MPLS Traffic Engineering—LSP Attributes

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This document describes how to configure label switched path (LSP) attributes for path options associated with Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnels.

The MPLS Traffic Engineering—LSP Attributes feature is an extension to MPLS TE that provides an LSP Attribute List feature and a Path Option for Bandwidth Override feature. These features provide flexibility in the configuration of LSP attributes for MPLS TE tunnel path options. Several LSP attributes can be applied to path options for TE tunnels using an LSP attribute list. If bandwidth is the only LSP attribute you require, then you can configure a path option for bandwidth override.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for MPLS Traffic Engineering—LSP Attributes" section on page 65.

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

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

Contents

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Prerequisites for MPLS Traffic Engineering—LSP Attributes

TheMPLS Traffic Engineering—LSP Attributes feature requires that you configure an MPLS TE tunnel before you configure either an LSP Attribute List or a Path Option for Bandwidth Override feature.

Restrictions for MPLS Traffic Engineering—LSP Attributes

Reoptimization between path options with different bandwidth pool types (subpool versus global pool) and different priorities is not supported. Specifically,

- With the Path Option for Bandwidth Override feature, you need to configure bandwidth for path options with the same bandwidth pool as configured for the tunnel.
- With the LSP Attribute List feature, you need to configure both a bandwidth pool and priority for path options that are consistent with the bandwidth pool and priority configured on the tunnel or in other path options used by the tunnel.

Information About MPLS Traffic Engineering—LSP Attributes

To configure the MPLS Traffic Engineering—LSP Attributes feature, you need the following information:

MPLS Traffic Engineering—LSP Attributes Benefits

The MPLS Traffic Engineering—LSP Attributes provides an LSP Attribute List feature and a Path Option for Bandwidth Override feature. These features have the following benefits:

- The LSP Attributes List feature provides the ability to configure values for several LSP-specific path options for TE tunnels.
- One or more TE tunnels can specify specific path options by referencing an LSP attribute list.
- LSP attribute lists make the MPLS TE user interface more flexible, easier to use, and easier to extend and maintain.
- The Path Option for Bandwidth Override feature provides a single command that allows a TE tunnel to fall back temporarily to path options that can reduce bandwidth constraints.

Traffic Engineering Bandwidth and Bandwidth Pools

MPLS traffic engineering allows constraint-based routing (CBR) of IP traffic. One of the constraints satisfied by CBR is the availability of required bandwidth over a selected path. Regular TE tunnel bandwidth is called the global pool. Subpool bandwidth is a portion of the global pool. Subpool bandwidth is not reserved from the global pool if it is not in use. Therefore, subpool tunnels require a higher priority than nonsubpool tunnels.

You can configure the LSP Attributes bandwidth path option to use either global pool (default) or subpool bandwidth. The bandwidth value for the path option may be any valid value and the pool does not have to be the same as that configured on the tunnel.

Note When you configure bandwidth for path options with the **bandwidth** [**sub-pool** | **global**] *kbps* command, use either all subpool bandwidths or all global-pool bandwidths.

You can configure bandwidth on both dynamic and explicit path options using either the LSP Attribute List feature or the Path Option for Bandwidth Override feature. The commands that enable these features are exclusive of each other. If bandwidth is the only LSP attribute that you need to set on the path option, then use the command to enable the Path Option for Bandwidth Override feature. This is the simplest way to configure multiple path options with decreasing bandwidth constraints. Once the **bandwidth** keyword is entered on the **tunnel mpls traffic-eng path-option** command in interface configuration mode, you cannot configure an LSP attribute list for that path option.

LSP Attribute Lists Usage and Management

This section contains the following topics about LSP attribute lists usage and management:

Tunnel Attributes and LSP Attributes

Cisco IOS tunneling interfaces have many parameters associated with MPLS TE. Typically, you configure these parameters with **tunnel mpls traffic-eng** commands in interface configuration mode. Many of these commands determine tunnel-specific properties, such as the load-sharing factor for the tunnel. These commands configure parameters that are unrelated to the particular LSP in use by the tunnel. However, some of the tunneling parameters apply to the LSP that the tunnel uses. You can configure the LSP-specific properties using an LSP attribute list.

LSP Attributes and the LSP Attribute List

An LSP attribute list can contain values for each LSP-specific parameter that is configurable for a TE tunnel. You configure an LSP attribute list with the **mpls traffic-eng lsp attributes** *string* command, where *string* identifies the attribute list. The LSP attributes that you can specify include the following:

- Attribute flags for links that make up the LSP (**affinity** command)
- Automatic bandwidth configuration (**auto-bw** command)
- LSP bandwidth—global pool or subpool (**bandwidth** command)

- Disable reoptimization of the LSP (**lockdown** command)
- LSP priority (**priority** command)
- Protection failure (**protection** command)
- Record the route used by the LSP (**record-route** command)

LSP Attribute Lists Management

The MPLS Traffic Engineering—LSP Attributes feature also provides commands that help you manage LSP attribute lists. You can do the following:

- Relist all attribute list entries (**list** command)
- Remove a specific attribute from the list (**no** *attribute* command)

The **exit** command exits from the LSP attributes configuration submode and returns you to global configuration mode.

Based on your requirements, you can configure LSP attributes lists with different sets of attributes for different path options. LSP attribute lists also provide an easy way to configure multiple TE tunnels to use the same LSP attributes. That is, you can reference the same LSP attribute list to configure LSP-specific parameters for one or more TE tunnels.

Autobandwidth and Path Option for Bandwidth Override

If Traffic Engineering automatic bandwidth (autobandwidth) adjustment is configured for a tunnel, traffic engineering automatically adjusts the bandwidth allocation for the traffic engineering tunnel based on its measured usage of the bandwidth of the tunnel.

Traffic engineering autobandwidth samples the average output rate for each tunnel marked for automatic bandwidth adjustment. For each marked tunnel, it periodically adjusts the allocated bandwidth for the tunnel to be the largest sample for the tunnel since the last adjustment. The default reoptimization setting in the MPLS AutoBandwidth feature is every 24 hours

The frequency with which tunnel bandwidth is adjusted and the allowable range of adjustments is configurable on a per-tunnel basis. In addition, the sampling interval and the interval over which to average tunnel traffic to obtain the average output rate is user-configurable on a per-tunnel basis.

For more information on automatic bandwidth adjustment for TE tunnels, see the *MPLS Traffic Engineering (TE)—Automatic Bandwidth Adjustment for TE Tunnels* feature documentation.

The Path Option for Bandwidth Override feature allows you to override the bandwidth configured on a TE tunnel. This feature also overrides bandwidth configured or recalculated by automatic bandwidth adjustment if the path option in effect has bandwidth override enabled.

Path Option Selection for MPLS TE Tunnel LSPs

This section contains the following topics about path option selection for MPLS TE Tunnel LSPs:

- Constraint-Based Routing and Path Option Selection, page 5
- Tunnel Reoptimization and Path Option Selection, page 5
- Path Option Selection with Bandwidth Override, page 5

Constraint-Based Routing and Path Option Selection

MPLS traffic engineering automatically establishes and maintains LSPs across the backbone by using the Resource Reservation Protocol (RSVP). The path that an LSP uses is determined by the LSP resource requirements and network resources, such as bandwidth. Traffic engineering tunnels are calculated at the LSP head based on a fit between required and available resources (constraint-based routing).

Without the Path Option for Bandwidth Override feature, a TE tunnel establishes an LSP based on dynamic or explicit path options in order of preference. However, the bandwidth and other attributes configured on the TE tunnel allow the setup of an LSP only if LSP path options satisfy the constraints. If a path cannot be found that satisfies the configured path options, then the tunnel is not set up.

The Path Option for Bandwidth Override feature provides a fallback path option that allows overriding the bandwidth configured on the TE tunnel interface. For example, you can configure a path option that sets the bandwidth to zero (0) effectively removing the bandwidth constraint imposed by the constraint-based routing calculation.

Tunnel Reoptimization and Path Option Selection

Reoptimization occurs when a device with traffic engineering tunnels periodically examines tunnels with established LSPs to learn if better LSPs are available. If a better LSP seems to be available, the device attempts to signal the better LSP. If the signaling is successful, the device replaces the older LSP with the new, better LSP.

Reoptimization can be triggered by a timer, the issuance of an **mpls traffic-eng reoptimize** command, or a configuration change that requires the resignalling of a tunnel. The MPLS AutoBandwidth feature, for example, uses a timer to set the frequency of reoptimization based on the bandwidth path option attribute. The Path Option for Bandwidth Override feature allows for the switching between bandwidth configured on the TE tunnel interface and bandwidth configured on a specific path option. This increases the success of signaling an LSP for the TE tunnel.

With bandwidth override configured on a path option, the traffic engineering software attempts to reoptimize the bandwidth every 30 seconds to reestablish the bandwidth configured on the tunnel (see the "Configuring a Path Option for Bandwidth Override" section on page 26).

You can disable reoptimization of an LSP with the **lockdown** command in an LSP attribute list. You can apply the LSP attribute list containing the **lockdown** command to a path option with the **tunnel mpls traffic-eng path-option** command.

Note When you configure bandwidth for path options with the **bandwidth** [**sub-pool** | **global**] *kpbs* command, use either all subpool bandwidths or all global-pool bandwidths. Do not mix subpool and nonsubpool bandwidths, otherwise the path option does not reoptimize later.

Path Option Selection with Bandwidth Override

The Path Option for Bandwidth Override feature allows you to configure bandwidth parameters on a specific path option with the **bandwidth** keyword on the **tunnel mpls traffic-eng path-option** command. When an LSP is signaled using a path option with a configured bandwidth, the bandwidth associated with the path option is signaled instead of the bandwidth configured directly on the tunnel.

This feature provides you with the ability to configure multiple path options that reduce the bandwidth constraint each time the headend of a tunnel fails to establish an LSP.

The following configuration shows three **tunnel mpls traffic-eng path-option** commands:

```
tunnel mpls traffic-eng bandwidth 1000
tunnel mpls traffic-eng path-option 1 explicit name path1
tunnel mpls traffic-eng path-option 2 explicit name path2 bandwidth 500
tunnel mpls traffic-eng path-option 3 dynamic bandwidth 0
```

The device selects a path option for an LSP in order of preference, as follows:

- The device attempts to signal an LSP using path options starting with path option 1.

  The device attempts to signal an LSP with the 1000 kbps bandwidth configured on the tunnel interface because path-option 1 has no bandwidth configured.
- If 1000 kbps bandwidth is not available over the network, the device attempts to establish an LSP using path-option 2.

  Path option 2 has a bandwidth of 500 kbps configured. This reduces the bandwidth constraint from the original 1000 kbps configured on the tunnel interface.
- If 500 kbps is not available, the device attempts to establish an LSP using path-option 3.

  Path-option 3 is configured as dynamic and has bandwidth 0. The device establishes the LSP if an IP path exists to the destination and all other tunnel constraints are met.

