOS Commands, on page 11
- DLP-J99 Configure an MPLS–TP Link Using Cisco IOS Commands, on page 16
- DLP-J226 Configure an MPLS–TP Link Without IP Addresses Using Cisco IOS Commands, on page 18
- DLP-J101 Create a Static OAM Class Using Cisco IOS Commands, on page 21
- DLP-J105 Configure Tunnel Midpoints Using Cisco IOS Commands, on page 27
- DLP–J106 Configure Tunnel Endpoints Using Cisco IOS Commands, on page 30

The following procedures can be performed using CTC to configure MPLS–TP:

- DLP-J96 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using CTC, on page 7
- DLP-J104 Specify Static Label Range Using CTC, on page 10
- DLP-J98 Create and Configure BFD Templates Using CTC, on page 13
- DLP-J100 Configure an MPLS–TP Link Number Using CTC, on page 19
- DLP-J102 Create a Static OAM Class Using CTC, on page 22

• DLP-J107 Create an MPLS–TP Tunnel Using CTC, on page 34
• DLP-J208 Edit MPLS–TP Tunnel Attributes Using CTC, on page 37

NTP-J36 Configure Global Settings for Multiprotocol Label Switching Transport Profile

Purpose	This procedure configures the global settings for MPLS–TP.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J95 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using Cisco IOS Commands, on page 5
- DLP-J96 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using CTC, on page 7

Stop. You have completed this procedure.

DLP-J95 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using Cisco IOS Commands

Purpose	This procedure configures the global settings for MPLS–TP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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 tp** **Example:** Router(config)# mpls tp	Enters MPLS–TP configuration mode, from where you can configure MPLS–TP parameters for the router.
Step 4	**router-id** *ip-address* **Example:** Router(config-mpls-tp)# router-id 209.165.200.225	Specifies the default MPLS–TP router ID. This address is used as the source node ID for all the MPLS–TP tunnels configured on the router.
Step 5	**global-id** *number* **Example:** Router(config-mpls-tp)# global-id 1	Specifies the default global ID used for all the endpoints and midpoints. The valid range is from 0 to 2147483647. The default value is 0.
Step 6	**fault-oam refresh-timer** *seconds* **Example:** Router(config-mpls-tp)# fault-oam refresh-timer 10	Specifies the maximum time between successive fault OAM messages specified in seconds. The valid range is from 1 to 255. The default value is 20.
Step 7	**wtr-timer** *seconds* **Example:** Router(config-mpls-tp)# wtr-timer 25	Specifies the wait-to-restore (WTR) timer. This timer controls the length of time to wait before reverting to the original working path following the repair of a fault on the original working path. The valid range is from 0 to 2147483647. **Note** For CPT 50 in ring mode, configure the wait-to-restore (WTR) timer to 60 seconds.
Step 8	**exit** **Example:** Router(config-mpls-tp)# exit	Returns the router to global configuration mode.
Step 9	Return to your originating procedure (NTP).	

	Command or Action	Purpose
	Example: —	

Example: Configure Global Settings for MPLS–TP

The following example shows how to configure the global settings for MPLS–TP using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# mpls tp
Router(config-mpls-tp)# router-id 209.165.200.225
Router(config-mpls-tp)# global-id 1
Router(config-mpls-tp)# fault-oam refresh-timer 10
Router(config-mpls-tp)# wtr-timer 25
Router(config-mpls-tp)# exit
```

DLP-J96 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using CTC

Purpose	This procedure configures the global settings for MPLS–TP using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to configure the global settings for MPLS–TP.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 From the left pane, click **MPLS TP**.

Step 6 Click the **Global Settings** tab.

Step 7 Enter the router IP address in the Node ID field. This IP address need not be the loopback IP address.

Step 8 In the TP Fault OAM area, enter the number of seconds in the Refresh Timer field to specify how often the static OAM packets must be sent out.

Step 9 Click **Apply** to save the configuration.

Step 10 Return to your originating procedure (NTP).

NTP-J40 Specify Static Label Range

Purpose	This procedure specifies the static label range.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J103 Specify Static Label Range Using Cisco IOS Commands, on page 9
- DLP-J104 Specify Static Label Range Using CTC, on page 10

Stop. You have completed this procedure.

DLP-J103 Specify Static Label Range Using Cisco IOS Commands

Purpose	This procedure specifies the static label range using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

You must specify the static label range before provisioning the MPLS–TP tunnel.

Procedure

	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 label range** *dyn-min-value dyn-max-value* **static** *static-min-value static-max-value* **Example:** Router(config)# mpls label range 1000 8000 static 16 999	Specifies the static label range that applies to both the pseudowire and MPLS–TP tunnel. The valid range of static and dynamic labels is from 16 to 8000. The dynamic label range is automatically calculated based on the values specified in the static label range.
Step 4	Return to your originating procedure (NTP). **Example:** —	

Example: Specify Static Label Range

The following example shows how to specify the static label range using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# mpls label range 1000 8000 static 16 999
```

DLP-J104 Specify Static Label Range Using CTC

Purpose	This procedure specifies the static label range using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

You must specify the static label range before provisioning the MPLS–TE or MPLS–TP tunnel.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to specify the static label range.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 From the left pane, click **Label Range**.

Step 6 In the MPLS Static Label Range area, enter the minimum label value in the Min Label field.

Step 7 Enter the maximum label value in the Max Label field.
The static label range specified in the static label applies to both the pseudowire and MPLS–TP tunnel. The valid range of static and dynamic labels is from 16 to 8000. You do not need to specify the values for dynamic labels. The dynamic label range is automatically calculated by CTC based on the values specified in the static label range. For example, if you choose 100 to 1000 for static labels, the dynamic label range is set to 1001 to 8000.

Step 8 Click **Apply** to specify the static label range.

Step 9 Return to your originating procedure (NTP).

Understanding Bidirectional Forwarding Detection

Bidirectional Forwarding Detection (BFD) provides a low–overhead, short–duration method of detecting failures in the forwarding path between two adjacent routers, including interfaces, data links, and forwarding planes.

BFD is a fault detection protocol that is enabled at the interface level. The BFD asynchronous mode, which depends on sending of BFD control packets between two systems to activate and maintain BFD neighbor sessions between routers, is supported. Therefore, to create a BFD session, BFD must be configured on both systems (or BFD peers). When BFD is enabled on the interfaces, a BFD session is created, BFD timers are negotiated, and the BFD peers begin to send BFD control packets to each other at the negotiated interval.

BFD provides continuity check for MPLS–TP LSPs to detect forwarding failures between two adjacent routers. When BFD is enabled on the MPLS–TP tunnel interface, MPLS–TP client creates separate BFD sessions for working and protect LSPs. A single set of BFD timers is configured on the tunnel that applies to both the working and protect LSPs.

NTP-J37 Configure BFD Templates

Purpose	This procedure creates and configures BFD templates.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J97 Create and Configure BFD Templates Using Cisco IOS Commands, on page 11
- DLP-J98 Create and Configure BFD Templates Using CTC, on page 13

Stop. You have completed this procedure.

DLP-J97 Create and Configure BFD Templates Using Cisco IOS Commands

Purpose	This procedure creates and configures a BFD template using Cisco IOS commands.
Tools/Equipment	None

Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**bfd-template single-hop** *template-name* **Example:** Router(config)# bfd-template single-hop bfdtemplate1	Creates a BFD template and enters BFD configuration mode. The **bfd-template** command allows you to create a BFD template and enters BFD configuration mode. The template can be used to specify a set of BFD interval values. You can then invoke the BFD template when you set up the MPLS–TP tunnel.
Step 4	**interval microseconds {both** *microseconds* | **min-tx** *microseconds* **min-rx** *microseconds*} [**multiplier** *multiplier-value*] **Example:** Router(config-bfd)# interval microseconds both 3300 multiplier 3	Configures the transmit and receive intervals in microseconds between BFD packets, and specifies the number of consecutive BFD control packets that must be missed from a BFD peer before BFD declares that a peer is unavailable.
Step 5	**interval {both** *milliseconds* | **min-tx** *milliseconds* **min-rx** *milliseconds*} [**multiplier** *multiplier-value*] **Example:** Router(config-bfd)# interval both 120 multiplier 3	Configures the transmit and receive intervals in milliseconds between BFD packets, and specifies the number of consecutive BFD control packets that must be missed from a BFD peer before BFD declares that a peer is unavailable.
Step 6	**exit** **Example:** Router(config-bfd)# exit	Exits BFD configuration mode and returns the router to global configuration mode.

