MPLS Traffic Engineering—AutoTunnel Mesh Groups

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This document shows how to configure autotunnel mesh groups for Multiprotocol Label Switching (MPLS) traffic engineering (TE) label switch routers (LSRs).

The MPLS Traffic Engineering—AutoTunnel Mesh Groups feature allows a network administrator to configure TE label-switched paths (LSPs) by using a few command-line interface (CLI) commands.

In a network topology where edge TE LSRs are connected by core LSRs, the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature automatically constructs a mesh of TE LSPs among the provider edge (PE) routers.

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—AutoTunnel Mesh Groups" section on page 42.

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—AutoTunnel Mesh Groups

- Be knowledgeable about MPLS TE. See the "Additional References" section on page 17.
- Decide how you will set up autotunnels (that is, identify the tunnel commands that you will include in the template interface).
- Identify a block of addresses that you will reserve for mesh tunnel interfaces.

Restrictions for MPLS Traffic Engineering—AutoTunnel Mesh Groups

- Mesh groups do not support interarea tunnels because the destinations of those tunnels do not exist in the local area TE database.
- You cannot enable autotunnel mesh groups on a router that is also configured with stateful switchover (SSO) redundancy. This restriction does not prevent an MPLS TE tunnel that is automatically configured via TE Autotunnel from being successfully recovered on a midpoint router along the LSP's path if that router experiences an SSO switchover.

Information About MPLS Traffic Engineering—AutoTunnel Mesh Groups

To configure autotunnel mesh groups, you need information about the following:

- AutoTunnel Mesh Groups Description and Benefits, page 2
- Access Lists for Mesh Tunnel Interfaces, page 3
- AutoTunnel Template Interfaces, page 3
- OSPF Flooding of Mesh Group Information, page 4

AutoTunnel Mesh Groups Description and Benefits

An autotunnel mesh group (referred to as a mesh group) is a set of connections between edge LSRs in a network. There are two types of mesh groups:

- Full—All the edge LSRs are connected. Each PE router has a tunnel to each of the other PE routers.
- Partial—Some of the edge LSRs are not connected to each other by tunnels.

In a network topology where edge TE LSRs are connected by core LSRs, the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature automatically constructs a mesh of TE LSPs among the provider edge (PE) routers.

Initially, you must configure each existing TE LSR to be a member of the mesh by using a minimal set of configuration commands. When the network grows (that is, when one or more TE LSRs are added to the network as PE routers), you do not need to reconfigure the existing TE LSR members of that mesh.

Mesh groups have the following benefits:

- Minimize the initial configuration of the network. You configure one template interface per mesh, and it propagates to all mesh tunnel interfaces, as needed.

- Minimize future configurations resulting from network growth. The feature eliminates the need to reconfigure each existing TE LSR to establish a full mesh of TE LSPs whenever a new PE router is added to the network.

- Enable existing routers to set up TE LSPs to new PE routers.

- Enable the construction of a mesh of TE LSPs among the PE routers automatically.

Access Lists for Mesh Tunnel Interfaces

The access list determines the destination addresses for the mesh tunnel interfaces. It is useful if you preallocate a block of related IP addresses. You can use that block of addresses to control the PE routers to which a full or partial mesh of TE tunnel LSPs is established. The access list allows matches for only the addresses that are learned and stored in the TE topology database.

For example, you can create an access list that matches all 10.1.1.1 IP addresses. You configure a template with the access list, then the template creates mesh tunnel interfaces to destinations within the TE topology database that match destinations in that access list.

Whenever the TE topology database is updated (for example, when a new TE LSR is inserted into the IGP), the destination address is stored in the TE topology database of each router in the IGP. At each update, the Mesh Group feature compares the destination address contained in the database to IP addresses in the access list associated with all template interfaces. If there is a match, the Mesh Group feature establishes a mesh tunnel interface to the tunnel destination IP address.

AutoTunnel Template Interfaces

An autotunnel template interface is a logical entity; that is, it is a configuration for a tunnel interface that is not tied to specific tunnel interfaces. It can be applied dynamically, when needed.