How to Configure MPLS Traffic Engineering—LSP Attributes

This section contains the following processes for configuring the MPLS Traffic Engineering—LSP Attributes feature:

- Configuring LSP Attribute Lists, page 6
- Configuring a Path Option for Bandwidth Override, page 26

Configuring LSP Attribute Lists

Perform the following tasks to configure and verify LSP attributes lists:

- Configuring an LSP Attribute List, page 7 (required)
- Adding Attributes to an LSP Attribute List, page 9 (optional)
- Removing an Attribute from an LSP Attribute List, page 11 (optional)
- Modifying an Attribute in an LSP Attribute List, page 12 (optional)
- Deleting an LSP Attribute List, page 14 (optional)
- Verifying Attributes Within an LSP Attribute List, page 15 (optional)
- Verifying All LSP Attribute Lists, page 16 (optional)
- Associating an LSP Attribute List with a Path Option for an MPLS TE Tunnel, page 17 (required)
- Modifying a Path Option to Use a Different LSP Attribute List, page 21 (optional)
- Removing a Path Option for an LSP for an MPLS TE Tunnel, page 23 (optional)
- Verifying the LSP is Signaled Using the Correct Attributes, page 25 (optional)

Configuring an LSP Attribute List

Perform this task to configure a label switched path (LSP) attribute list with the desired attributes to be applied on a path option. Based on your requirements, you can configure LSP attributes lists with different sets of attributes for different path options. The LSP attribute list provides an user interface that is flexible, easy to use, and easy to extend and maintain for the configuration of MPLS TE tunnel path options.

LSP attribute lists also provide an easy way to configure multiple TE tunnels to use the same LSP attributes. That is, you can reference the same LSP attribute list to configure LSP-specific parameters for one or more TE tunnels.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng lsp attributes** *string*
4. **affinity** *value* [**mask** *value*]
5. **auto-bw** [**frequency** *secs*] [**max-bw** *kbps*] [**min-bw** *kbps*] [**collect-bw**]
6. **bandwidth** [**sub-pool** | **global**] *kbps*
7. **list**
8. **lockdown**
9. **priority** *setup-priority* [*hold-priority*]
10. **protection fast-reroute**
11. **record-route**
12. **no** *sub-command*
13. **exit**
14. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`mpls traffic-eng lsp attributes` *string* **Example:** `Router(config)# mpls traffic-eng lsp attributes 1`	Configures an LSP attribute list and enters LSP Attributes configuration mode. • The *string* argument identifies a specific LSP attribute list.

	Command or Action	Purpose
Step 4	**affinity** *value* [**mask** *value*] **Example:** `Router(config-lsp-attr)# affinity 0 mask 0`	(Optional) Specifies attribute flags for links comprising an LSP. • The *value* argument is a value required for links that make up an LSP. Values of the bits are either 0 or 1. • The **mask** *value* keyword argument combination indicates which attribute values should be checked. – If a bit in the mask is 0, an attribute value of the link or that bit is irrelevant. – If a bit in the mask is 1, the attribute value of that link and the required affinity of the LSP for that bit must match.
Step 5	**auto-bw** [**frequency** *secs*] [**max-bw** *kbps*] [**min-bw** *kbps*] [**collect-bw**] **Example:** `Router(config-lsp-attr)# auto-bw`	(Optional) Specifies automatic bandwidth configuration. • The **frequency** *secs* keyword argument combination specifies the interval between bandwidth adjustments. The specified interval can be from 300 to 604800 seconds. • The **max-bw** *kbps* keyword argument combination specifies the maximum automatic bandwidth, in kbps, for this path option. The value can be from 0 to 4294967295. • The **min-bw** *kpbs* keyword argument combination specifies the minimum automatic bandwidth, in kbps, for this path option. The value can be from 0 to 4294967295. • The **collect-bw** keyword collects output rate information for the path option, but does not adjust the bandwidth of the path option.
Step 6	**bandwidth** [**sub-pool** | **global**] *kbps* **Example:** `Router(config-lsp-attr)# bandwidth 5000`	(Optional) Specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295.
Step 7	**list** **Example:** `Router(config-lsp-attr)# list`	(Optional) Displays the contents of the LSP attribute list.
Step 8	**lockdown** **Example:** `Router(config-lsp-attr)# lockdown`	(Optional) Disables reoptimization of the LSP.

	Command or Action	Purpose
Step 9	**priority** *setup-priority* [*hold-priority*] **Example:** `Router(config-lsp-attr)# priority 1 1`	(Optional) Specifies the LSP priority. • The *setup-priority* argument is used when signaling an LSP to determine which existing LSPs can be preempted. Valid values are from 0 to 7, where a lower number indicates a higher priority. Therefore, an LSP with a setup priority of 0 can preempt any LSP with a non-0 priority. • The *hold-priority* argument is associated with an LSP to determine if it should be preempted by other LSPs that are being signaled. Valid values are from 0 to 7, where a lower number indicates a higher priority.
Step 10	**protection fast-reroute** **Example:** `Router(config-lsp-attr)# protection fast-reroute`	(Optional) Enables failure protection on the LSP.
Step 11	**record-route** **Example:** `Router(config-lsp-attr)# record-route`	(Optional) Records the route used by the LSP.
Step 12	**no** *sub-command* **Example:** `Router(config-lsp-attr)# no record-route`	(Optional) Removes a specific attribute from the LSP attributes list. • The *sub-command* argument names the LSP attribute to remove from the attributes list.
Step 13	**exit** **Example:** `Router(config-lsp-attr)# exit`	(Optional) Exits LSP Attributes configuration mode.
Step 14	**end** **Example:** `Router(config)# end`	(Optional) Exits to privileged EXEC mode.

Adding Attributes to an LSP Attribute List

Perform this task to add attributes to an LSP attribute list. The LSP attribute list provides a user interface that is flexible, easy to use, and that can be extended or changed at any time to meet the requirements of your MPLS TE tunnel traffic. LSP Attributes configuration mode is used to display the specific LSP attributes list and to add or change the required path option attribute.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng lsp attributes** *string* [**affinity** *value* [**mask** *value*]]

4. **bandwidth** [**sub-pool** | **global**] *kbps*
5. **priority** *setup-priority* [*hold-priority*]
6. **list**
7. **exit**
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**mpls traffic-eng lsp attributes** *string* [**affinity** *value* [**mask** *value*]] **Example:** `Router(config)# mpls traffic-eng lsp attributes 1 affinity 1 mask 1`	Configures an LSP attribute list and enters LSP Attributes configuration mode. • The *string* argument identifies a specific LSP attribute list. • The **affinity** *value* keyword argument combination indicates a value required for links comprising an LSP. Values of bits are either 0 or 1. • The **mask** *value* keyword argument combination indicates which attribute values should be checked. – If a bit in the mask is 0, an attribute value of the link or that bit is irrelevant. – If a bit in the mask is 1, the attribute value of that link and the required affinity of the tunnel for that bit must match.
Step 4	**bandwidth** [**sub-pool** | **global**] *kbps* **Example:** `Router(config-lsp-attr)# bandwidth 1000`	Specifies an LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295.

	Command or Action	Purpose
Step 5	**priority** *setup-priority* [*hold-priority*] **Example:** `Router(config-lsp-attr)# priority 2 2`	Specifies the LSP priority. • The *setup-priority* argument is used when signaling an LSP to determine which existing LSPs can be preempted. Valid values are from 0 to 7, where a lower number indicates a higher priority. Therefore, an LSP with a setup priority of 0 can preempt any LSP with a non-0 priority. • The *hold-priority* argument is associated with an LSP to determine if it should be preempted by other LSPs that are being signaled. Valid values are from 0 to 7, where a lower number indicates a higher priority.
Step 6	**list** **Example:** `Router(config-lsp-attr)# list`	(Optional) Displays the contents of the LSP attribute list. • Use the **list** command to display the path option attributes added to the attribute list.
Step 7	**exit** **Example:** `Router(config-lsp-attr)# exit`	(Optional) Exits LSP Attributes configuration mode.
Step 8	**end** **Example:** `Router(config)# end`	(Optional) Exits to privileged EXEC mode.

Removing an Attribute from an LSP Attribute List

Perform this task to remove an attribute from an LSP attribute list. The LSP attributes list provides a means to easily remove a path option attribute that is no longer required for your MPLS TE tunnel traffic. LSP Attributes configuration mode is used to display the specific LSP attribute list and for the **no** *sub-command* command, which is used to remove the specific attribute from the list. Replace the *sub-command* argument with the command that you want to remove from the list.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng lsp attributes** *string*
4. **no** *sub-command*
5. **list**
6. **exit**
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**mpls traffic-eng lsp attributes** *string* **Example:** `Router(config)# mpls traffic-eng lsp attributes 1`	Configures an LSP attribute list and enters LSP Attributes configuration mode. • The *string* argument identifies a specific LSP attribute list.
Step 4	**no** *sub-command* **Example:** `Router(config-lsp-attr)# no priority`	Removes a specific attribute from the LSP attribute list. • The *sub-command* argument names the LSP attribute to remove from the attributes list.
Step 5	**list** **Example:** `Router(config-lsp-attr)# list`	(Optional) Displays the contents of the LSP attribute list. • Use the **list** command to verify that the path option attribute is removed from the attribute list.
Step 6	**exit** **Example:** `Router(config-lsp-attr)# exit`	(Optional) Exits LSP Attributes configuration mode.
Step 7	**end** **Example:** `Router(config)# end`	(Optional) Exits to privileged EXEC mode.

Modifying an Attribute in an LSP Attribute List

Perform this task to modify an attribute in an LSP attribute list. The LSP attribute list provides a flexible user interface that can be extended or modified an any time to meet the requirements of your MPLS TE tunnel traffic. LSP Attributes configuration mode is used to display the specific LSP attributes list and to modify the required path option attribute.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng lsp attributes** *string*
4. **affinity** *value* [**mask** *value*]

5. **list**
6. **affinity** *value* [**mask** *value*]
7. **list**
8. **exit**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**mpls traffic-eng lsp attributes** *string* **Example:** `Router(config)# mpls traffic-eng lsp attributes 1`	Configures an LSP attribute list and enters LSP Attributes configuration mode. • The *string* argument identifies a specific LSP attribute list.
Step 4	**affinity** *value* [**mask** *value*] **Example:** `Router(config-lsp-attr)# affinity 1 mask 1`	Specifies attribute flags for links comprising an LSP. • The *value* argument is a value required for links comprising an LSP. Values of bits are either 0 or 1. • The **mask** *value* keyword argument combination indicates which attribute values should be checked. – If a bit in the mask is 0, an attribute value of the link or that bit is irrelevant. – If a bit in the mask is 1, the attribute value of that link and the required affinity of the tunnel for that bit must match.
Step 5	**list** **Example:** `Router(config-lsp-attr)# list`	(Optional) Displays the contents of the LSP attribute list. • Use the **list** command to display the path option attributes configured in the attribute list.

	Command or Action	Purpose
Step 6	**affinity** *value* [**mask** *value*] **Example:** `Router(config-lsp-attr)# affinity 0 mask 0`	Specifies attribute flags for links comprising an LSP. • The *value* argument is a value required for links comprising an LSP. Values of bits are either 0 or 1. • The **mask** *value* keyword argument combination indicates which attribute values should be checked. – If a bit in the mask is 0, an attribute value of the link or that bit is irrelevant. – If a bit in the mask is 1, the attribute value of that link and the required affinity of the tunnel for that bit must match.
Step 7	**list** **Example:** `Router(config-lsp-attr)# list`	(Optional) Displays the contents of the LSP attribute list. • Use the **list** command to verify that the path option attributes is modified in the attribute list.
Step 8	**exit** **Example:** `Router(config-lsp-attr)# exit`	(Optional) Exits LSP Attributes configuration mode.
Step 9	**end** **Example:** `Router(config)# end`	(Optional) Exits to privileged EXEC mode.