	Command or Action	Purpose
Step 7	Return to your originating procedure (NTP). **Example:** —	

Example: Create and Configure BFD Templates

The following example shows how to create and configure a BFD template using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# bfd-template single-hop bfdtemplate1
Router(config-bfd)# interval microseconds both 3300 multiplier 3
Router(config-bfd)# exit
```

DLP-J98 Create and Configure BFD Templates Using CTC

Purpose	This procedure creates and configures a BFD template using CTC. You need to enable BFD on both the source and destination nodes of the MPLS–TP tunnel.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to create and configure a BFD template.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 From the left pane, click **MPLS TP**.

Step 6 Click the **BFD Template** tab.

Step 7 Click **Create**. The **Create BFD Template** dialog box appears.

Step 8 Enter the name of the BFD template in the Name field.
The **Single Hop** check box is checked and cannot be changed.

Step 9 Specify the time unit in milliseconds or microseconds.

Step 10 To specify the same interval for transmit and receive between BFD packets:

a) Check the **Use Single Value** check box.

b) Enter the interval between BFD packets in the Interval Value field. The range is from 4 to 999 milliseconds.

Step 11 To specify different intervals for transmit and receive between BDF packets:

a) Enter the transmit interval between BFD packets in the Min_Tx Interval field. The range is from 4 to 999 milliseconds.

b) Enter the receive interval between BFD packets in the Min_Rx Interval field. The range is from 4 to 999 milliseconds.

Step 12 Enter the number of consecutive BFD control packets that must be missed before BFD declares that a peer is unavailable in the Multiplier field.

Step 13 Click **OK** to create and configure a BFD template.

Step 14 Return to your originating procedure (NTP).

Understanding Multiprotocol Label Switching Transport Profile Link Numbers

The MPLS–TP link numbers are configured only on the physical interfaces. Only one MPLS–TP link number can be configured for each interface. The user-assigned link numbers must be unique within the router. The **show mpls tp link-number** command shows all the configured links on the router.

The MPLS–TP link numbers are not assigned to bundled interfaces and virtual interfaces.

The MPLS–TP link numbers can be configured either using the next hop IP address or the MAC address. The valid range of MPLS–TP link number is from 1 to 10000.

Note For Release 9.7, the valid range of MPLS-TP link number is from 1 to 1000.

When you configure a MPLS–TP link using an IP address for the next hop, you use the following commands, where 209.165.200.226 is the IP address of the next hop router:

```
interface TenGigabitEthernet4/1
ip address 209.165.200.225 255.255.255.0
mpls tp link 1 ipv4 209.165.200.226
```

MPLS-TP over Ethernet Without IP Addressing

Transport networks usually do not use IP addresses. You can configure MPLS–TP with links that do not require IP addresses. Instead, Ethernet MAC addresses are used to establish MPLS adjacency between the nodes on Ethernet links. MPLS–TP uses IP only to determine the MAC address of the next hop device through Address Resolution Protocol (ARP).

When you configure a MPLS–TP link without an IP address, you use the following commands:

```
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# medium p2p
Router(config-if)# mpls tp link 1
```

You can use these commands whether the interface has an IP address or not. However, the commands are primarily used when the router and its neighbor router do not have IP addresses.

The **medium p2p** command changes an interface that allows multiple connections to a point-to-point interface. This command allows the router to send and receive all the MPLS-TP packets using a common multicast MAC address knowing that it is communicating with only one other device.

An interface that is natively point-to-point, such as serial, does not require the **medium p2p** command.

Alternatively, you can configure the unicast MAC address of the next-hop device as follows:

```
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# medium p2p
Router(config-if)# mpls tp link 1 tx-mac 0000.0c00.1234
```

You can also configure to transmit and receive on some other multicast address as follows:

```
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# medium p2p
Router(config-if)# mpls tp link 1 tx-mac 0100.0c99.8877 rx-mac 0100.0c99.8877
```

Note When a MPLS–TP link is configured without an IP address on an Ethernet interface, Cisco uses an IEEE Bridge Group MAC address (0180.c200.0000) for communication by default.

NTP-J38 Configure an MPLS–TP Link

Purpose	This procedure configures an MPLS-TP link number on a physical interface.
Tools/Equipment	None
Prerequisite Procedures	None

Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J99 Configure an MPLS–TP Link Using Cisco IOS Commands, on page 16
- DLP-J226 Configure an MPLS–TP Link Without IP Addresses Using Cisco IOS Commands, on page 18
- DLP-J100 Configure an MPLS–TP Link Number Using CTC, on page 19

Stop. You have completed this procedure.

DLP-J99 Configure an MPLS–TP Link Using Cisco IOS Commands

Purpose	This procedure configures an MPLS-TP link number on a physical interface using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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.

	Command or Action	Purpose
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ip address** *ip-address mask-value* **Example:** Router(config-if)# ip address 209.165.200.225 255.255.255.0	Assigns an IP network address and network mask to the interface.
Step 5	**ip rsvp bandwidth** *value* **Example:** Router(config-if)# ip rsvp bandwidth 100	Enables Resource Reservation Protocol (RSVP) for IP on this interface. If you configure non-zero bandwidth for the MPLS–TP tunnel or at a midpoint LSP, ensure that the interface to which the output link is attached has enough available bandwidth. For example, if three tunnel LSPs run over link 1 and each LSP was assigned 1000 with the **tp bandwidth** command, the interface associated with link 1 needs bandwidth of 3000 with the **ip rsvp bandwidth** command.
Step 6	**mpls tp link** *link-num* {**ipv4** *nexthop-ip-address* | **tx-mac** *mac-address* } **Example:** Router(config-if)# mpls tp link 1 ipv4 209.165.200.226	Configures the MPLS–TP link either with the IPv4 address of the next hop router or using a per-interface transmit multicast MAC address. The *link-num* is a number assigned to the link. It must be unique to the device. Only one link number can be assigned per interface. The valid range is from 1 to 10000. **Note** For Release 9.7, the valid range is from 1 to 1000.
Step 7	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.
Step 8	Return to your originating procedure (NTP). **Example:** —	

DLP-J226 Configure an MPLS–TP Link Without IP Addresses Using Cisco IOS Commands

Purpose	This procedure configures an MPLS-TP link without IP addresses using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**medium p2p** **Example:** Router(config-if)# medium p2p	Changes an interface that allows multiple connections to a point-to-point interface. This command allows the router to send and receive all the MPLS–TP packets using a common multicast MAC address knowing that it is communicating with only one other device.
Step 5	**mpls tp link** *link-num* {**ipv4** *ip-address* | **tx-mac** *mac-address* **rx-mac** *mac-address*} **Example:** Router(config-if)# mpls tp link 1 tx-mac 0000.0c00.1234	Configures an MPLS–TP link without the IP address. The **tx-mac** keyword is available on Ethernet interfaces, but the interface must be point-to-point to configure the value of **tx-mac** as a multicast MAC address. The **rx-mac** keyword is available only when the **tx-mac** keyword is used and only when the interface is point-to-point.

	Command or Action	Purpose
Step 6	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.
Step 7	Return to your originating procedure (NTP). **Example:** —	

Example: Configure MPLS–TP Link Numbers Without IP Addresses

The following example shows how to create an MPLS–TP link without an IP address using Cisco IOS commands:

```
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# medium p2p
Router(config-if)# mpls tp link 1
```

The following example shows how to configure the unicast MAC address of the next-hop device using Cisco IOS commands:

```
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# medium p2p
Router(config-if)# mpls tp link 1 tx-mac 0000.0c00.1234
```

Th following example shows how to configure the transmit and receive parameters for a different multicast address using Cisco IOS commands:

```
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# medium p2p
Router(config-if)# mpls tp link 1 tx-mac 0100.0c99.8877 rx-mac 0100.0c99.8877
```

DLP-J100 Configure an MPLS–TP Link Number Using CTC

Purpose	This procedure configures an MPLS–TP link number on a physical interface, using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note You can also create an MPLS-TP link automatically. For more information, see the DLP-J69 Provision PPM and Port Using CTC procedure.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to configure an MPLS-TP link number.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 From the left pane, click **MPLS TP**.

Step 6 Click the **Link Config** tab.

Step 7 Click **Create**. The **Create Link** dialog box appears.

Step 8 From the Slot drop-down list, choose a slot to configure the MPLS–TP link.

Step 9 From the Port drop-list, choose a port.

Step 10 Enter a link number in the Link Number field.

Step 11 To configure the link with the IP address:

a) Check the **Arp** check box.

b) Enter the next hop IP address in the Next Hop IP field.

Note The next hop IP address must be in the same subnet as the IP address of the interface.

Step 12 To configure the MPLS-TP link number with the MAC address, complete one of the following options:

a) Check the **P2P Link** check box.
In the Tx–Mac area, enter the unicast or multicast transmit MAC address in the Mac Address field.

In the Rx–Mac area, enter the unicast or multicast receive MAC address in the Mac Address field.

b) Check the **P2P Link** check box.
In the Tx–Mac area, enter the unicast or multicast transmit MAC address in the Mac Address field.

Step 13 Click **OK** to create the MPLS–TP link.

Step 14 Return to your originating procedure (NTP).

NTP-J39 Create a Static OAM Class

Purpose	This procedure creates a static OAM class.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed

Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J101 Create a Static OAM Class Using Cisco IOS Commands, on page 21
- DLP-J102 Create a Static OAM Class Using CTC, on page 22

Stop. You have completed this procedure.

DLP-J101 Create a Static OAM Class Using Cisco IOS Commands

Purpose	This procedure creates a static OAM class using Cisco IOS commands. You must create a static OAM class for static pseudowire OAM that specifies the OAM timeout refresh intervals.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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.

	Command or Action	Purpose
Step 3	**pseudowire-static-oam class** *class-name* **Example:** Router(config)# pseudowire-static-oam class oam-class1	Specifies the name of the static OAM class.
Step 4	**timeout refresh send** *seconds* **Example:** Router(config-st-pw-oam-class)# timeout refresh send 20	Specifies how often the static OAM packets must be sent out. The valid range is from 1 to 4095 seconds. The default value is 30 seconds.
Step 5	**exit** **Example:** Router(config-st-pw-oam-class)# exit	Returns the router to global configuration mode.
Step 6	Return to your originating procedure (NTP). **Example:** —	

Example: Create a Static OAM Class

The following example shows how to create a static OAM class using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# pseudowire-static-oam class oam-class1
Router(config-st-pw-oam-class)# timeout refresh send 20
Router(config-st-pw-oam-class)# exit
```

DLP-J102 Create a Static OAM Class Using CTC

Purpose	This procedure creates a static OAM class using CTC. You must create a static OAM class for static pseudowire OAM that specifies the OAM timeout refresh intervals.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to create a static OAM class.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 From the left pane, click **MPLS TP**.