Mesh tunnel interfaces are tunnel interfaces that are created, configured dynamically (for example, by the applying [or cloning] of a template interface), used, and then freed when they are no longer needed.

A mesh tunnel interface obtains its configuration information from a template, except for the tunnel's destination address, which it obtains from the TE topology database that matches an access list or from the IGP mesh group advertisement.

The template interface allows you to enter commands once per mesh group. These commands specify how mesh tunnel interfaces are created. Each time a new router is added to the network, a new mesh tunnel interface is created. The configuration of the interface is duplicated from the template. Each mesh tunnel interface has the same path constraints and other parameters configured on the template interface. Only the tunnel destination address is different.

OSPF Flooding of Mesh Group Information

A former release of the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature uses an address-based discovery to identify mesh group members. Cisco IOS Release 12.0(29)S introduces an Open Shortest Path First (OSPF)-based discovery for identifying mesh group members.

For OSPF to advertise or flood mesh group information, you need to configure a mesh group in OSPF and add that mesh group to an autotemplate interface. When the configuration is complete, OSPF advertises the mesh group IDs to all LSRs. MPLS TE LSPs automatically connect the edge LSRs in each mesh group. For configuration information, see the "Configuring IGP Flooding for Autotunnel Mesh Groups" section on page 14.

OSPF can advertise mesh group IDs for an OSPF area. OSPF is the only IGP supported in the Cisco IOS 12.0(29)S, 12,2(33)SRA, and 12.(33)SXH releases of the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature.

How to Configure MPLS Traffic Engineering—AutoTunnel Mesh Groups

Perform the following procedures to configure the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature:

- Configuring a Mesh of TE Tunnel LSPs, page 4 (required)
- Specifying the Range of Mesh Tunnel Interface Numbers, page 10 (optional)
- Showing Configuration Information About Tunnels, page 11 (optional)
- Monitoring Your Autotunnel Mesh Network, page 12 (required)
- Configuring IGP Flooding for Autotunnel Mesh Groups, page 14 (optional)

Configuring a Mesh of TE Tunnel LSPs

Perform the following tasks on each PE router in your network to configure a mesh of TE tunnel LSPs:

- Enabling Autotunnel Mesh Groups Globally, page 5
- Creating an Access List Using a Name, page 5
- Creating an Autotunnel Template Interface, page 7

Note You can perform these tasks in any order.

Enabling Autotunnel Mesh Groups Globally

Perform the following task to enable autotunnel mesh groups globally. Perform this task on all PE routers in your network that you want to be part of an autotunnel mesh group.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng auto-tunnel mesh**
4. **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 auto-tunnel mesh** **Example:** `Router(config)# mpls traffic-eng auto-tunnel mesh`	Enables autotunnel mesh groups globally.
Step 4	**end** **Example:** `Router(config)# end`	Exits to privileged EXEC mode.

Creating an Access List Using a Name

Perform the following task to create an access list using a name.

The access list determines the destination addresses for the mesh tunnel interfaces. You can use an access list to control the PE routers to which a full or partial mesh of TE tunnel LSPs is established. The access list allows matches for only the addresses that are learned and stored in the TE topology database.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list** {**standard** | **extended**} *access-list-name*

4. **permit** *source* [*source-wildcard*]

5. **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	**ip access-list** {**standard** | **extended**} *access-list-name* **Example:** Router(config)# ip access-list standard a1	Defines an IP access list using a name and enters standard named access list configuration mode. • The **standard** keyword specifies a standard IP access list. • The **extended** keyword specifies an extended IP access list. • The *access-list-name* argument is the name of the access list. A name cannot contain a space or quotation mark and must begin with an alphabetic character. This prevents confusion with numbered access lists.

	Command or Action	Purpose

Step 4	**permit** *source* [*source-wildcard*]
	
	Example:
	`Router(config-std-nacl)# permit 10.0.0.0 0.255.255.255`
		Sets conditions to allow a packet to pass a named IP access list.
		