Deleting an LSP Attribute List

Perform this task to delete an LSP attribute list. You would perform this task when you no longer require the LSP attribute path options specified in the LSP attribute list for an MPLS TE tunnel.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **no mpls traffic-eng lsp attributes** *string*
4. **end**
5. **show mpls traffic-eng lsp attributes** [*string*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**no mpls traffic-eng lsp attributes** *string* **Example:** `Router(config)# no mpls traffic-eng lsp attributes 1`	Removes a specified LSP attribute list from the device configuration. • The *string* argument identifies the specific LSP attribute list to remove.
Step 4	**end** **Example:** `Router(config)# end`	(Optional) Exits to privileged EXEC mode.
Step 5	**show mpls traffic-eng lsp attributes** [*string*] **Example:** `Router# show mpls traffic-eng lsp attributes`	(Optional) Displays information about configured LSP attribute lists. • Use the **show mpls traffic-eng lsp attributes** command to verify that the LSP attribute list was deleted from the router.

Verifying Attributes Within an LSP Attribute List

Perform this task to verify attributes within an LSP attribute list.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng lsp attributes** *string* **list**
4. **exit**
5. **end**

DETAILED STEPS

Step 1 **enable**

Use this command to enable privileged EXEC mode. Enter your password if prompted. For example:

```
Router> enable
Router#
```

Step 2 **configure terminal**

Use this command to enter global configuration mode. For example:

```
Router# configure terminal
Router(config)#
```

Step 3 **mpls traffic-eng lsp attributes** *string* **list**

Use this command to enter LSP Attributes configuration mode for a specific LSP attribute list and to verify that the contents of the attributes list are as expected. For example:

```
Router(config)# mpls traffic-eng lsp attributes 1 list

LIST 1
 bandwidth 1000
 priority 1 1
```

Step 4 **exit**

Use this command to exit LSP Attributes configuration mode. For example:

```
Router(config-lsp-attr)# exit
Router(config)#
```

Step 5 **end**

Use this command to exit to privileged EXEC mode. For example:

```
Router(config)# exit
Router#
```

Verifying All LSP Attribute Lists

Perform this task to verify all configured LSP attribute lists. Use this task to display all LSP attribute lists to verify that the attributes lists that you configured are in operation.

SUMMARY STEPS

1. **enable**
2. **show mpls traffic-eng lsp attributes** [*string*] [**details**]
3. **show running-config** | **begin** *text-string*
4. **exit**

DETAILED STEPS

Step 1 **enable**

Use this command to enable privileged EXEC mode. Enter your password if prompted. For example:

```
Router> enable
Router#
```

Step 2 **show mpls traffic-eng lsp attributes** [*string*] [**details**]

Use this command to verify that all configured LSP attribute lists are as expected. For example:

```
Router# show mpls traffic-eng lsp attributes

LIST 1
```

```
  affinity 1 mask 1
  bandwidth 1000
  priority 1 1
LIST 2
  bandwidth 5000
LIST hipriority
  priority 0 0
!
```

Step 3 **show running-config** | **begin** *text-string*

Use this command to verify that all configured LSP attribute lists are as expected. Use the **begin** command modifier with the **mpls traffic-eng lsp** text-string to locate the LSP attributes information in the configuration file. For example:

```
Router# show running-config | begin mpls traffic-eng lsp

mpls traffic-eng lsp attributes 1
  affinity 1 mask 1
  bandwidth 1000
  priority 1 1
!
mpls traffic-eng lsp attributes 2
  bandwidth 5000
!
mpls traffic-eng lsp attributes hipriority
  priority 0 0
.
.
.
Router#
```

Step 4 **exit**

Use this command to exit to user EXEC mode. For example:

```
Router# exit
Router>
```

Associating an LSP Attribute List with a Path Option for an MPLS TE Tunnel

Perform this task to associate an LSP attribute list with a path option for an MPLS TE tunnel. This task is required if you want to apply the LSP attribute list that you configured to path options for your MPLS TE tunnels.

Based on your requirements, you can configure LSP attributes lists with different sets of attributes for different path options. LSP attribute lists also provide an easy way to configure multiple TE tunnels to use the same LSP attributes. That is, you can reference the same LSP attribute list to configure LSP-specific parameters for one or more TE tunnels.

Default Path Option Attributes for TE Tunnels Using LSP Attribute Lists

Values for path option attributes for a TE tunnel are determined in this manner:

- LSP attribute list values referenced by the path option take precedence over the values configured on the tunnel interface.
- If an attribute is not specified in the LSP attribute list, the device uses the attribute in the tunnel configuration. LSP attribute lists do not have defaults.

- If the attribute is not configured on the tunnel, then the device uses the tunnel default value, as follows:

  {affinity= affinity 0 mask 0,

  auto-bw= no auto-bw,

  bandwidth= bandwidth 0,

  lockdown= no lockdown,

  priority= priority 7 7,

  protection fast-reroute= no protection fast-reroute,

  record-route= no record-route

  .

  .

  .

  }

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **tunnel destination** {*hostname* | *ip-address*}
5. **tunnel mode mpls traffic-eng**
6. **tunnel mpls traffic-eng autoroute announce**
7. **tunnel mpls traffic-eng bandwidth** [**sub-pool** | **global**] *kbps*
8. **tunnel mpls traffic-eng priority** *setup-priority* [*hold-priority*]
9. **tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**]
10. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type number* **Example:** `Router(config)# interface tunnel 1`	Configures an interface type and enters interface configuration mode. • The *type* argument is the type of interface that you want to configure. • The *number* argument is the number of the tunnel interface that you want to create or configure.
Step 4	**tunnel destination** {*hostname* | *ip-address*} **Example:** `Router(config-if)# tunnel destination 10.10.10.12`	Specifies the destination of the tunnel for this path option. • The *hostname* argument is the name of the host destination. • The *ip-address* argument is the IP address of the host destination expressed in decimal in four-part, dotted notation.
Step 5	**tunnel mode mpls traffic-eng** **Example:** `Router(config-if)# tunnel mode mpls traffic-eng`	Sets the encapsulation mode for the tunnel for MPLS TE.
Step 6	**tunnel mpls traffic-eng autoroute announce** **Example:** `Router(config-if)# tunnel mpls traffic-eng autoroute announce`	Specifies that the IGP should use the tunnel (if the tunnel is up) in its enhanced shortest path first (SPF) calculation.
Step 7	**tunnel mpls traffic-eng bandwidth** [**sub-pool** | **global**] *bandwidth* **Example:** `Router(config-if)# tunnel mpls traffic-eng bandwidth 1000`	Configures the bandwidth required for an MPLS TE tunnel and assigns it either to the subpool or the global pool. • The **sub-pool** keyword indicates a subpool tunnel. • The **global** keyword indicates a global pool tunnel. Entering this keyword is not necessary, for all tunnels are in the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the bandwidth, in kilobits per second, set aside for the MPLS TE tunnel. The range is from 1 to 4294967295.
Step 8	**tunnel mpls traffic-eng priority** *setup-priority* [*hold-priority*] **Example:** `Router(config-if)# tunnel mpls traffic-eng priority 1 1`	Sets the priority to be used when the system determines which existing tunnels are eligible to be preempted. • The *setup-priority* argument is the priority used when signaling an LSP for this tunnel to determine which existing tunnels can be preempted. Valid values are from 0 to 7. A lower number indicates a higher priority. An LSP with a setup priority of 0 can preempt any LSP with a non-0 priority. • The *hold-priority* argument is the priority associated with an LSP for this tunnel to determine if it should be preempted by other LSPs that are being signaled. Valid values are from 0 to 7, where a lower number indicates a higher priority.

	Command or Action	Purpose
Step 9	**tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**] **Example:** `Router(config-if)# tunnel mpls traffic-eng path-option 1 dynamic attributes 1`	Adds an LSP attribute list to specify LSP-related parameters for a path options for an MPLS TE tunnel. • The *number* argument identifies the path option. • The **dynamic** keyword indicates that the path option is dynamically calculated (the router figures out the best path). • The **explicit** keyword indicates that the path option is specified. You specify the IP addresses of the path. • The **name** *path-name* keyword argument combination identifies the name of the explicit path option. • The *path-number* argument identifies the number of the explicit path option. • The **verbatim** keyword bypasses the topology database verification. **Note** You can use the **verbatim** keyword only with the explicit path option. • The **attributes** *string* keyword argument combination names an attribute list to specify path options for the LSP. • The **bandwidth** keyword specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295. • The **lockdown** keyword disables reoptimization of the LSP.
Step 10	**end** **Example:** `Router(config-if)# end`	(Optional) Exits to privileged EXEC mode.

Modifying a Path Option to Use a Different LSP Attribute List

Perform this task to modify the path option to use a different LSP attribute list.

Based on your requirements, you can configure LSP attributes lists with different sets of attributes for different path options or change the set of attributes associated with a path option. You use the **tunnel mpls traffic-eng path-option** *number* **dynamic attributes** *string* command in interface configuration mode to modify the path option to use a different LSP attribute list. The **attributes** *string* keyword and argument names the new LSP attribute list for the path option specified.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **tunnel destination** {*hostname* | *ip-address*}
5. **tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**]
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface tunnel 1`	Configures the interface type and enters interface configuration mode. • The *type* argument is the type of interface that you want to configure. • The *number* argument is the number of the tunnel interface that you want to create or configure.
Step 4	**tunnel destination** {*hostname* | *ip-address*} **Example:** `Router(config-if)# tunnel destination 10.10.10.12`	Specifies the destination of the tunnel for this path option. • The *hostname* argument is the name of the host destination. • The *ip-address* argument is the IP address of the host destination expressed in decimal in four-part, dotted notation.

	Command or Action	Purpose
Step 5	**tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**] **Example:** `Router(config-if)# tunnel mpls traffic-eng path-option 1 dynamic attributes 1`	Adds an LSP attribute list to specify LSP-related parameters for a path options for an MPLS TE tunnel. • The *number* argument identifies the path option. • The **dynamic** keyword indicates that the path option is dynamically calculated (the router figures out the best path). • The **explicit** keyword indicates that the path option is specified. You specify the IP addresses of the path. • The **name** *path-name* keyword argument combination identifies the name of the explicit path option. • The *path-number* argument identifies the number of the explicit path option. • The **verbatim** keyword bypasses the topology database verification. **Note** You can use the **verbatim** keyword only with the explicit path option. • The **attributes** *string* keyword argument combination names an attribute list to specify path options for the LSP. • The **bandwidth** keyword specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295. • The **lockdown** keyword disables reoptimization of the LSP.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits to privileged EXEC mode.