Step 6 Click the **Static OAM Class** tab.

Step 7 Click **Create**. The **Create Static OAM Class** dialog box appears.

Step 8 Enter the name of static OAM class in the Name field.

Step 9 Enter the number of seconds in the Refresh Send field to specify how often the static OAM packets must be sent out.

Step 10 Click **OK** to create a static OAM class.

Step 11 Return to your originating procedure (NTP).

NTP-J67 Create a Provisionable Patchcord Using CTC

Purpose	This procedure creates a Provisionable Patchcord (PPC), also called a virtual link, using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note PPCs can be created only between ports of the same size (1GE-1GE or 10GE-10GE) for Client/Trunk to Client/Trunk (layer 2) PPCs.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to create a provisionable patchcord.

Step 2 In the node view (single-shelf mode), click the **Provisioning > Comm Channels > PPC** tabs. Alternatively, in network view, click the **Provisioning > Provisionable Patchcord (PPC)** tabs.
PPCs can be created in either node or network view. However, if you create the PPC in node view, the PPC origination ports will be restricted to the cards installed on the node. Therefore, choose node view only if you know that the PPC origination port resides on a card installed in the node.

Step 3 Click **Create**. The PPC Attributes screen of the PPC Creation wizard appears.

Step 4 Choose the Client/Trunk to Client/Trunk (L2) link type.
This link type creates a PPC between two NNI client or trunk ports.

Step 5 Click **Next**.

Step 6 In the PPC Origination screen of the wizard, specify the following:

- From the Node drop-down list, choose the node where the PPC will originate.
- From the Slot drop-down list, choose the slot where the PPC will originate.
- From the Port drop-down list, choose the port where the PPC will originate.

The ID field displays the ID automatically assigned to the PPC.

Step 7 Click **Next**.

Step 8 In the PPC Termination screen of the wizard, specify the following:

- From the Node drop-down list, choose the node where the PPC will terminate.
- From the Slot drop-down list, choose the slot where the PPC will terminate.
- From the Port drop-down list, choose the port where the PPC will terminate.

The ID field displays the ID automatically assigned to the PPC.

Step 9 Click **Next**.

Step 10 In the PPCs ID page, review the PPC information. If the PPC information is correct, click **Finish**. If you need to make corrections, click **Back** and return to the wizard page where you want to change the information.
Stop. You have completed this procedure.

Understanding Multiprotocol Label Switching Transport Profile Tunnels

An MPLS–TP tunnel consists of a pair of unidirectional tunnels providing a bidirectional LSP. Each unidirectional tunnel can be protected with a protect LSP that activates automatically upon failure. MPLS–TP tunnels are provisioned manually at their endpoints across the network.

Tunnel Identifiers

MPLS–TP tunnel identifiers uniquely identify an MPLS–TP tunnel within the network. The tunnel identifier consists of a global identifier, a node identifier, and a tunnel number for each endpoint of the MPLS–TP LSP.

The node identifier is an IP address for an interface on the endpoint router. The tunnel number is the tunnel–tp number assigned when the tunnel–tp virtual interface is created on the endpoint router.

Tunnel Source

The tunnel source is the MPLS–TP node identifier of the endpoint router that is configured. This tunnel source can be specified to override the router-id configured in the global MPLS-TP configuration.

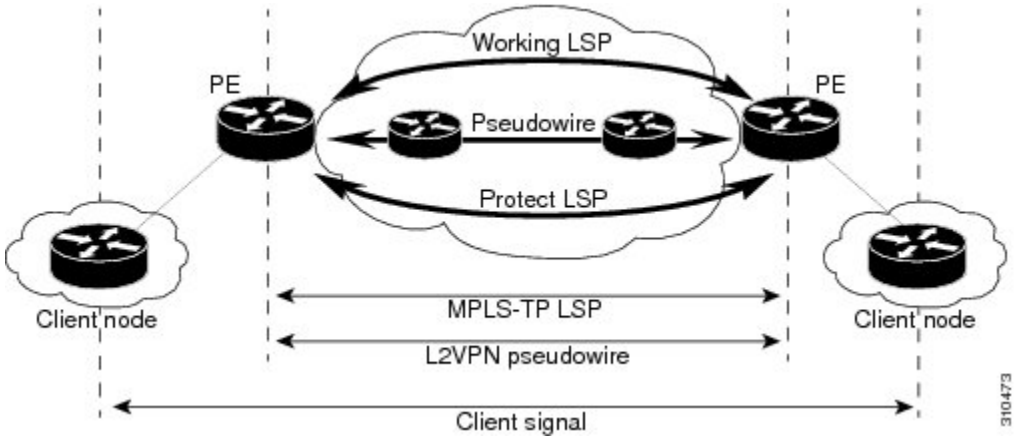
Tunnel Destination

The tunnel destination is the MPLS–TP node identifier of the remote endpoint router. The destination tunnel number is the virtual interface number assigned to the remote tunnel interface when it is provisioned. This destination tunnel number can be optionally configured. If the destination tunnel number is not configured, it defaults to the local tunnel number.

Understanding MPLS–TP LSPs

MPLS–TP LSPs are bidirectional and corouted and are comprised of two unidirectional LSPs that are supported by the MPLS forwarding infrastructure. The static and bidirectional MPLS–TP LSPs can be configured either through CTC or Cisco IOS commands. The LSPs are configured and managed without a control plane. The MPLS–TP LSPs have a fixed path. The statically defined LSP does not require an Interior Gateway Protocol (IGP).

Figure 1: MPLS–TP LSP



MPLS–TP LSPs are not supported over a Link Aggregation Group (LAG). The static pseudowire is the only traffic carried over MPLS–TP LSPs in this release.

LSP Path Protection

MPLS–TP LSPs support 1:1 revertive path protection. The working and protect LSPs can be configured as part of configuring MPLS–TP tunnels. The working LSP is the primary LSP used to route the traffic. The

protect LSP is a backup for the working LSP. When the working LSP fails, the traffic is switched to the protect LSP until the working LSP is restored, at which time the forwarding reverts to the working LSP.

LSP Number

The LSP number is assigned when the MPLS–TP LSP is configured. The default value of the LSP number is 0 for the working LSP and 1 for the protect LSP. You cannot edit LSP numbers using CTC.

LSP Ping and Trace

The LSP **ping** and **trace** commands are supported on MPLS–TP bidirectional LSPs and pseudowires.

LSP Lockout

The working LSP or protect LSP can be locked out. Only one LSP must be locked out at a time. When the LSP is currently locked out, the **lockout** command is not available in the other LSP configuration submode. The lockout of a working or protect LSP is cleared using the **no lockout** command.

When the LSP is locked out, the user traffic is not forwarded over the locked out LSP. However, the OAM traffic and BFD traffic is forwarded over the locked out LSP.

Because an MPLS-TP tunnel is statically configured, the possibility exists that the working LSP could be locked out at one MPLS-TP tunnel endpoint and the protect LSP could be locked out at the other MPLS-TP tunnel endpoint. If this occurs, the MPLS-TP tunnel is deadlocked and non-functional until the lockout configuration is changed at one of the endpoints.

LSP Shutdown

When the LSP is shut down, the LDI messages, user traffic, and OAM traffic are not sent.

Tunnel Midpoints and Endpoints

Tunnel LSPs, whether endpoint or midpoint, use the same identifying information. However, it is entered differently.

- At the midpoint, all the information for the LSP is specified with the **mpls tp lsp** command, which enters the submode for configuring forward and reverse information for forwarding.
- At the midpoint, determining which end is source and which end is destination is arbitrary. That is, if you are configuring a tunnel between your router and a coworker's router, your router is the source. However, your coworker considers his or her router to be the source. At the midpoint, either router could be considered the source. At the midpoint, the forward direction is from source to destination, and the reverse direction is from destination to source.
- At the endpoint, the source information comes either from the global router ID or from locally configured information using the **tp source** command after you enter the command **interface tunnel-tp** *number* command, where *number* is the source tunnel number.
- At the endpoint, the remote information (destination) is configured using the **tp destination** command after you enter the command **interface tunnel-tp** *number*. The **tp destination** command includes the destination node ID, optionally the global ID, and optionally the destination tunnel number. If you do not specify the destination tunnel number, the source tunnel number is used.
- At the endpoint, the LSP number is configured in working-lsp or protect-lsp submode. The default value is 0 for the working LSP and 1 for the protect LSP.