Removing a Path Option for an LSP for an MPLS TE Tunnel

Perform this task to remove a path option for an LSP for an MPLS TE tunnel. Use this task to remove a path option for an LSP when your MPLS TE tunnel traffic requirements change.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **tunnel destination** {*hostname* | *ip-address*}
5. **no tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**]
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface tunnel 1`	Configures the interface type and enters interface configuration mode. • The *type* argument is the type of interface that you want to configure. • The *number* argument is the number of the tunnel interface that you want to create or configure.
Step 4	**tunnel destination** {*hostname* | *ip-address*} **Example:** `Router(config-if)# tunnel destination 10.10.10.12`	Specifies the destination of the tunnel for this path option. • The *hostname* argument is the name of the host destination. • The *ip-address* argument is the IP address of the host destination expressed in decimal in four-part, dotted notation.

	Command or Action	Purpose
Step 5	**no tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**] **Example:** `Router(config-if)# no tunnel mpls traffic-eng path-option 1 dynamic attributes 1`	Removes an LSP attribute list that specifies LSP-related parameters for a path option for an MPLS TE tunnel. • The *number* argument identifies the path option. • The **dynamic** keyword indicates that the path option is dynamically calculated (the router figures out the best path). • The **explicit** keyword indicates that the path option is specified. You specify the IP addresses of the path. • The **name** *path-name* keyword argument combination identifies the name of the explicit path option. • The *path-number* argument identifies the number of the explicit path option. • The **verbatim** keyword bypasses the topology database verification. **Note** You can use the **verbatim** keyword only with the explicit path option. • The **attributes** *string* keyword argument combination names an attribute list to specify path options for the LSP. • The **bandwidth** keyword specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295. • The **lockdown** keyword disables reoptimization of the LSP.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits to privileged EXEC mode.

Verifying the LSP is Signaled Using the Correct Attributes

Perform this task to verify that the LSP is signaled using the correct attributes.

SUMMARY STEPS

1. **enable**
2. **show mpls traffic-eng tunnels** *tunnel-interface* [**brief**]
3. **exit**

DETAILED STEPS

Step 1 **enable**

Use this command to enable privileged EXEC mode. Enter your password if prompted. For example:

```
Router> enable
Router#
```

Step 2 **show mpls traffic-eng tunnels** *tunnel-interface* [**brief**]

Use this command to verify that the LSP is signaled using the correct attributes for the specified tunnel. For example:

```
Router# show mpls traffic-eng tunnels tunnel1

Name: Router-10-c_t1                       (Tunnel1) Destination: 10.10.10.12
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 2, type explicit path2 (Basis for Setup, path weight 65834)

  Config Parameters:
    Bandwidth: 1000      kbps (Global)  Priority: 1  1   Affinity: 0x0/0xFFFF
    Metric Type: IGP (global)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 1        bw-based
    auto-bw: disabled
  Active Path Option Parameters:
    State: explicit path option 2 is active
    BandwidthOverride: enabled   LockDown: disabled  Verbatim: disabled

    Bandwidth Override:
      Signalling: 1        kbps (Global)
      Overriding: 1000        kbps (Global) configured on tunnel
```

The output shows that the following attributes are signaled for tunnel tunnel1: affinity 0 mask 0, auto-bw disabled, bandwidth 1000, lockdown disabled, and priority 1 1.

Step 3 **exit**

Use this command to return to user EXEC mode. For example:

```
Router# exit
Router>
```

Configuring a Path Option for Bandwidth Override

This section contains the following tasks for configuring a path option for bandwidth override:

- Configuring Fallback Bandwidth Path Options for TE Tunnels, page 26 (required)
- Modifying the Bandwidth on a Path Option for Bandwidth Override, page 29 (optional)
- Removing a Path Option for Bandwidth Override, page 31 (optional)
- Verifying the LSP Is Signaled Using the Correct Bandwidth, page 32 (optional)

Note Once you configure bandwidth as a path-option parameter, you can no longer configure an LSP attribute list as a path-option parameter.

Configuring Fallback Bandwidth Path Options for TE Tunnels

Perform this task to configure fallback bandwidth path options for a TE tunnel. Use this task to configure path options that reduce the bandwidth constraint each time the headend of a tunnel fails to establish an LSP.

Configuration of the Path Option for Bandwidth Override feature can reduce bandwidth constraints on path options temporarily and improve the chances that an LSP is set up for the TE tunnel. When a TE tunnel uses a path option with bandwidth override, the traffic engineering software attempts every 30 seconds to reoptimize the tunnel to use the preferred path option with the original configured bandwidth. The Path Option for Bandwidth Override feature is designed as a temporary reduction in bandwidth constraint. To force immediate reoptimization of all traffic engineering tunnels, you can use the **mpls traffic-eng reoptimize** command. You can also configure the **lockdown** command with bandwidth override to prevent automatic reoptimization.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **tunnel destination** {*hostname* | *ip-address*}
5. **tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path--name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**]
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface tunnel 1`	Configures an interface type and enters interface configuration mode. • The *type* argument is the type of interface that you want to configure. • The *number* argument is the number of the tunnel interface that you want to create or configure.
Step 4	**tunnel destination** {*hostname* | *ip-address*} **Example:** `Router(config-if)# tunnel destination 10.10.10.12`	Specifies the destination of the tunnel for this path option. • The *hostname* argument is the name of the host destination. • The *ip-address* argument is the IP address of the host destination expressed in decimal in four-part, dotted notation.

	Command or Action	Purpose
Step 5	**tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**] **Example:** `Router(config-if)# tunnel mpls traffic-eng path-option 1 dynamic bandwidth 500`	Adds a path option for bandwidth override to specify a bandwidth fallback for a path option for an MPLS TE tunnel. • The *number* argument identifies the path option. • The **dynamic** keyword indicates that the path option is dynamically calculated (the router figures out the best path). • The **explicit** keyword indicates that the path option is specified. You specify the IP addresses of the path. • The **name** *path-name* keyword argument combination identifies the name of the explicit path option. • The *path-number* argument identifies the number of the explicit path option. • The **verbatim** keyword bypasses the topology database verification. **Note** You can use the **verbatim** keyword only with the explicit path option. • The **attributes** *string* keyword argument combination names an attribute list to specify path options for the LSP. • The **bandwidth** keyword specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295. • The **lockdown** keyword disables reoptimization of the LSP.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits to privileged EXEC mode.

Modifying the Bandwidth on a Path Option for Bandwidth Override

Perform this task to modify the bandwidth on a path option for bandwidth override. You might need to further reduce or modify the bandwidth constraint for a path option to ensure that the headend of a tunnel establishes an LSP.

The Path Option for Bandwidth Override feature is designed as a temporary reduction in bandwidth constraint. To force immediate reoptimization of all traffic engineering tunnels, you can use the **mpls traffic-eng reoptimize** command. You can also configure the **lockdown** command with bandwidth override to prevent automatic reoptimization.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **tunnel destination** {*hostname* | *ip-address*}
5. **tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**]
6. **end**
7. **show mpls traffic-eng tunnels** *tunnel-interface* [**brief**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface tunnel 1`	Configures the interface type and enters interface configuration mode. • The *type* argument is the type of interface that you want to configure. • The *number* argument is the number of the tunnel interface that you want to create or configure.
Step 4	**tunnel destination** {*hostname* | *ip-address*} **Example:** `Router(config-if)# tunnel destination 10.10.10.12`	Specifies the destination of the tunnel for this path option. • The *hostname* argument is the name of the host destination. • The *ip-address* argument is the IP address of the host destination expressed in decimal in four-part, dotted notation.

	Command or Action	Purpose
Step 5	**tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**] **Example:** `Router(config-if)# tunnel mpls traffic-eng path-option 2 dynamic bandwidth 500`	Adds a path option for bandwidth override to specify a bandwidth fallback for a path option for an MPLS TE tunnel. • The *number* argument identifies the path option. • The **dynamic** keyword indicates that the path option is dynamically calculated (the router figures out the best path). • The **explicit** keyword indicates that the path option is specified. You specify the IP addresses of the path. • The **name** *path-name* keyword argument combination identifies the name of the explicit path option. • The *path-number* argument identifies the number of the explicit path option. • The **verbatim** keyword bypasses the topology database verification. **Note** You can use the **verbatim** keyword only with the explicit path option. • The **attributes** *string* keyword argument combination names an attribute list to specify path options for the LSP. • The **bandwidth** keyword specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295. • The **lockdown** keyword disables reoptimization of the LSP.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits to privileged EXEC mode.
Step 7	**show mpls traffic-eng tunnels** *tunnel-interface* [**brief**] **Example:** `Router# show mpls traffic-eng tunnels tunnel1`	(Optional) Displays information about tunnels. • Use the **show mpls traffic-eng tunnels** command to verify which bandwidth path option is in use by the LSP.

Removing a Path Option for Bandwidth Override

Perform this task to remove the bandwidth on the path option for bandwidth override. The Path Option for Bandwidth Override feature is designed as a temporary reduction in bandwidth constraint. Use this task to remove the bandwidth override when it is not required.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **tunnel destination** {*hostname* | *ip-address*}
5. **no tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**]
6. **end**
7. **show mpls traffic-eng tunnels** *tunnel-interface* [**brief**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface tunnel 1`	Configures an interface type and enters interface configuration mode. • The *type* argument is the type of interface that you want to configure. • The *number* argument is the number of the tunnel interface that you want to create or configure.
Step 4	**tunnel destination** {*hostname* | *ip-address*} **Example:** `Router(config-if)# tunnel destination 10.10.10.12`	Specifies the destination of the tunnel for this path option. • The *hostname* argument is the name of the host destination. • The *ip-address* argument is the IP address of the host destination expressed in decimal in four-part, dotted notation.

	Command or Action	Purpose
Step 5	**no tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*} [**verbatim**]} [**attributes** *string*] [**bandwidth** [**sub-pool** | **global**] *kbps*] [**lockdown**] **Example:** `Router(config-if)# no tunnel mpls traffic-eng path-option 2 dynamic bandwidth 500`	Removes a path option for bandwidth override that specifies a bandwidth fallback for a path option for an MPLS TE tunnel. • The *number* argument identifies the path option. • The **dynamic** keyword indicates that the path option is dynamically calculated (the router figures out the best path). • The **explicit** keyword indicates that the path option is specified. You specify the IP addresses of the path. • The **name** *path-name* keyword argument combination identifies the name of the explicit path option. • The *path-number* argument identifies the number of the explicit path option. • The **verbatim** keyword bypasses the topology database verification. **Note** You can use the **verbatim** keyword only with the explicit path option. • The **attributes** *string* keyword argument combination names an attribute list to specify path options for the LSP. • The **bandwidth** keyword specifies LSP bandwidth. • The **sub-pool** keyword indicates a subpool path option. • The **global** keyword indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword. • The *kbps* argument is the number of kilobits per second set aside for the path option. The range is from 1 to 4294967295. • The **lockdown** keyword disables reoptimization of the LSP.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits to privileged EXEC mode.
Step 7	**show mpls traffic-eng tunnels** *tunnel-interface* [**brief**] **Example:** `Router# show mpls traffic-eng tunnels tunnel1`	(Optional) Displays information about tunnels. • Use the **show mpls traffic-eng tunnels** command to verify which bandwidth path option is in use by the LSP.

Verifying the LSP Is Signaled Using the Correct Bandwidth

Perform this task to verify that the LSP is signaled with the correct bandwidth.

SUMMARY STEPS

1. **enable**
2. **show mpls traffic-eng tunnels** *tunnel-interface* [**brief**]
3. **exit**

DETAILED STEPS

Step 1 **enable**

Use this command to enable privileged EXEC mode. Enter your password if prompted. For example:

```
Router> enable
Router#
```

Step 2 **show mpls traffic-eng tunnels** *tunnel-interface* [**brief**]

Use this command to verify that the LSP is signaled with the correct bandwidth and to verify that the bandwidth configured on the tunnel is overridden. For example:

```
Router# show mpls traffic-eng tunnels tunnel21

Name: Router-15-c_t21                     (Tunnel21) Destination: 10.10.10.12
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected

    path option 2, type explicit path2 (Basis for Setup, path weight 65834)
    path option 1, type explicit path1

  Config Parameters:
    Bandwidth: 1000      kbps (Global)  Priority: 1  1   Affinity: 0x0/0xFFFF
    Metric Type: IGP (global)
    AutoRoute:  enabled   LockDown: disabled  Loadshare: 1        bw-based
    auto-bw: disabled
  Active Path Option Parameters:
    State: explicit path option 2 is active
    BandwidthOverride: enabled   LockDown: disabled  Verbatim: disabled

    Bandwidth Override:
      Signalling: 500 kbps (Global)
      Overriding: 1000        kbps (Global) configured on tunnel
```

If bandwidth override is actively being signaled, the **show mpls traffic-eng tunnel** command displays the bandwidth override information under the Active Path Option Parameters heading. The example shows that BandwidthOverride is enabled and that the tunnel is signaled using path-option 2. The bandwidth signaled is 500. This is the value configured on the path option 2 and it overrides the 1000 kbps bandwidth configured on the tunnel interface.

Step 3 **exit**

Use this command to exit to user EXEC mode. For example:

```
Router# exit
Router>
```

Troubleshooting Tips

If the tunnel state is down and you configured a path-option with bandwidth override enabled, the **show mpls traffic-eng tunnels** command indicates other reasons why a tunnel is not established. For example:

- The tunnel destination is not in the routing table.
- If the bandwidth override value is not zero, the bandwidth constraint may still be too large.
- Other attributes configured on the tunnel, such as affinity, might prevent the calculation of a path over the existing topology.
- TE might not be configured on all links necessary to reach tunnel destination.

Configuration Examples for MPLS Traffic Engineering—LSP Attributes

This section contains the following configuration examples for the MPLS Traffic Engineering—LSP Attributes features:

- Configuring LSP Attribute List: Examples, page 34
- Configuring a Path Option for Bandwidth Override: Examples, page 37

Configuring LSP Attribute List: Examples

This section contains the following examples for configuring LSP attribute lists:

- Configuring an LSP Attribute List: Example, page 34
- Adding Attributes to an LSP Attribute List: Example, page 35
- Removing an Attribute from an LSP Attribute List: Example, page 35
- Modifying an Attribute in an LSP Attribute List: Example, page 35
- Deleting an LSP Attribute List: Example, page 35
- Associating an LSP Attribute List with a Path Option for a TE Tunnel: Example, page 36
- Modifying a Path Option to Use a Different LSP Attribute List: Example, page 36
- Removing a Path Option for Bandwidth Override: Example, page 39

Configuring an LSP Attribute List: Example

This example shows the configuration of the affinity, bandwidth, and priority LSP-related attributes in an LSP attribute list identified with the numeral 1:

```
Router(config)# mpls traffic-eng lsp attributes 1
Router(config-lsp-attr)# affinity 7 7
Router(config-lsp-attr)# bandwidth 1000
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# exit
```

Adding Attributes to an LSP Attribute List: Example

This example shows the addition of protection attributes to the LSP attribute list identified with the numeral 1:

```
Router(config)# mpls traffic-eng lsp attributes 1
Router(config-lsp-attr)# affinity 7 7
Router(config-lsp-attr)# bandwidth 1000
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# protection fast-reroute
Router(config-lsp-attr)# exit
```

Removing an Attribute from an LSP Attribute List: Example

The following example shows removing the priority attribute from the LSP attribute list identified by the string simple:

```
Router(config)# mpls traffic-eng lsp attributes simple
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# list

LIST simple
 priority 1 1
!
Router(config-lsp-attr)# no priority
Router(config-lsp-attr)# list

LIST simple
!
Router(config-lsp-attr)# exit
```

Modifying an Attribute in an LSP Attribute List: Example

The following example shows modifying the bandwidth in an LSP attribute list identified by the numeral 5:

```
Router(config)# mpls traffic-eng lsp attributes 5
Router(config-lsp-attr)# bandwidth 1000
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# list

LIST 5
 bandwidth 1000
 priority 1 1

Router(config-lsp-attr)# bandwidth 500
Router(config-lsp-attr)# list

LIST 5
 bandwidth 500
 priority 1 1

Router(config-lsp-attr)# exit
```

Deleting an LSP Attribute List: Example

The following example shows the deletion of an LSP attribute list identified by numeral 1:

```
Router(config)# mpls traffic-eng lsp attributes 1
Router(config-lsp-attr)# affinity 7 7
```

```
Router(config-lsp-attr)# bandwidth 1000
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# exit
!
Router(config)# no mpls traffic-eng lsp attributes 1
```

Associating an LSP Attribute List with a Path Option for a TE Tunnel: Example

The following example associates the LSP attribute list identified by the numeral 3 with path option 1:

```
Router(config)# mpls traffic-eng lsp attributes 3
Router(config-lsp-attr)# bandwidth 1000
Router(config-lsp-attr)# priority 2 2
Router(config-lsp-attr)# protection fast-reroute
Router(config-lsp-attr)# exit
!
!
Router(config)# interface Tunnel 1
Router(config-if)# ip unnumbered Ethernet4/0/1
Router(config-if)# tunnel destination 10.112.0.12
Router(config-if)# tunnel mode mpls traffic-eng
Router(config-if)# tunnel mpls traffic-eng affinity 1
Router(config-if)# tunnel mpls traffic-eng bandwidth 5000
Router(config-if)# tunnel mpls traffic-eng path-option 1 dynamic attributes 3
```

In this configuration, the LSP will have the following attributes:

```
{bandwidth = 1000
 priority = 2 2
 affinity 1
 reroute enabled.
 }
```

The LSP attribute list referenced by the path option will take precedence over the values configured on the tunnel interface.

Modifying a Path Option to Use a Different LSP Attribute List: Example

The following example modifies path option 1 to use an LSP attribute list identified by the numeral 1:

```
Router(config)# mpls traffic-eng lsp attributes 1
Router(config-lsp-attr)# affinity 7 7
Router(config-lsp-attr)# bandwidth 500
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# exit

Router(config)# mpls traffic-eng lsp attributes 2
Router(config-lsp-attr)# bandwidth 1000
Router(config-lsp-attr)# priority 1 1
Router(config-lsp-attr)# exit

Router(config)# interface Tunnel 1
Router(config-if)# ip unnumbered Ethernet4/0/1
Router(config-if)# tunnel destination 10.112.0.12
Router(config-if)# tunnel mode mpls traffic-eng
Router(config-if)# tunnel mpls traffic-eng affinity 1
Router(config-if)# tunnel mpls traffic-eng bandwidth 5000
Router(config-if)# tunnel mpls traffic-eng path-option 1 dynamic attributes 1
```

In this configuration, the LSP will have the following attributes:

```
{affinity = 7 7
```

```
bandwidth = 500
priority = 1 1
}
```

Removing a Path Option for an LSP for an MPLS TE Tunnel: Example

The following example shows the removal of path option 1 for an LSP for a TE tunnel:

```
Router(config)# interface Tunnel 1
Router(config-if)# ip unnumbered Ethernet4/0/1
Router(config-if)# tunnel destination 10.112.0.12
Router(config-if)# tunnel mode mpls traffic-eng
Router(config-if)# tunnel mpls traffic-eng affinity 1
Router(config-if)# tunnel mpls traffic-eng bandwidth 5000
Router(config-if)# tunnel mpls traffic-eng path-option 1 explicit path1 attributes 1
Router(config-if)# tunnel mpls traffic-eng path-option 2 explicit path2 attributes 2
!
!
Router(config-if)# no tunnel mpls traffic-eng path-option 1 explicit path1 attributes 1
```

Configuring a Path Option for Bandwidth Override: Examples

This section contains the following examples for configuring a path option for bandwidth override:

Path Option for Bandwidth Override and LSP Attribute List Configuration Command Examples

The following are examples of the Cisco IOS command-line interface (CLI) to use when you configure a path option to override the bandwidth:

```
Router(config-if)# tunnel mpls traffic-eng path-option 3 explicit name path1 ?

       attributes Specify an LSP attribute list
       bandwidth  override the bandwidth configured on the tunnel
       lockdown   not a candidate for reoptimization
       <cr>

Router(config-if)# tunnel mpls traffic-eng path-option 3 explicit name path1 bandwidth ?

       <0-4294967295>  bandwidth requirement in kbps
       sub-pool        tunnel uses sub-pool bandwidth

Router(config-if)# tunnel mpls traffic-eng path-option 3 explicit name path1 bandwidth 500
?
       lockdown   not a candidate for reoptimization
       <cr>
```

Note Once you configure bandwidth as a path-option parameter, you can no longer configure an LSP attribute list as a path-option parameter.

Configuring Fallback Bandwidth Path Options for TE Tunnels: Example

The following example shows multiple path options configured with the **tunnel mpls traffic-eng path-option** command:

```
interface Tunnel 1
 ip unnumbered Loopback0
 tunnel destination 10.10.10.12
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name path1
 tunnel mpls traffic-eng path-option 2 explicit name path2 bandwidth 500
 tunnel mpls traffic-eng path-option 3 dynamic bandwidth 0
end
```

The device selects a path option for an LSP in order of preference, as follows:

- The device attempts to signal an LSP using path options starting with path-option 1.

  The device attempts to signal an LSP with the 1000 kbps bandwidth configured on the tunnel interface because path-option 1 has no bandwidth configured.

- If 1000 kbps bandwidth is not available over the network, the device attempts to establish an LSP using path-option 2.

  Path-option 2 has a bandwidth of 500 kbps configured. This reduces the bandwidth constraint from the original 1000 kbps configured on the tunnel interface.

- If 500 kbps is not available, the device attempts to establish an LSP using path-option 3.

  Path-option 3 is configured as dynamic and has bandwidth 0. The device establishes the LSP if an IP path exists to the destination and all other tunnel constraints are met.

Modifying the Bandwidth on a Path Option for Bandwidth Override: Example

The following example shows modifying the bandwidth on a path option for bandwidth override. Path-option 3 is changed to an explicit path with a bandwidth of 100 kbps. Path-option 4 is configured with bandwidth 0.

```
interface Tunnel 1
 ip unnumbered Loopback0
 tunnel destination 10.10.10.12
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name path1
 tunnel mpls traffic-eng path-option 2 explicit name path2 bandwidth 500
 tunnel mpls traffic-eng path-option 3 dynamic bandwidth 0
!
!
Router(config)# tunnel mpls traffic-eng path-option 3 explicit name path3 bandwidth 100

Router(config)# tunnel mpls traffic-eng path-option 4 dynamic bandwidth 0
```

Removing a Path Option for Bandwidth Override: Example

The following example shows removing a path option for bandwidth override:

```
interface Tunnel 1
 ip unnumbered Loopback0
 tunnel destination 10.10.10.12
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng bandwidth 1000
 tunnel mpls traffic-eng path-option 1 explicit name path1
 tunnel mpls traffic-eng path-option 2 explicit name path2 bandwidth 500
 tunnel mpls traffic-eng path-option 3 explicit name path3 bandwidth 100
 tunnel mpls traffic-eng path-option 4 dynamic bandwidth 0
!
Router(config)# no tunnel mpls traffic-eng path-option 3 explicit name path3 bandwidth 100
```

Additional References

The following sections provide references related to the MPLS Traffic Engineering—LSP Attributes feature.