NTP-J41 Configure an MPLS-TP Tunnel

Purpose	This procedure configures an MPLS–TP tunnel.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J105 Configure Tunnel Midpoints Using Cisco IOS Commands, on page 27
- DLP–J106 Configure Tunnel Endpoints Using Cisco IOS Commands, on page 30
- DLP-J107 Create an MPLS–TP Tunnel Using CTC, on page 34
- DLP-J208 Edit MPLS–TP Tunnel Attributes Using CTC, on page 37

Stop. You have completed this procedure.

DLP-J105 Configure Tunnel Midpoints Using Cisco IOS Commands

Purpose	This procedure configures the midpoints for the MPLS–TP tunnel.
Tools/Equipment	None
Prerequisite Procedures	• DLP-J95 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using Cisco IOS Commands, on page 5 • DLP-J99 Configure an MPLS–TP Link Using Cisco IOS Commands, on page 16 • DLP-J103 Specify Static Label Range Using Cisco IOS Commands, on page 9
Required/As Needed	As needed
Onsite/Remote	Onsite or remote

Security Level	Provisioning or higher

Procedure

	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 tp lsp source** *ip-address* [**global-id** *number*] **tunnel-tp** *tunnelnumber* **lsp** {*lspnumber* | **working** | **protect**} **destination** *ip-address* [**global-id** *number*] **tunnel-tp** *tunnelnumber* **Example:** Router(config)# mpls tp lsp source 209.165.200.225 tunnel-tp 15 lsp 0 destination 209.165.200.226 tunnel-tp 20	Configures the source and destination parameters of the MPLS–TP tunnel. The source and destination parameters may be specified in a different order at different midpoints of an MPLS–TP tunnel. The default value of source and destination global–id is 0. The LSP number defined for one of the endpoints can uniquely identify an MPLS–TP LSP.
Step 4	**forward–lsp** **Example:** Router(config-mpls-tp-lsp)# forward–lsp	Enters the configuration mode of the forward LSP.
Step 5	**bandwidth** *number* **Example:** Router(config-mpls-tp-lsp-forw)# bandwidth 100	Configures the bandwidth for the forward LSP. The forward LSP refers to the unidirectional LSP going from the source to the destination.
Step 6	**in–label** *locallabelnumber* **out-label** *outlabelnumber* **out-link** *outlinknumber* **Example:** Router(config-mpls-tp-lsp-forw)# in-label 200 out-label 300 out-link 2	Assigns an incoming label (local label), outgoing label, and outgoing link to the forward LSP. The values for the incoming label must be within the static label range that is defined. The outgoing label must be a valid and unreserved MPLS label.
Step 7	**exit** **Example:** Router(config-mpls-tp-lsp-forw)# exit	Exits the configuration mode of the forward LSP.

	Command or Action	Purpose
Step 8	**reverse–lsp** **Example:** Router(config-mpls-tp-lsp)# reverse–lsp	Enters the configuration mode of the reverse LSP.
Step 9	**bandwidth** *number* **Example:** Router(config-mpls-tp-lsp-rev)# bandwidth 100	Configures the bandwidth for the reverse LSP. The reverse LSP refers to the unidirectional LSP going from the destination to the source.
Step 10	**in–label** *locallabelnumber* **out-label** *outlabelnumber* **out-link** *out-tp-link* **Example:** Router(config-mpls-tp-lsp-rev)# in-label 201 out-label 301 out-link 4	Assigns an incoming label (local label), outgoing label, and outgoing link to the reverse LSP. The values for the incoming label must be within the static label range that is defined. The outgoing label must be a valid and unreserved MPLS label.
Step 11	**exit** **Example:** Router(config-mpls-tp-lsp-rev)# exit	Exits the configuration mode of the reverse LSP.
Step 12	**exit** **Example:** Router(config-mpls-tp-lsp)# exit	Exits the LSP configuration mode.
Step 13	Return to your originating procedure (NTP). **Example:** —	

Example: Configuring Tunnel Midpoints

The following example shows how to configure the midpoints of the MPLS–TP tunnel using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# mpls label range 1000 8000 static 16 999
Router(config)# bfd bfd-tp-template

Router(config)# mpls tp
Router(config-mpls-tp)# router-id 2.2.2.2
Router(config-mpls-tp)# exit

Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# mpls tp link 1 ipv4 11.10.10.15
Router(config-if)# exit
Router(config)# interface TenGigabitEthernet4/2
Router(config-if)# mpls tp link 1 ipv4 11.10.10.16
```

```
Router(config-if)# exit


Router(config)# mpls tp lsp source 1.1.1.1 tunnel-tp 10 lsp working destination 3.3.3.3
tunnel-tp 30
Router(config-mpls-tp-lsp)# forward-lsp
Router(config-mpls-tp-lsp-forw)# bandwidth 1000
Router(config-mpls-tp-lsp-forw)# in-label 200 out-label 300 out-link 2
Router(config-mpls-tp-lsp-forw)# exit
Router(config-mpls-tp-lsp)# reverse-lsp
Router(config-mpls-tp-lsp-rev)# in-label 250 out-label 100 out-link 1
Router(config-mpls-tp-lsp-rev)# exit
Router(config-mpls-tp-lsp)# exit
Router(config-mpls-tp)# exit