Related Documents

Related Topic	Document Title
MPLS TE automatic bandwidth adjustment for TE tunnels configuration tasks	*MPLS Traffic Engineering (TE)—Automatic Bandwidth Adjustment for TE Tunnels*
MPLS TE configuration tasks	Part 3: MPLS Traffic Engineering in the *Cisco IOS Multiprotocol Label Switching Configuration Guide*, Release 12.4
MPLS TE command descriptions	*Cisco IOS Multiprotocol Label Switching Command Reference*, Release 12.2SR

Standards

Standards	Title
None	—

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
None	—

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register on Cisco.com.	http://www.cisco.com/techsupport

Command Reference

This section documents modified commands only.

- **affinity (LSP Attributes)**
- **auto-bw (LSP Attributes)**
- **bandwidth (LSP Attributes)**
- **exit (LSP Attributes)**
- **list (LSP Attributes)**
- **lockdown (LSP Attributes)**
- **mpls traffic-eng lsp attributes**
- **priority (LSP Attributes)**
- **protection (LSP Attributes)**
- **record-route (LSP Attributes)**
- **show mpls traffic-eng lsp attributes**
- **show mpls traffic-eng tunnels**

affinity (LSP Attributes)

To specify attribute flags for links of a label switched path (LSP) in an LSP attribute list, use the **affinity** command in LSP Attributes configuration mode. To remove the specified attribute flags, use the **no** form of this command.

affinity *value* [**mask** *value*]

no affinity

Syntax Description

value	Attribute flag value required for links that make up an LSP. Values of the bits are either 0 or 1.
mask *value*	(Optional) Indicates which attribute values should be checked. If a bit in the mask is 0, an attribute value of the link or that bit is irrelevant. If a bit in the mask is 1, the attribute value of that link and the required affinity of the tunnel for that bit must match.

Command Default

Attribute values are not checked.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to set the affinity and affinity mask values for an LSP in an LSP attribute list.

The affinity value determines the attribute flags for links that make up the LSP, either 0 or 1. The attribute mask determines which attribute value the router should check. If a bit in the mask is 0, an attribute value of a link or that bit is irrelevant. If a bit in the mask is 1, the attribute value of a link and the required affinity of the LSP for that bit must match.

An LSP can use a link if the link affinity equals the attribute flag value and the affinity mask value.

Any value set to 1 in the affinity should also be set to 1 in the mask.

To associate the LSP affinity attribute and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

Examples

The following example sets the affinity values for a path option in an LSP attribute list:

```
configure terminal
!
mpls traffic-eng lsp attributes 1
 affinity 0 mask 0
 exit
end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

auto-bw (LSP Attributes)

To specify automatic bandwidth configuration for a label switched path (LSP) in an LSP attribute list, use the **auto-bw** command in LSP Attributes configuration mode. To remove automatic bandwidth configuration, use the **no** form of this command.

auto-bw [**frequency** *secs*] [**max-bw** *kbps*] [**min-bw** *kbps*] [**collect-bw**]

no auto-bw

Syntax Description

frequency *secs*	(Optional) Interval between bandwidth adjustments. The specified interval can be from 300 to 604800 seconds.
max-bw *kbps*	(Optional) Maximum automatic bandwidth for the path option. The value can be from 0 to 4294967295 kilobits per second (kbps).
min-bw *kbps*	(Optional) Minimum automatic bandwidth for the path option. The value is from 0 to 4294967295 kilobits per second (kbps).
collect-bw	(Optional) Collects output rate information for the path option, but does not adjust its bandwidth.

Command Default

If the command is entered with no optional keywords, automatic bandwidth adjustment for the LSP is enabled, with adjustments made every 24 hours and with no constraints on the bandwidth adjustments made.
If the **collect-bw** keyword is entered, the bandwidth is sampled but not adjusted, and the other options, if any, are ignored.
If the **collect-bw** keyword is not entered and some, but not all of the other keywords are entered, the defaults for the keywords not entered are: **frequency**, every 24 hours; **min-bw**, unconstrained (0); **max-bw**, unconstrained.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to set an automatic bandwidth configuration in an LSP attributes list.

To sample the bandwidth used by an LSP without automatically adjusting it, specify the **collect-bw** keyword in the **auto-bw** command in an LSP attribute list.

If you enter the **auto-bw** command without the **collect-bw** keyword, the bandwidth of the LSP is adjusted to the largest average output rate sampled for the LSP since the last bandwidth adjustment for the LSP was made.

To constrain the bandwidth adjustment that can be made to an LSP in an LSP attribute list, use the **max-bw** and/or **min-bw** keywords and specify the permitted maximum allowable bandwidth and/or minimum allowable bandwidth, respectively.

The **no** form of the **auto-bw** command disables bandwidth adjustment for the tunnel and restores the configured bandwidth for the LSP where configured bandwidth is determined as follows:

- If the LSP bandwidth was explicitly configured with the **mpls traffic-eng lsp attributes lsp-id bandwidth** command after the running configuration was written (if at all) to the startup configuration, the configured bandwidth is the bandwidth specified by that command.
- Otherwise, the configured bandwidth is the bandwidth specified for the tunnel in the startup configuration.

To associate the LSP automatic bandwidth adjustment attribute and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

Examples

The following example sets automatic bandwidth configuration for an LSP in an LSP attribute list:

```
configure terminal
!
mpls traffic-eng lsp attributes 1
 auto-bw
 exit
end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

bandwidth (LSP Attributes)

To configure label switched path (LSP) bandwidth in an LSP attribute list, use the **bandwidth** command in LSP Attributes configuration mode. To remove the configured bandwidth from the LSP attribute list, use the **no** form of this command.

bandwidth [**sub-pool** | **global**] *kbps*

no bandwidth

Syntax Description

sub-pool	Indicates a subpool path option.
global	(Optional) Indicates a global pool path option. Entering this keyword is not necessary, for all path options are from the global pool in the absence of the **sub-pool** keyword.
kbps	Number of kilobits per second set aside for the path option. The range is from 1 to 4294967295.

Command Default

The default bandwidth is 0.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to configure LSP bandwidth in the LSP attribute list. The bandwidth configured can be associated with both dynamic and explicit path options.

To associate the LSP bandwidth and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

The bandwidth configured in the LSP attribute list will override the bandwidth configured on the tunnel.

Examples

The following example shows how to set the LSP bandwidth to 5000 kbps in the LSP attribute list identified with the numeral 2:

```
configure terminal
!
mpls traffic-eng lsp attributes 2
 bandwidth 5000
 exit
end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

exit (LSP Attributes)

To exit from the label switched path (LSP) attribute list, use the **exit** command in LSP Attributes configuration mode.

exit

Syntax Description

This command has no arguments or keywords.

Command Default

No default behavior or values.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command after you have configured LSP-related attributes for a traffic engineering (TE) tunnel to exit the LSP attribute list and the LSP Attributes configuration mode.

Examples

The following example shows how to set up an LSP attribute list and exit the LSP Attributes configuration mode when the list is complete:

```
Router(config)# mpls traffic-eng lsp attributes 1

Router(config-lsp-attr)# priority 7 7

Router(config-lsp-attr)# affinity 0 0

Router(config-lsp-attr)# exit
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

list (LSP Attributes)

To display the contents of a label switched path (LSP) attribute list, use the **list** command in LSP Attributes configuration mode.

list

Syntax Description

This command has no arguments or keywords.

Command Default

No default behavior or values.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

This command displays the contents of the LSP attribute list. You can display each of the following configurable LSP attributes using the **list** command: affinity, auto-bw, bandwidth, lockdown, priority, protection, and record-route.

Examples

The following example shows how to display the contents of an LSP attribute list identified with the string priority:

```
!
Router(config)# mpls traffic-eng lsp attributes priority

Router(config-lps-attr)# priority 0 0

Router(config-lps-attr)# list

LIST priority
 priority 0 0

Router(config-lsp-attr)#
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

lockdown (LSP Attributes)

To disable reoptimization of the label switched path (LSP), use the **lockdown** command in LSP Attributes configuration mode. To reenable reoptimization, use the **no** form of this command.

lockdown

no lockdown

Syntax Description

This command has no arguments or keywords.

Command Default

Reoptimization of the LSP is enabled.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to set up in an LSP attribute list the disabling of reoptimization of an LSP triggered by a timer, or the issuance of the **mpls traffic-eng reoptimize** command, or a configuration change that requires the resignalling of an LSP.

To associate the LSP lockdown attribute and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

Examples

The following example shows how to configure disabling of reoptimization in an LSP attribute list:

```
Configure terminal
!
mpls traffic-eng lsp attributes 4
 bandwidth 1000
 priority 1 1
 lockdown
 end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

mpls traffic-eng lsp attributes

To create or modify a label switched path (LSP) attribute list, use the **mpls traffic-eng lsp attributes** command in global configuration mode. To remove a specified LSP attribute list from the device configuration, use the **no** form of this command.

mpls traffic-eng lsp attributes *string*

no mpls traffic-eng lsp attributes *string*

Syntax Description

string	LSP attributes list identifier.

Command Default

An LSP attribute list is not created unless you create one.

Command Modes

Global configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

This command sets up an LSP attribute list and enters LSP Attributes configuration mode, in which you can enter LSP attributes.

To associate the LSP attributes and LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

An LSP attribute referenced by the path option takes precedence over the values configured on the tunnel interface. If an attribute is not specified in the LSP attribute list, the devices takes the attribute from the tunnel configuration. LSP attribute lists do not have default values. If the attribute is not configured on the tunnel, then the device uses tunnel default values.

Once you type the **mpls traffic-eng lsp attributes** command, you enter the LSP Attributes configuration mode where you define the attributes for the LSP attribute list that you are creating.

The mode commands are as follows:

- **affinity**—Specifies attribute flags for links that make up an LSP.
- **auto-bw**—Specifies automatic bandwidth configuration.
- **bandwidth**—Specifies LSP bandwidth.
- **lockdown**—Disables reoptimization for the LSP.
- **priority**—Specifies LSP priority.
- **protection**—Enables failure protection.

- **record-route**—Records the route used by the LSP.

The following monitoring and management commands are also available in the LSP Attributes configuration mode:

- **exit**—Exits from LSP Attributes configuration mode.
- **list**—Relists all the entries in the LSP attribute list.
- **no**—Removes a specific attribute from the LSP attribute list.

Examples

The following example shows how to set up an LSP attribute list identified with the numeral 6 with the **bandwidth** and **priority** mode commands. The example also shows how to use the **list** mode command:

```
Router(config)# mpls traffic-eng lsp attributes 6

Router(config-lsp-attr)# bandwidth 500

Router(config-lsp-attr)# list

LIST 6
 bandwidth 500

Router(config-lsp-attr)# priority 1 1

Router(config-lsp-attr)# list

LIST 6
 bandwidth 500
 priority 1 1

Router(config-lsp-attr)# exit
```

Related Commands

Command	Description
show mpls traffic-eng lsp attributes	Displays global LSP attributes lists.

priority (LSP Attributes)

To specify the label switched path (LSP) priority in an LSP attribute list, use the **priority** command in LSP Attributes configuration mode. To remove the specified priority, use the **no** form of this command.

priority *setup-priority* [*hold-priority*]

no priority

Syntax Description

setup-priority	Priority used when signaling an LSP to determine which existing LSPs can be preempted. Valid values are from 0 to 7, where a lower number indicates a higher priority. Therefore, an LSP with a setup priority of 0 can preempt any LSP with a non-0 priority.
hold-priority	(Optional) Priority associated with an LSP to determine if it should be preempted by other LSPs that are being signaled. Valid values are from 0 to 7, where a lower number indicates a higher priority.

Command Default

No priority is set in the attribute list.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to configure setup and hold priority for an LSP in an LSP attribute list. Setup priority and hold priority are typically configured to be equal, and setup priority cannot be better (numerically smaller) than the hold priority.

To associate the LSP priority attribute and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

Examples

The following example shows how to set the LSP hold and setup property to 0 in an LSP attribute list identified by the string hipriority:

```
configure terminal
!
mpls traffic-eng lsp attributes hipriority
 priority 0 0
 exit
end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

protection (LSP Attributes)

To configure failure protection on the label switched path (LSP) in an LSP attribute list, use the **protection** command in LSP Attributes configuration mode. To disable failure protection, use the **no** form of this command.

protection fast-reroute

no protection

Syntax Description

fast-reroute	Enables an LSP to use an established backup LSP in the event of a link failure.

Command Default

Failure protection is not enabled for the LSP in the LSP attribute list.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to set up LSP failure protection in an LSP attribute list.

To associate the LSP failure protection attribute and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

Examples

The following example shows how to enable failure protection on an LSP in an LSP attribute list:

```
configure terminal
!
mpls traffic-eng lsp attributes protect
 protection fast-reroute
 exit
end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

record-route (LSP Attributes)

To record the route used by the label switched path (LSP), use the **record-route** command in LSP Attributes configuration mode. To stop the recording the route used by the LSP, use the **no** form of this command.

record-route

no record-route

Syntax Description

This command has no arguments or keywords.

Command Default

The LSP route is not recorded.

Command Modes

LSP Attributes configuration

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to set up in an LSP attribute list the recording of the route taken by the LSP.

To associate the LSP record-route attribute and the LSP attribute list with a path option for an LSP, you must configure the **tunnel mpls traffic-eng path option** command with the **attributes** *string* keyword and argument, where *string* is the identifier for the specific LSP attribute list.

Examples

The following example shows how to set up LSP route recording in an LSP attribute list:

```
configure terminal
!
mpls traffic-eng lsp attributes 9
 record-route
 exit
end
```

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.
show mpls traffic-eng lsp attributes	Displays global LSP attribute lists.

show mpls traffic-eng lsp attributes

To display global label switched path (LSP) attribute lists, use the **show mpls traffic-eng lsp attributes** command in privileged EXEC mode.

show mpls traffic-eng lsp attributes [*string*]

Syntax Description

string	Identifies a specific LSP attribute list.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.0(26)S	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

Use this command to display information about all LSP attribute lists or a specific LSP attribute list.

Examples

The following example shows output from the **show mpls traffic-eng lsp attributes** command:

```
Router# show mpls traffic-eng lsp attributes

LIST 1
  affinity 1 mask 1
  bandwidth 1000
  priority 1 1
LIST 2
  bandwidth 5000
LIST hipriority
  priority 0 0
!
.
.
.
Router#
```

Table 1 describes the significant fields shown in the display.

Table 1 show mpls traffic-eng lsp attributes Field Descriptions

Field	Description
LIST *xxx*	The *xxx* identifies the LSP attribute list.
affinity	LSP attribute that specifies attribute flags for LSP links.Values are 0 or 1.
mask	Indicates which attribute values should be checked.

Table 1 show mpls traffic-eng lsp attributes Field Descriptions (continued)

Field	Description
bandwidth	LSP attribute that specifies LSP bandwidth.
priority	LSP attribute that specifies LSP priority.

Related Commands

Command	Description
mpls traffic-eng lsp attributes	Creates or modifies an LSP attribute list.

show mpls traffic-eng tunnels

To display information about tunnels, use the **show mpls traffic-eng tunnels** command in user EXEC or privileged EXEC mode.

show mpls traffic-eng tunnels
[**tunnel** *number*]
[**accounting**]
[**attributes**]
[**backup** | **brief** | **protection**]
[**destination** *address*]
[**interface in** *phys-intf*] [**interface out** *phys-intf* | **interface** *phys-intf*]
[**name** *name*]
[**name-regexp** *reg-exp*]
[**property** {**auto-tunnel** | **backup-tunnel** | **fast-reroute**}]
[**role** {**all** | **head** | **middle** | **tail** | **remote**}]
[**source-id** {*num* | *ipaddress* | *ipaddress num*}]
[**statistics**]
[**suboptimal constraints** {**none** | **current** | **max**}]
[**summary**]
[**up** | **down**]

Syntax Description

tunnel *number*	(Optional) Restricts the display to the specified tunnel interface.
accounting	(Optional) Displays accounting information (the rate of the traffic flow) for tunnels.
attributes	(Optional) Restricts the display to tunnels that use a matching attributes list.
backup	(Optional) Displays information about the Fast Reroute protection provided by each tunnel selected by other options specified with this command. The information includes the physical interface protected by the tunnel, the number of traffic engineering (TE) label-switched packets (LSPs) (that is, tunnels) protected, and the bandwidth protected.
brief	(Optional) Specifies a format with one line per tunnel.
protection	(Optional) Displays information about the protection provided by each tunnel selected by other options specified with this command. The information includes whether protection is configured for the tunnel, the protection (if any) provided to the tunnel by this router, and the bandwidth protected.
destination *address*	(Optional) Restricts the display to tunnels destined to the specified IP address.
interface in *phys-intf*	(Optional) Displays information for the specified input interface.
interface out *phys-intf*	(Optional) Displays information for the specified output interface.
interface *phys-intf*	(Optional) Displays tunnels that use the specified interface as an input or output interface.
name *name*	(Optional) Displays tunnel with the specified string. The tunnel string is derived from the interface description, if specified; otherwise, it is the interface name. The tunnel string is included in the signaling message so that it is available at all hops.

name-regexp *regexp*	(Optional) Displays tunnels whose descriptions match the specified regular expression.
property auto-tunnel	(Optional) Displays information about autotunnels.
property backup-tunnel	(Optional) Selects Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnels being used to protect physical interfaces on this router. A tunnel configured to protect a link against failure is a backup tunnel and has the backup tunnel property.
property fast-reroute	(Optional) Selects Fast Reroute-protected MPLS TE tunnels originating, transmitting, or terminating on this router.
role	(Optional) Restricts the display to tunnels with the indicated role (all, head, middle, tail, or remote).
all	Displays all tunnels.
head	Displays tunnels with their head at this router.
middle	Displays tunnels with a midpoint at this router.
tail	Displays tunnels with a tail at this router.
remote	Displays tunnels with their head at some other router; this is a combination of **middle** and **tail**.
source-id	(Optional) Restricts the display to tunnels with a matching source IP address or tunnel number.
num	Tunnel number.
ipaddress	Source IP address.
ipaddress num	Source IP address and tunnel number.
statistics	(Optional) Displays tunnel counters and statistics.
suboptimal constraints none	(Optional) Displays tunnels whose path metric is greater than the shortest unconstrained path. Selected tunnels have a longer path than the Interior Gateway Protocol's (IGP) shortest path.
suboptimal constraints current	(Optional) Displays tunnels whose path metric is greater than the current shortest path, constrained by the tunnel's configured options. Selected tunnels would have a shorter path if they were reoptimized immediately.
suboptimal constraints max	(Optional) Displays information for the specified tunneling interface.
summary	(Optional) Displays summary information about tunnels that provide Fast Reroute protection.
up	(Optional) Displays tunnels if the tunnel interface is up. Tunnel midpoints and tails are typically up or not present.
down	(Optional) Displays tunnels that are down.

Defaults

If you specify this command without any arguments or keywords, the command displays general information about each MPLS TE tunnel known to the router.

Command Modes

User EXEC
Privileged EXEC

Command History

Release	Modification
12.0(5)S	This command was introduced.
12.1(3)T	Input and output interface information was added to the new **brief** form of the output. The **suboptimal** and **interface** keywords were added to the nonbrief format. The nonbrief, nonsummary formats contain the history of the LSP selection.
12.0(10)ST	This command was integrated into Cisco IOS Release 12.0(10)ST.
12.0(22)S	The **property** and **protection** keywords were added. The command is supported on the Cisco 10000 series routers.
12.2(18)S	The following keywords were added: **accounting**, **attributes**, **property auto-tunnel**, and **name-regexp**. The **property backup** keyword was changed to **property backup-tunnel**.
12.2(18)SXD1	This command was integrated into Cisco IOS Release 12.2(18)SXD1.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

To select the tunnels for which information is displayed, use the **tunnel**, **attributes**, **destination**, **name**, **name-regexp**, **source-id**, **role**, **up**, **down**, **name**, **suboptimal constraints**, **interface,** and **property** keywords and options singly or combined.

To select the type of information displayed about the selected tunnels, use the **accounting**, **backup**, **protection**, **statistics**, and **summary** keywords.

The **tunnel** and **property** keywords display the same information, except that the **property** keyword restricts the display to autotunnels, backup tunnels, or tunnels that are Fast Reroute-protected.

The **name-regexp** keyword displays output for each tunnel whose name contains a specified string. For example, if there are tunnels named iou-100_t1, iou-100_t2, and iou-100_t100, the following command displays output for the three tunnels whose name contains the string iou-100.

```
Router# show mpls traffic-eng tunnels name-regexp iou-100
```

If you specify the **name** keyword, there is command output only if the command name is an exact match. For example: iou-100_t1.

Examples

The following is sample output from the **show mpls traffic-eng tunnels brief** command. It displays brief information about every MPLS TE tunnel known to the router.

```
Router# show mpls traffic-eng tunnels brief 500

Signalling Summary:
    LSP Tunnels Process:            running
    RSVP Process:                   running
    Forwarding:                     enabled
    Periodic reoptimization:        every 3600 seconds, next in 1706 seconds
TUNNEL NAME                      DESTINATION      UP IF     DOWN IF   STATE/PROT
Router_t1                        10.112.0.12      -         PO4/0/1   up/up
Router_t2                        10.112.0.12      -         unknown   up/down
Router_t3                        10.112.0.12      -         unknown   admin-down
Router_t1000                     10.110.0.10      -         unknown   up/down
Router_t2000                     10.110.0.10      -         PO4/0/1   up/up
Displayed 5 (of 5) heads, 0 (of 0) midpoints, 0 (of 0) tails
```

Table 2 describes the significant fields shown in the displays.