Router(config)# mpls tp lsp source 1.1.1.1 tunnel-tp 10 lsp protect destination 3.3.3.3
tunnel-tp 30
Router(config-mpls-tp-lsp)# forward-lsp
Router(config-mpls-tp-lsp-forw)# bandwidth 1000
Router(config-mpls-tp-lsp-forw)# in-label 201 out-label 301 out-link 4
Router(config-mpls-tp-lsp-forw)# exit
Router(config-mpls-tp-lsp)# reverse-lsp
Router(config-mpls-tp-lsp-rev)# in-label 251 out-label 101 out-link 3
Router(config-mpls-tp-lsp-rev)# exit
Router(config-mpls-tp-lsp)# exit
Router(config-mpls-tp)# exit
```

DLP–J106 Configure Tunnel Endpoints Using Cisco IOS Commands

Purpose	This procedure configures the endpoints for MPLS–TP tunnels. The MPLS–TP tunnel is provisioned as a virtual interface.
Tools/Equipment	None
Prerequisite Procedures	• DLP-J95 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using Cisco IOS Commands, on page 5 • DLP-J97 Create and Configure BFD Templates Using Cisco IOS Commands, on page 11 • DLP-J99 Configure an MPLS–TP Link Using Cisco IOS Commands, on page 16 • DLP-J103 Specify Static Label Range Using Cisco IOS Commands, on page 9
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**interface tunnel–tp** *tunnelnumber* **Example:** Router(config)# interface tp–tunnel 30	Enters the interface configuration mode and configures the parameters of the tunnel.
Step 4	**description** *tunnel-description* **Example:** Router(config–if)# description firsttunnel	Provides a description for the tunnel. The description is used only when displaying information about the MPLS–TP tunnel.
Step 5	**tp bandwidth** *number* **Example:** Router(config–if)# tp bandwidth 1000	Configures the bandwidth for the MPLS–TP tunnel. If you configure non-zero bandwidth for the MPLS–TP tunnel or at a midpoint LSP, ensure that the interface to which the output link is attached has enough available bandwidth. For example, if three tunnel LSPs run over link 1 and each LSP was assigned 1000 with the **tp bandwidth** command, the interface associated with link 1 needs bandwidth of 3000 with the **ip rsvp bandwidth** command.
Step 6	**tp source** *ip-address* [**global-id** *number*] **Example:** Router(config–if)# tp source 209.165.200.225	Configures the MPLS–TP tunnel source IP address. The source IP address is the ID of the endpoint router that is configured. The **global-id** is the default global ID used for all midpoints and endpoints. The default value of the **global–id** is 0. The valid range is from 0 to 2147483647.
Step 7	**tp destination** *ip-address* [**tunnel-tp** *number*] [**global-id** *number*] **Example:** Router(config–if)# tp destination 209.165.200.226	Configures the MPLS–TP tunnel destination IP address. The **tunnel-tp** is the tunnel–TP number of the MPLS–TP tunnel destination. If the tunnel–TP number is not specified, the number assigned to the local tunnel is used. The **global-id** is the default global ID used for the endpoint. The default value of the global–id is 0. The valid range is from 0 to 2147483647.

	Command or Action	Purpose
Step 8	**bfd** *bfdtemplatename* **Example:** Router(config–if)# bfd bfd1	Configures a BFD template for the MPLS–TP tunnel. The BFD configuration template used for the working LSP is the same as that of the protect LSP.
Step 9	**working-lsp** **Example:** Router(config–if)# working-lsp	Enters the configuration mode of the working LSP.
Step 10	**out-label** *outlabelnumber* **out-link** *out-tp-link* **Example:** Router(config–if–working)# out–label 250 out–link 1	Assigns an outgoing label and outgoing link to the working LSP. The outgoing label must be a valid and unreserved MPLS label. The working LSP is the primary LSP that is used to route traffic.
Step 11	**in–label** *locallabelnumber* **Example:** Router(config–if–working)# in–label 10	Assigns an incoming label (local label) to the working LSP. The values for the incoming label must be within the static label range (16 to 8000).
Step 12	**lsp–num** *number* **Example:** Router(config–if–working)# lsp–num 0	Configures the LSP number for the working LSP. The default LSP number for the working LSP is 0. The range is 0 to 255. The local and remote LSP numbers must match.
Step 13	**lockout** **Example:** Router(config–if–working)# lockout	Locks out the working LSP.
Step 14	**protect-lsp** **Example:** Router(config–if)# protect-lsp	Enters the configuration mode of the protect LSP.
Step 15	**out-label** *outlabelnumber* **out-link** *out-tp-link* **Example:** Router(config–if–protect)# out–label 251 out–link 2	Assigns an outgoing label and outgoing link to the protect LSP. The outgoing label must be a valid and unreserved MPLS label. A protect LSP is a backup for a working LSP. If the working LSP fails, the traffic is switched to the protect LSP until the working LSP is restored, when forwarding reverts to the working LSP.

	Command or Action	Purpose
Step 16	**in–label** *locallabelnumber* **Example:** Router(config–if–protect)# in–label 20	Assigns an incoming label (local label) to the protect LSP. The values for the incoming label must be within the static label range that is defined.
Step 17	**lsp–num** *number* **Example:** Router(config–if–protect)# lsp–num 1	Configures the LSP number for the protect LSP. The default LSP number for the protect LSP is 1. The range is 1 to 255. The local and remote LSP numbers must match.
Step 18	**lockout** **Example:** Router(config–if–protect)# lockout	Locks out the protect LSP.
Step 19	**shutdown** **Example:** Router(config–if)# shutdown	Performs an administrative shut down of the MPLS–TP tunnel.
Step 20	Return to your originating procedure (NTP).	

Example: Configuring Tunnel Endpoints

The following example shows how to configure one of the endpoints of the MPLS–TP tunnel using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# mpls label range 1000 8000 static 16 999
Router(config)# bfd bfd-tp-template

Router(config)# mpls tp
Router(config-mpls-tp)# router-id 1.1.1.1
Router(config-mpls-tp)# exit

Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# mpls tp link 1 ipv4 11.10.10.15
Router(config-if)# exit
Router(config)# interface TenGigabitEthernet4/2
Router(config-if)# mpls tp link 1 ipv4 11.10.10.16
Router(config-if)# exit

Router(config)# interface tunnel–tp 10
Router(config-if)# description MPLS-TP tunnel connecting ABC customer A PE routers
Router(config–if)# bandwidth  tx 1000
Router(config-if)# tp bandwidth  1000
Router(config-if)# no ip address
Router(config-if)# no keepalive
Router(config-if)# tp destination 3.3.3.3 tunnel-tp 30
Router(config-if)# bfd  bfd-tp-template

Router(config-if)# working-lsp
Router(config-if-working)# out-label 200 out-link 1
```

```
Router(config-if-working)# in-label 100
Router(config-if-working)# lsp-number 0
Router(config-if-working)# exit

Router(config-if)# protect-lsp
Router(config-if-protect)# out-label 201 out-link 2
Router(config-if-protect)# in-label 101
Router(config-if-protect)# lsp-number 1
Router(config-if-protect)# exit
Router(config-if)# exit
```

The following example shows how to configure another endpoint of the MPLS–TP tunnel using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# mpls label range 1000 8000 static 16 999
Router(config)# bfd bfd-tp-template

Router(config)# mpls tp
Router(config-mpls-tp)# router-id 2.2.2.2
Router(config-mpls-tp)# exit

Router(config)# interface TenGigabitEthernet4/3
Router(config-if)# mpls tp link 1 ipv4 11.10.11.17
Router(config-if)# exit
Router(config)# interface TenGigabitEthernet4/4
Router(config-if)# mpls tp link 1 ipv4 11.10.11.18
Router(config-if)# exit

Router(config)# interface tunnel-tp 30
Router(config-if)# description  MPLS-TP tunnel connecting ABC customer A PE routers
Router(config-if)# bandwidth  tx 1500
Router(config-if)# tp bandwidth  1500
Router(config-if)# no ip address
Router(config-if)# no keepalive
Router(config-if)# tp destination 1.1.1.1 tunnel-tp 10
Router(config-if)# bfd  bfd-tp-template

Router(config-if)# working-lsp
Router(config-if-working)# out-label 250 out-link  1 in-label 300
Router(config-if-working)# lsp-number 2
Router(config-if-working)# exit

Router(config-if)# protect-lsp
Router(config-if-protect)# out-label 251 out-link 2 in-label 301
Router(config-if-working)# lsp-number 3
Router(config-if-protect)# exit
Router(config-if)# exit
```

DLP-J107 Create an MPLS–TP Tunnel Using CTC

Purpose	This procedure creates an MPLS–TP tunnel using CTC.
Tools/Equipment	None

Prerequisite Procedures	• DLP-J96 Configure Global Settings for Multiprotocol Label Switching Transport Profile Using CTC, on page 7 • DLP-J98 Create and Configure BFD Templates Using CTC, on page 13 • DLP-J100 Configure an MPLS–TP Link Number Using CTC, on page 19 • DLP-J104 Specify Static Label Range Using CTC, on page 10 • NTP-J67 Create a Provisionable Patchcord Using CTC, on page 23
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note You cannot create an MPLS–TE tunnel and an MPLS–TP tunnel on the same interface.

Note The layer 2 services on CPT can be created on top of layer 2 PPCs or OCHTrails.

For CPT cards, select GCC rate as**1200k** from the GCC drop-down list. To configure the GCC rates follow the path: Home View/Chassis View-> Provisioning pane-> Comm channels-> GCC.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to create an MPLS–TP tunnel.

Step 2 From the View menu, choose **Go to Network View**.

Step 3 Click the **Layer2+** tab.

Step 4 In the left pane, click **Circuits**.

Step 5 Click the **MPLS TP Tunnels** tab.

Step 6 Click **Create**. The Circuit Creation wizard appears.

Step 7 In the Circuit Attributes screen of the wizard:

a) Enter the name of the tunnel that you want to create, in the Name field.

b) Enter the description of the tunnel in the Description field.
The type of the tunnel is MPLS_TP and cannot be changed. The tunnel is always created as a bidirectional tunnel.

c) Check the **Protection** check box to create a protected tunnel.

d) Check the **IP Unnumbered** check box to configure the MPLS–TP tunnel with the loopback address of the node.

e) From the Admin State drop–down list, choose **UP** or **DOWN** . The default value is UP.

f) Enter the bandwidth of the MPLS–TP tunnel in Kbps (default), Mbps, or Gbps and click **Next**.
The specified bandwidth is checked against the available bandwidth on the endpoint ports. If the specified bandwidth exceeds the available bandwidth on the endpoint ports, an error message is displayed.

Note The specified bandwidth is used only for accounting purposes. The specified bandwidth is not reserved by the CPT system for the actual traffic nor is it enforced on services. For example, if the actual traffic exceeds the bandwidth value, the CPT system carries the traffic and does not raise an alarm.

g) Select the **Create PW Class Automatically** check box to automatically create a pseudowire class with default values at the source and destination nodes of the MPLS-TP tunnel.

Note For VPWS circuits, by default the interworking is NONE. To configure rewrite for VPWS circuits with CPT 50, select the interworking as Ethernet.

Step 8 In the Source screen of the wizard, specify the parameters for one endpoint:

a) Check the RING ID check box.

Note This check box is enabled only if the service state of the ring is enabled.

b) From the RING ID drop–down list, choose a ring .

Note This drop down list is enabled only if the RING ID check box is checked.

c) From the Slot/CPT50 drop-down list, choose a slot or CPT 50.

Note If you select the RING ID check box, a list of available CPT 50s is displayed. Otherwise, a list of available slots is displayed.

d) From the Attach BFD drop-down list, choose a BFD template to attach to this endpoint.

Note It is recommended that the same BFD template be attached for the endpoints.

e) Enter the unique tunnel number for this endpoint in the Tunnel Number field.

Note The LSP Number field is a read-only field. 0 indicates the default LSP number of the working LSP. 1 indicates the default LSP number of the protect LSP.

Step 9 In the Destination screen of the wizard, specify the parameters for another endpoint. Repeat the previous step to do this.

Step 10 In the TP Tunnel Circuit Routing Preferences screen of the wizard, specify the routing preferences for the tunnel:

a) For constraint–based routing, check the **Using Required Nodes/Spans** check box. The **Route Automatically** check box is set by default and cannot be changed.

b) Specify the diversity constraints by choosing **Nodal Diversity Required**, **Nodal Diversity Desired**, or **Link Diversity Only**.

- Nodal Diversity Required—Ensures that the primary and alternate paths within path protection portions of the complete circuit path are nodally diverse.
- Nodal Diversity Desired—Specifies that node diversity is preferred, but if node diversity is not possible, CTC creates fiber-diverse paths for the path protection portion of the complete circuit path.

  Node diversity is not applicable if the source and destination are directly connected with fiber diverse path.
- Link Diversity Only—Specifies that only fiber-diverse primary and alternate paths for path protection portions of the complete circuit path are needed. The paths might be node-diverse, but CTC does not check for node diversity.

c) Click **Next**.

Step 11 In the TP Tunnel Circuit Routing Constraints screen of the wizard, the route of the MPLS–TP tunnel is displayed.

a) In the route, choose the nodes appropriately to include or exclude in the MPLS–TP tunnel.
b) Click **Next**.

Step 12 In the TP Tunnel Circuit Label Preview screen of the wizard:

a) Change the local label and outgoing label for working LSP and protect LSP as appropriate.
b) Click **Apply**.
c) Click **Finish** to create an MPLS–TP tunnel.
It is not recommended to delete the MPLS–TP tunnel in Partial state. For example, the tunnel is in Partial state due to missing intermediate LSP information. If you delete this Partial tunnel, you cannot delete the LSP information on the intermediate node and reuse the tunnel bandwidth.

When you change the PPC paths of a tunnel in Discovered state, you cannot delete the LSP information on the intermediate node. For example, consider a tunnel that spans three nodes A, B, and C. The PPC links from A to B and B to C are deleted and a direct PPC link is created from A to C. In this case, the LSP information on the intermediate node B cannot be deleted.

Step 13 Return to your originating procedure (NTP).

DLP-J208 Edit MPLS–TP Tunnel Attributes Using CTC

Purpose	This procedure edits MPLS–TP tunnel attributes using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J107 Create an MPLS–TP Tunnel Using CTC, on page 34
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to edit an MPLS–TP tunnel.

Step 2 From the View menu, choose **Go to Network View**.

Step 3 Click the **Layer2+** tab.

Step 4 From the left pane, click **Circuits**.

Step 5 Click the **MPLS TP Tunnels** tab.

Step 6 Choose a tunnel to edit and click **Edit**. The Edit Circuit screen appears.

Step 7 In the General tab, modify the name, description, and bandwidth of the MPLS–TP tunnel as required.

Step 8 In the LSPs tab, edit, add, or remove the LSPs:

a) To edit an LSP:

1. Choose an LSP to edit.
2. From the Node drop-down list, choose a node.
3. Click **Edit LSP**.
4. Modify the values in the Local Label and Out Label fields as appropriate.
5. Click **Apply**.

b) To add an LSP:

1. Click **Add LSP**. The Add LSP Members wizard appears.
2. In the Circuit Attributes screen of the wizard, verify the LSP number in the LSP Number field and click **Next.**

   Note The LSP Number field is a read-only field. 0 indicates the default LSP number of the working LSP. 1 indicates the default LSP number of the protect LSP.
3. In the Routing and Member Preferences screen of the wizard, check the **Using Required Nodes/Spans** check box for constraint–based routing. The **Route Automatically** check box is set by default and cannot be changed.
4. Specify the diversity constraints by choosing **Nodal Diversity Required**, **Nodal Diversity Desired**, or **Link Diversity Only** and click **Next**.
5. In the Constraints for Automatic Routing screen of the wizard, choose the nodes appropriately to include or exclude and click **Next**.
6. In the Circuit Label Preview screen of the wizard, enter the local label and outgoing label for the working LSP and protect LSP as appropriate.
7. Click **Apply**.
8. Click **Finish** to add an LSP.

c) To delete an LSP:

1. Choose an LSP to delete.
2. Click **Delete LSP**. The Delete LSP dialog box appears.

3 Click **OK** in the Delete LSP dialog box.

Step 9 In the BFD tab, choose an appropriate BFD template from the BFD Template field and click **Apply**.

Step 10 In the Lockout tab, choose a node from the Endpoint field.

Step 11 From the Switch State drop–down list, choose **LOCKOUT** or **CLEAR**
The Lockout option specifies that the locked out LSP do not carry traffic. Only one LSP can be locked out at a time. The Lockout option can be applied only when there are two LSPs. The Clear option clears the lockout condition.

Step 12 In the State tab, choose UP or DOWN from the Target Circuit Admin State drop-down list and click **Apply**.

Step 13 Return to your originating procedure (NTP).

DLP-J368 Query an MPLS-TP Circuit Using CTC

Purpose	This procedure allows you to discover the MPLS-TP services using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J107 Create an MPLS–TP Tunnel Using CTC, on page 34
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note When the discovered nodes are disconnected, the circuits move to Partial state. When the disconnected nodes become online in CTC, re-query the circuits to move the circuits to Discovered state.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to query for an MPLS-TP circuit.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Click the **Layer2+** tab.

Step 4 From the left pane, click **Carrier Ethernet**.

Step 5 Click **Query**. The L2 Services Query dialog box appears.

Step 6 From the Existing/New Query drop-down list, choose an existing query or a new query.

Step 7 In the Equipment Termination area, choose **Port** or **Query Group**.

Step 8 If you choose Port, specify the following:

a) Click **Port**. The Port/Channel Group Selection dialog box appears.

b) Choose the node, card, and port/channel group and click **OK**.
c) Close the Port/Channel Group Selection dialog box.

Step 9 If you choose Query Group, specify the following:
a) Click **Query Group**. The User Query Group Chooser dialog box appears.
b) From the Group drop-down list, choose a query group.
c) Add the nodes that can be grouped for the query from the Available Nodes area to the Grouped Nodes area.
d) Click **Save** to save the query group and close the User Query Group Chooser dialog box.

Step 10 In the L2 Services Query dialog box, click **Save**. The Store a Set of Query Criteria dialog box appears.

Step 11 Enter the query name in the Name field and click **Save** to save the query.

Step 12 In the L2 Services Query dialog box, click **Run Query**.
The results of the query appear in the Service Query Results area.

Step 13 Click **Discover All** to discover all the MPLS-TP services, click **Discover Selected** to discover the selected MPLS-TP services or click **Delete** to delete the midpoint nodes of the MPLS-TP services.

Note If a CPT50 in a ring is not discovered by CTC then the services on that CPT50 in a ring, are not manageable by CTC, i.e. user cannot query, view, edit, create or delete the service on that CPT50 in a ring. In the above state, the services passing through such a CPT50 will be displayed as PARTIAL at CTC though the actual traffic might not be affected depending on the type of failure.

A CPT50 in a ring can be unreachable in CTC due to one or more of the following reasons:

1. Link failure. CPT50 is failed or not ready for configuration.
2. Topo-Mis-Config alarm present in the ring.
3. Disabled ring state.
4. Ring ports are shut.

Some of the above conditions can be verified from the Show Actual Topology.

Close the L2 Services Query dialog box. The discovered MPLS-TP services appear in the Carrier Ethernet Circuits area.

Step 14 Return to your originating procedure (NTP).

NTP-J107 Perform ping and traceroute Operations on Services Using CTC

Purpose	This procedure performs ping and traceroute operations on services using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to perform ping and traceroute operations.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Maintenance** tab.

Step 4 In the left pane, click **OAM**.

Step 5 From the Service drop-down list, choose **TP Tunnel**, **TE Tunnel**, **Pseudowire**, or **EVC**.

Step 6 From the Command drop-down list, choose **Ping** or **Traceroute**.

Step 7 If you choose TP Tunnel as the service, complete the following:

a) Enter the tunnel ID in the Tunnel No field.
b) From the LSP drop-down list, choose **Active**, **Working**, or **Protect**.

Step 8 If you choose TE Tunnel as the service, complete the following:

a) Enter the tunnel ID in the Tunnel No field.

Step 9 If you choose Pseudowire as the service, complete the following:

a) Enter the IP address in the IP field.
b) Enter the virtual circuit ID in the VC ID field.

Step 10 If you choose EVC as the service, complete the following:

a) From the drop-down list, choose **MPID**, **MacAddr**, or **Multicast**.
The Multicast option appears only when you selected the Ping operation.

b) If you choose MPID, enter the remote MEP ID in the field.
If you choose MacAddr, enter the unicast remote MAC address in the field.

c) Enter the MEP domain name in the Domain Name field.
d) Check the **Port** check box for port MEP.
e) Enter the EVC service ID in the ID field.
f) Enter the local MEP ID in the Source field.
The range is from 1 to 8191. This ID is required when there are multiple MEPs in a domain.

g) Enter the class-of-service (CoS) for CFM packets in the COS field.
h) (Only for ping) Check the **de** check box for drop eligibility.
i) (Only for traceroute) Check the **Fdb-Only** check box to look up the destination MAC address in the forwarding database table to proceed with the traceroute operation.

Step 11 Click **Execute** to run the OAM operation for the specified service.
Stop. You have completed this procedure.

NTP-J120 Display Bandwidth Utilization on Services Using CTC

Purpose	This procedure displays bandwidth utilization on services using CTC.

Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note Use this procedure to display the available bandwidth for each port in the slot or fan-out group. The available bandwidth is displayed for services such as EVC, Pseudowire, MPLS-TP, MPLS-TE, and VPLS that are configured from CTC. For example, when the graph displays as 0% for a port, it indicates that the port has the maximum bandwidth available for the service.

For MPLS–TE tunnels, the tunnel bandwidth is displayed. The automatic bandwidth and bandwidth on explicit path are not considered.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to display the bandwidth utilization on services.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Maintenance** -> **Bandwidth Utilization** tabs.

Step 4 From the Slot drop-down list, choose a slot.

Step 5 (Optional) From the Service Type drop-down list, choose **EVC**, **Pseudowire**, **MPLS TP**, **MPLS TE**, or **VPLS**.
The bandwidth that is utilized by all the ports in a slot or fan-out group is displayed in a graph.

Step 6 **Stop. You have completed this procedure.**

Understanding Node Addition

A MPLS–TP tunnel can traverse through multiple nodes. The Node Addition feature is a CTC enhancement that allows the user to add new nodes over an existing MPLS–TP tunnel. If a new node needs be added to the network, the user does not have to delete and re-route the MPLS–TP tunnel. Instead, CTC re-discovers the path and re-directs the MPLS–TP tunnel.

When a new node is added, the Provisionable Patchcord (PPC) needs to be created between this node and the other node of the MPLS–TP tunnel.

Limitations

The Node Addition feature assumes that the new node being added is a new node without services. The node addition could fail for some MPLS-TP tunnels if there are existing services on the node with the same service IDs.

DLP-J338 Adding a Node to the MPLS–TP Tunnel Using CTC

Purpose	This procedure adds a node for the existing MPLS–TP tunnel using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J107 Create an MPLS–TP Tunnel Using CTC, on page 34
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to add a node.

Step 2 From the View menu, choose Go to **Network View** to view the nodes that form a MPLS–TP tunnel.

Step 3 Delete the PPC between the existing nodes of the MPLS-TP tunnel.

Step 4 From the File menu, choose **Add Node** to add a new node in the network.

Step 5 In the Add Node dialog, enter the node name and click **OK**.

Step 6 Create PPCs to the new node from the other nodes of the MPLS–TP tunnel over the same ports. See NTP-J67 Create a Provisionable Patchcord Using CTC, on page 23.

Step 7 Right-click the new node and choose **Update Circuits with New Node** to update circuits with the new node. CTC re-discovers the path and re-directs the MPLS–TP tunnel.

Note Before selecting **Update Circuits with New Node**, ensure that you configure an MPLS-TP link for the added midpoint node so that the circuits are successfully updated. See DLP-J100 Configure an MPLS–TP Link Number Using CTC, on page 19.

Step 8 Click **Yes** in the Update Circuits dialog.

Step 9 Return to your originating procedure (NTP).

MPLS–TP Show Commands

This section describes several show commands that can be used with MPLS–TP tunnels.

Display MPLS–TP Tunnel Summary

This command displays a count of the configured tunnels, midpoint LSPs, and the global configuration parameters.