Table 2 show mpls traffic-eng tunnels Field Descriptions

Field	Description
LSP Tunnels Process	Status of the LSP tunnels process.
RSVP Process	Status of the Resource Reservation Protocol (RSVP) process.
Forwarding	Status of forwarding (enabled or disabled).
Periodic reoptimization	Schedule for periodic reoptimization (in seconds).
TUNNEL NAME	Name of the interface that is configured at the tunnel head.
DESTINATION	Identifier of the tailend router.
UP IF	Upstream interface that the tunnel used.
DOWN IF	Downstream interface that the tunnel used.
STATE/PROT	For tunnel heads, admin-down. up, or down. For nonheads, signaled.

The following is sample output from the **show mpls traffic-eng tunnels property backup brief** command. It displays brief information about all MPLS TE tunnels acting as Fast Reroute backup tunnels (**property backup**) for interfaces on the router.

```
Router# show mpls traffic-eng tunnels property backup brief

Signalling Summary:
    LSP Tunnels Process:            running
    RSVP Process:                   running
    Forwarding:                     enabled
    Periodic reoptimization:        every 3600 seconds, next in 2231 seconds
    Periodic FRR Promotion:         every 300 seconds, next in 131 seconds
    Periodic auto-bw collection:    disabled
TUNNEL NAME                     DESTINATION      UP IF     DOWN IF   STATE/PROT
Router_t2000                    10.110.0.10      -         PO4/0/1   up/up
Router_t2                       10.112.0.12      -         unknown   up/down
Router_t3                       10.112.0.12      -         unknown   admin-down
Displayed 3 (of 9) heads, 0 (of 1) midpoints, 0 (of 0) tails
```

The following is sample output from the **show mpls traffic-eng tunnels backup** command. This command selects every MPLS TE tunnel known to the router and displays information about the Fast Reroute protection each selected tunnels provides for interfaces on this router; the command does not generate output for tunnels that do not provide Fast Reroute protection of interfaces on this router.

```
Router# show mpls traffic-eng tunnels backup

Router_t578
  LSP Head, Tunnel578, Admin: up, Oper: up
  Src 10.55.55.55, Dest 10.88.88.88, Instance 1
  Fast Reroute Backup Provided:
    Protected i/fs: PO1/0, PO1/1, PO3/3
    Protected lsps: 1
    Backup BW: any pool unlimited; inuse: 100 kbps
Router_t5710
  LSP Head, Tunnel5710, Admin: admin-down, Oper: down
  Src 10.55.55.55, Dest 192.168.7.7, Instance 0
  Fast Reroute Backup Provided:
    Protected i/fs: PO1/1
```

```
    Protected lsps: 0
    Backup BW: any pool unlimited; inuse: 0 kbps
Router_t5711
  LSP Head, Tunnel5711, Admin: up, Oper: up
  Src 10.55.55.55, Dest 10.7.7.7, Instance 1
  Fast Reroute Backup Provided:
    Protected i/fs: PO1/0
    Protected lsps: 2
    Backup BW: any pool unlimited; inuse: 6010 kbps
```

The following is sample output from the **show mpls traffic-eng tunnels property fast-reroute protection** command. This command selects every MPLS TE tunnel known to the router that was signaled as a Fast Reroute-protected LSP (**property fast-reroute**) and displays information about the protection this router provides each selected tunnel.

```
Router# show mpls traffic-eng tunnels property fast-reroute protection

Router_t1
  LSP Head, Tunnel1, Admin: up, Oper: up
  Src 10.55.55.55, Dest 10.88.88.88, Instance 25
  Fast Reroute Protection: Requested
    Outbound: FRR Ready
      Backup Tu5711 to LSP nhop
        Tu5711: out i/f: PO1/1, label: implicit-null
      LSP signalling info:
        Original: out i/f: PO1/0, label: 12304, nhop: 10.1.1.7
        With FRR: out i/f: Tu5711, label: 12304
      LSP bw: 6000 kbps, Backup level: any unlimited, type: any pool
Router_t2
  LSP Head, Tunnel2, Admin: up, Oper: up
  Src 10.55.55.55, Dest 10.88.88.88, Instance 2
  Fast Reroute Protection: Requested
    Outbound: FRR Ready
      Backup Tu578 to LSP nhop
        Tu578: out i/f: PO1/0, label: 12306
      LSP signalling info:
        Original: out i/f: PO3/3, label: implicit-null, nhop: 10.3.3.8
        With FRR: out i/f: Tu578, label: implicit-null
      LSP bw: 100 kbps, Backup level: any unlimited, type: any pool
r9_t1
  LSP Midpoint, signalled, connection up
  Src 10.9.9.9, Dest 10.88.88.88, Instance 2347
  Fast Reroute Protection: Requested
    Inbound:  FRR Inactive
      LSP signalling info:
        Original: in i/f: PO1/2, label: 12304, phop: 10.205.0.9
    Outbound: FRR Ready
      Backup Tu5711 to LSP nhop
        Tu5711: out i/f: PO1/1, label: implicit-null
      LSP signalling info:
        Original: out i/f: PO1/0, label: 12305, nhop: 10.1.1.7
        With FRR: out i/f: Tu5711, label: 12305
      LSP bw: 10 kbps, Backup level: any unlimited, type: any pool
```

The following is sample output from the **show mpls traffic-eng tunnels tunnel** command. This command displays information about just a single tunnel.

```
Router# show mpls traffic-eng tunnels tunnel 1

Name: swat76k1_t1                         (Tunnel1) Destination: 1.0.0.4
   Status:
     Admin: admin-down Oper: down   Path: not valid   Signalling: Down
     path option 1, type explicit gi7/4-R4
```

```
   Config Parameters:
     Bandwidth: 0        kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
     Metric Type: TE (default)
     AutoRoute:  disabled  LockDown: disabled  Loadshare: 0        bw-based
     auto-bw: disabled

   Shortest Unconstrained Path Info:
     Path Weight: 2 (TE)
     Explicit Route: 10.1.0.1 10.1.0.2 172.0.0.1 192.0.0.4
   History:
     Tunnel:
       Time since created: 13 days, 52 minutes
       Number of LSP IDs (Tun_Instances) used: 0 swat76k1#

swat76k1#sh mpls traf tun property ?
   auto-tunnel    auto-tunnel created tunnels
   backup-tunnel  Tunnels used as fast reroute
   fast-reroute   Tunnels protected by fast reroute
```

The following is sample output from the **show mpls traffic-eng tunnels accounting** command. This command displays the rate of the traffic flow for the tunnels.

```
Router# show mpls traffic-eng tunnels accounting

Tunnel1 (Destination 103.103.103.103; Name iou-100_t1)
 5 minute output rate 0 kbits/sec, 0 packets/sec
Tunnel2 (Destination 103.103.103.103; Name iou-100_t2)
 5 minute output rate 0 kbits/sec, 0 packets/sec Tunnel100 (Destination 10.101.101.101;
Name iou-100_t100)
 5 minute output rate 0 kbits/sec, 0 packets/sec Totals for 3 Tunnels
 5 minute output rate 0 kbits/sec, 0 packets/sec
```

Related Commands

Command	Description
mpls traffic-eng reoptimize timers frequency	Controls the frequency with which tunnels with established LSPs are checked for better LSPs.
mpls traffic-eng tunnels (configuration)	Enables MPLS traffic engineering tunnel signaling on a device.
mpls traffic-eng tunnels (interface)	Enables MPLS traffic engineering tunnel signaling on an interface.

Feature Information for MPLS Traffic Engineering—LSP Attributes

Table 3 lists the release history for this feature.

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

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

Note Table 3 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 3 Feature Information for MPLS Traffic Engineering—LSP Attributes

Feature Name	Releases	Feature Information
MPLS Traffic Engineering—LSP Attributes	12.0(26)S 12.2(33)SRA 12.2(33)SXH	This document describes how to configure label switched path (LSP) attributes for path options associated with Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnels. The MPLS Traffic Engineering—LSP Attributes feature is an extension to MPLS TE that provides an LSP Attribute List feature and a Path Option for Bandwidth Override feature. These features provide flexibility in the configuration of LSP attributes for MPLS TE tunnel path options. Several LSP attributes can be applied to path options for TE tunnels using an LSP attribute list. If bandwidth is the only LSP attribute you require, then you can configure a path option for bandwidth override. In 12.0(26)S, this feature was introduced. In 12.2(33)SRA, this feature was integrated into a 12.2SRA release. In 12.2(33)SXH, this feature was integrated into a 12.2SXH release. The following sections provide information about this feature: • MPLS Traffic Engineering—LSP Attributes Benefits, page 2 • Traffic Engineering Bandwidth and Bandwidth Pools, page 3 • LSP Attribute Lists Usage and Management, page 3 • Autobandwidth and Path Option for Bandwidth Override, page 4

Table 3 Feature Information for MPLS Traffic Engineering—LSP Attributes (continued)

Feature Name	Releases	Feature Information
		• Path Option Selection for MPLS TE Tunnel LSPs, page 4 • Configuring LSP Attribute Lists, page 6 • Configuring a Path Option for Bandwidth Override, page 26 The following commands were introduced or modified by this feature: **affinity** (LSP Attributes), **auto-bw** (LSP Attributes), **bandwidth** (LSP Attributes), **exit** (LSP Attributes), **list** (LSP Attributes), **lockdown** (LSP Attributes), **mpls traffic-eng lsp attributes**, **priority** (LSP Attributes), **protection** (LSP Attributes), **record-route** (LSP Attributes), **show mpls traffic-eng lsp attributes**, and **show mpls traffic-eng tunnels**.

Glossary

bandwidth—The difference between the highest and lowest frequencies available for network signals. The term also is used to describe the rated throughput capacity of a given network medium or protocol. The frequency range necessary to convey a signal measured in units of hertz (Hz). For example, voice signals typically require approximately 7 kHz of bandwidth and data traffic typically requires approximately 50 kHz of bandwidth.

bandwidth reservation—The process of assigning bandwidth to users and applications served by a network. This process involves assigning priority to different flows of traffic based on how critical and delay-sensitive they are. This makes the best use of available bandwidth, and if the network becomes congested, lower-priority traffic can be dropped. Sometimes called bandwidth allocation

global pool—The total bandwidth allocated to an MPLS traffic engineering link.

label switched path (LSP) tunnel—A configured connection between two routers, using label switching to carry the packets.

LSR—label switch router. A Multiprotocol Label Switching (MPLS) node that can forward native Layer 3 packets. The LSR forwards a packet based on the value of a label attached to the packet.

MPLS TE—MPLS traffic engineering (formerly known as “RRR” or Resource Reservation Routing). The use of label switching to improve traffic performance along with an efficient use of network resources.

subpool—The more restrictive bandwidth in an MPLS traffic engineering link. The subpool is a portion of the link's overall global pool bandwidth.

TE—traffic engineering. The techniques and processes used to cause routed traffic to travel through the network on a path other than the one that would have been chosen if standard routing methods had been used. The application of scientific principles and technology to measure, model, and control internet traffic in order to simultaneously optimize traffic performance and network resource utilization.

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

tunnel—A secure communication path between two peers, such as two routers.

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