```
Router# show mpls tp summary
```

```
Endpoints: 4      Midpoints: 3
ICC:
Router Id: 3.3.3.3
Global Id: 0
Path protection mode:  1:1 revertive
Fault OAM timer: 0
```

Display Link Number Information

This command provides information about the MPLS–TP link numbers. It displays the mappings between link numbers and physical interfaces and next hop addresses when appropriate.

```
Router# show mpls tp link-numbers
```

```
Link Number     Interface               Next Hop
 1              Ethernet0/0             1.2.3.4
 2              Ethernet1/0             2.3.4.5
 3              Ethernet0/3             fcce.c1cc.cc01
```

Display MPLS–TP Tunnel Information

This command displays the tunnel information of MPLS–TP tunnels.

```
Router# show mpls tp tunnel-tp
```

```
Tunnel    Peer node-id::tun  Working/   Local  Outgoing  Outgoing  Oper
Number                       Protect    Label  Label     Interface State

   5       4.4.4.4::5           w        100     110        Et0/0    up
   6       6.6.6.6::7           w        200     210        Et0/0    up
```

Display MPLS–TP Tunnel Information with LSPs

This command displays the tunnel information of MPLS–TP tunnels with LSPs.

```
Router# show mpls tp tunnel-tp lsps
```

```
Tunnel  Peer node-id::tun  Working/  Local Outgoing Outgoing  Oper
Number                     Protect   Label Label    Interface State

   5       4.4.4.4::5          w       100     110     Et0/0    up
          LSP: working                100     110     Et0/0    up active

          LSP: protect                120     130     Et1/0    up standby
```

```
  6       6.6.6.6::7          w       200     210     Et0/0    up
          LSP: working                200     210     Et0/0    up active

          LSP: protect                220     230     Et1/0    up standby
```

Display Detailed MPLS–TP Tunnel Information

This command displays detailed tunnel information of MPLS–TP tunnels.

```
Router# show mpls tp tunnel-tp detail
```

```
MPLS-TP Tunnels:
  MPLS-TP tunnel 5:
      source global id  0 : node id 3.3.3.3 : tunnel 5
      dest global id  0 : node id 4.4.4.4 : tunnel 5
      description:  this is test tunnel 5
      UMC: tunnel5    ICC: ATT
      Admin: up           Oper: up
      bandwidth transmit     1400, receive     1500
      BFD template:  bfd-template-5
      working-lsp: active      lsp num 0
      protect-lsp: standby      lsp num 1
  MPLS-TP tunnel 6:
      source global id  0 : node id 3.3.3.3 : tunnel 6
      dest global id  0 : node id 6.6.6.6 : tunnel 7
      description:  this is test tunnel  6
      Admin: up           Oper: up
      bandwidth transmit     1600, receive     1700
      BFD template:
      working-lsp: active      lsp num 0
      protect-lsp: standby      lsp num 1
  MPLS-TP tunnel 65530:
      source global id  0 : node id 123.123.123.123 : tunnel 65530
      dest global id  0 : node id 124.124.124.124 : tunnel 65530
      description:  this is test tunnel  65530
      UMC: big_id
      Admin: up           Oper: up
      bandwidth transmit     1600, receive     1700
      BFD template:
      working-lsp: active      lsp num 0
      protect-lsp: standby      lsp num 1
```

Display Detailed MPLS–TP Tunnel Information with LSPs

This command displays detailed tunnel information of MPLS–TP tunnels with LSPs.

```
Router# show mpls tp tunnel-tp lsps detail
```

```
MPLS-TP Tunnels:
  MPLS-TP tunnel 5:
      source global id  0 : node id 3.3.3.3 : tunnel 5
      dest global id  0 : node id 4.4.4.4 : tunnel 5
      description:  this is test tunnel 5
      UMC: tunnel5    ICC: ATT
      Admin: up           Oper: up
      bandwidth transmit     1400, receive     1500
```

```
     BFD template:  bfd-template-5
     working-lsp: active      lsp num 0
        0::3.3.3.3::5::0::4.4.4.4::5::0
        local label 100    local label table 0    outgoing label   110
        outgoing tp-link 1   interface Et0/0
        UMC: working-5
     protect-lsp: standby      lsp num 1
        0::3.3.3.3::5::0::4.4.4.4::5::1
        local label 120    local label table 0    outgoing label   130
        outgoing tp-link 2   interface Et1/0
  MPLS-TP tunnel 6:
     source global id  0 : node id 3.3.3.3 : tunnel 6
     dest global id  0 : node id 6.6.6.6 : tunnel 7
     description:  this is test tunnel  6
     Admin: up           Oper: up
     bandwidth transmit     1600, receive     1700
     BFD template:
     working-lsp: active      lsp num 0
        0::3.3.3.3::6::0::6.6.6.6::7::0
        local label 200    local label table 0    outgoing label   210
        outgoing tp-link 1   interface Et0/0
     protect-lsp: standby      lsp num 1
        0::3.3.3.3::6::0::6.6.6.6::7::1
        local label 220    local label table 0    outgoing label   230
        outgoing tp-link 2   interface Et1/0
        UMC: protect-6
  MPLS-TP tunnel 65530:
     source global id  0 : node id 123.123.123.123 : tunnel 65530
     dest global id  0 : node id 124.124.124.124 : tunnel 65530
     description:  this is test tunnel  65530
     UMC: big_id
     Admin: up           Oper: up
     bandwidth transmit     1600, receive     1700
     BFD template:
     working-lsp: active      lsp num 0
        0::123.123.123.123::65530::0::124.124.124.124::65530::0
        local label 300    local label table 0    outgoing label   310
        outgoing tp-link 1   interface Et0/0
     protect-lsp: standby      lsp num 1
        0::123.123.123.123::65530::0::124.124.124.124::65530::1
        local label 320    local label table 0    outgoing label   330
        outgoing tp-link 2   interface Et1/0
```

Display MPLS–TP Tunnel Information for a Single Tunnel

This command displays the tunnel information for a single MPLS–TP tunnel.

```
Router# show mpls tp tunnel-tp tunnelnumber
```

```
Tunnel    Peer node-id::tun  Working/   Local  Outgoing  Outgoing  Oper
Number                       Protect    Label  Label     Interface State

   5       4.4.4.4::5           w        100     110        Et0/0    up
```

Display MPLS–TP Tunnel Information for a Single Tunnel with LSPs

This command displays the tunnel information for a single MPLS–TP tunnel with LSPs.

```
Router# show mpls tp tunnel-tp tunnelnumber lsps
```

```
Tunnel  Peer node-id::tun  Working/  Local Outgoing Outgoing  Oper
Number                     Protect   Label Label    Interface State

   5       4.4.4.4::5          w       100     110     Et0/0    up
           LSP: working                100     110     Et0/0    up active

           LSP: protect                120     130     Et1/0    up standby



   6       6.6.6.6::7          w       200     210     Et0/0    up
           LSP: working                200     210     Et0/0    up active

           LSP: protect                220     230     Et1/0    up standby
```

Display Detailed MPLS–TP Tunnel Information for a Single Tunnel

This command displays the detailed tunnel information for a single MPLS–TP tunnel.

```
Router# show mpls tp tunnel-tp tunnelnumber detail
```

```
MPLS-TP Tunnels:
  MPLS-TP tunnel 5:
      source global id  0 : node id 3.3.3.3 : tunnel 5
      dest global id  0 : node id 4.4.4.4 : tunnel 5
      description:  this is test tunnel 5
      UMC: tunnel5    ICC: ATT
      Admin: up           Oper: up
      bandwidth transmit     1400, receive     1500
      BFD template:  bfd-template-5
      working-lsp: active      lsp num 0
      protect-lsp: standby      lsp num 1
```

Display Detailed MPLS–TP Tunnel Information for a Single Tunnel with LSPs

This command displays the detailed tunnel information for a single MPLS–TP tunnel with LSPs.

```
Router# show mpls tp tunnel-tp tunnelnumber lsps detail
```

```
MPLS-TP Tunnels:
  MPLS-TP tunnel 5:
      source global id  0 : node id 3.3.3.3 : tunnel 5
      dest global id  0 : node id 4.4.4.4 : tunnel 5
      description:  this is test tunnel 5
      UMC: tunnel5    ICC: ATT
      Admin: up           Oper: up
      bandwidth transmit     1400, receive     1500
      BFD template:  bfd-template-5
      working-lsp: active      lsp num 0
         0::3.3.3.3::5::0::4.4.4.4::5::0
         local label 100    local label table 0    outgoing label   110
         outgoing tp-link 1   interface Et0/0
         UMC: working-5
```

```
      protect-lsp: standby      lsp num 1
         0::3.3.3.3::5::0::4.4.4.4::5::1
         local label 120    local label table 0    outgoing label   130
         outgoing tp-link 2   interface Et1/0
```

Display LSP Information

This command displays information for all the MPLS–TP LSPs (midpoint and endpoint LSPs) configured on this router.

```
Router# show mpls tp lsps
```

```
MPLS-TP Endpoint LSPs:
LSP Identifier                        Local  Outgoing  Outgoing  Oper   Role
                                      Label  Label     Interface State
0::3.3.3.3::5::0::4.4.4.4::5::0       100    110       Et0/0     up   active
0::3.3.3.3::5::0::4.4.4.4::5::1       120    130       Et1/0     up   standby
0::3.3.3.3::6::0::6.6.6.6::7::0       200    210       Et0/0     up   active
0::3.3.3.3::6::0::6.6.6.6::7::1       220    230       Et1/0     up   standby

MPLS-TP Midpoint LSPs:
LSP Identifier                        LSP  Local Outgoing  Outgoing
                                           Label Label     Interface
0::1.1.1.1::1::0::6.6.6.6::1::0       forw  150   151       Et0/0
                                      rev   152   153       Et1/0
0::1.1.1.1::9::0::9.9.9.9::9::0       forw  160   161       Et0/0
                                      rev   162   163       Et1/0
```

Display Midpoint LSP Information

This command displays information for the midpoint LSP.

```
Router# show mpls tp lsps midpoints
```

```
MPLS-TP Midpoint LSPs:
LSP Identifier                        LSP  Local Outgoing  Outgoing
                                           Label Label     Interface
0::1.1.1.1::1::0::6.6.6.6::1::0       forw  150   151       Et0/0
                                      rev   152   153       Et1/0
0::1.1.1.1::9::0::9.9.9.9::9::0       forw  160   161       Et0/0
                                      rev   162   163       Et1/0
```

Display Endpoint LSP Information

This command displays information for the endpoint LSP.

```
Router# show mpls tp lsps endpoints
```

```
MPLS-TP Endpoint LSPs:
LSP Identifier                        Local  Outgoing  Outgoing  Oper   Role
                                      Label  Label     Interface State
0::3.3.3.3::5::0::4.4.4.4::5::0       100    110       Et0/0     up   active
0::3.3.3.3::5::0::4.4.4.4::5::1       120    130       Et1/0     up   standby
0::3.3.3.3::6::0::6.6.6.6::7::0       200    210       Et0/0     up   active
0::3.3.3.3::6::0::6.6.6.6::7::1       220    230       Et1/0     up   standby
```

Display Detailed LSP Information

This command displays detailed LSP information.

```
Router# show mpls tp lsps detail
```

```
MPLS-TP Endpoint LSPs:
   0::3.3.3.3::5::0::4.4.4.4::5::0
   local label 100    local label table 0    outgoing label   110
   outgoing tp-link 1   interface Et0/0
   UMC: working-5
   0::3.3.3.3::5::0::4.4.4.4::5::1
   local label 120    local label table 0    outgoing label   130
   outgoing tp-link 2   interface Et1/0
   0::3.3.3.3::6::0::6.6.6.6::7::0
   local label 200    local label table 0    outgoing label   210
   outgoing tp-link 1   interface Et0/0
   0::3.3.3.3::6::0::6.6.6.6::7::1
   local label 220    local label table 0    outgoing label   230
   outgoing tp-link 2   interface Et1/0
   UMC: protect-6
   0::123.123.123.123::65530::0::124.124.124.124::65530::0
   local label 300    local label table 0    outgoing label   310
   outgoing tp-link 1   interface Et0/0
   0::123.123.123.123::65530::0::124.124.124.124::65530::1
   local label 320    local label table 0    outgoing label   330
   outgoing tp-link 2   interface Et1/0

MPLS-TP Midpoint LSPs:
   0::1.1.1.1::1::0::6.6.6.6::1::0
      source global id  0 : node id 1.1.1.1 : tunnel 1
      dest global id  0 : node id 6.6.6.6 : tunnel 1
      lsp    working
      UMC: midpoint_1_2    ICC: ATT
      forward-lsp:  local label 150   outgoing label   151
                    outgoing tp-link 1   interface Et0/0
      bandwidth  1122
      reverse-lsp:  local label 152   outgoing label   153
                    outgoing tp-link 2   inteface Et1/0
         bandwidth  2211
   0::1.1.1.1::9::0::9.9.9.9::9::0
      source global id  0 : node id 1.1.1.1 : tunnel 9
      dest global id  0 : node id 9.9.9.9 : tunnel 9
      lsp    working
      forward-lsp:  local label 160   outgoing label   161
                    outgoing tp-link 1   interface Et0/0
      bandwidth  0
      reverse-lsp:  local label 162   outgoing label   163
                    outgoing tp-link 2   inteface Et1/0
         bandwidth  0
   0::2.2.2.2::2::0::9.9.9.9::2::0
      source global id  0 : node id 2.2.2.2 : tunnel 2
      dest global id  0 : node id 9.9.9.9 : tunnel 2
      lsp    working
      forward-lsp:  local label 170   outgoing label   171
                    outgoing tp-link 1   interface Et0/0
      bandwidth  0
      reverse-lsp:  local label 172   outgoing label   173
```

```
                    outgoing tp-link 2   inteface Et1/0
         bandwidth  0
```

Display Matching LSP Information

This command displays information for the MPLS–TP LSPs that match the specified filter value. The filter value can be node-id, global-id, tunnel number, or lsp number. The specified filter value is applied to each source and destination LSP identifier.

```
Router# show mpls tp lsps 6.6.6.6
```

```
MPLS-TP Endpoint LSPs:
LSP Identifier                       Local  Outgoing  Outgoing  Oper   Role
                                     Label  Label     Interface State
0::3.3.3.3::6::0::6.6.6.6::7::0      200    210        Et0/0     up   active
0::3.3.3.3::6::0::6.6.6.6::7::1      220    230       Et1/0     up   standby

MPLS-TP Midpoint LSPs:
LSP Identifier                       LSP  Local Outgoing  Outgoing
                                          Label Label     Interface
0::1.1.1.1::1::0::6.6.6.6::1::0      forw  150   151        Et0/0
                                     rev   152   153        Et1/0
```