		• The *source* argument is the number of the network or host from which the packet is being sent. There are three alternative ways to specify the source:
		
		  – Use a 32-bit quantity in four-part dotted decimal format.
		
		  – Use the **any** keyword as an abbreviation for a source and source-wildcard of 0.0.0.0 255.255.255.255.
		
		  – Use host source as an abbreviation for a source and source-wildcard of source 0.0.0.0.
		
		• The *source-wildcard* argument is the wildcard bits to be applied to source. There are three alternative ways to specify the source wildcard:
		
		  – Use a 32-bit quantity in four-part dotted decimal format. Place 1s in the bit positions you want to ignore.
		
		  – Use the **any** keyword as an abbreviation for a source and source-wildcard of 0.0.0.0 255.255.255.255.
		
		  – Use host source as an abbreviation for a source and source-wildcard of source 0.0.0.0.

Step 5	**end** **Example:** `Router(config-std-nacl)# end`	Exits to privileged EXEC mode.

Creating an Autotunnel Template Interface

Perform the following task to create an autotunnel template interface. This helps minimize the initial configuration of the network. You configure one template interface per mesh, and it propagates to all mesh tunnel interfaces, as needed.

> **Note** You can enter various commands. The commands shown below are used to create a minimal configuration.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface auto-template** *interface-num*
4. **ip unnumbered** *type number*
5. **tunnel mode** {**aurp** | **cayman** | **dvmrp** | **eon** | **gre** | **ipip** | **iptalk** | **mpls** | **nos**}

6. **tunnel mpls traffic-eng autoroute announce**

7. **tunnel mpls traffic-eng priority** *setup-priority* [*hold-priority*]

8. **tunnel mpls traffic-eng auto-bw** [**collect-bw**] [**frequency** *seconds*] [**max-bw** *kbps*] [**min-bw** *kbps*]

9. **tunnel mpls traffic-eng path-option** *number* {**dynamic** | **explicit** {**name** *path-name* | *path-number*}} [**lockdown**]

10. **tunnel destination access-list** *num*

11. **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 auto-template** *interface-num* **Example:** Router(config)# interface auto-template 1	Creates a template interface and enters interface configuration mode. • The *interface-num* argument is the interface number. Valid values are 1 to 25.
Step 4	**ip unnumbered** *type number* **Example:** Router(config-if)# ip unnumbered Loopback 0	Enables IP processing on an interface without assigning an explicit IP address to the interface. • The *type* and *number* arguments name the type and number of another interface on which the router has an assigned IP address. It cannot be another unnumbered interface.
Step 5	**tunnel mode** {**aurp**	**cayman**	**dvmrp**	**eon**	**gre**	**ipip**	**iptalk**	**mpls**	**nos**} **Example:** Router(config-if)# tunnel mode mpls	Sets the encapsulation mode for the tunnel interface.
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 algorithm (SPF) calculation.

	Command or Action	Purpose
Step 7	`tunnel mpls traffic-eng priority` *setup-priority* [*hold-priority*] **Example:** `Router(config-if)# tunnel mpls traffic-eng priority 1 1`	Configures the setup and reservation priority for an MPLS TE tunnel. • The *setup-priority* argument is the priority used when an LSP is signaled for this tunnel and determines which existing tunnels 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 the priority associated with an LSP for this tunnel and determines 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 8	`tunnel mpls traffic-eng auto-bw` [`collect-bw`] [`frequency` *seconds*] [`max-bw` *kbps*] [`min-bw` *kbps*] **Example:** `Router(config-if)# tunnel mpls traffic-eng auto-bw`	Configures a tunnel for automatic bandwidth adjustment and for control of the manner in which the bandwidth for a tunnel is adjusted. • The **collect-bw** keyword collects output rate information for the tunnel, but does not adjust the tunnel's bandwidth. • The **frequency** *seconds* keyword-argument pair is the interval between bandwidth adjustments. The specified interval can be from 300 to 604800 seconds. Do not specify a value lower than the output rate sampling interval specified in the **mpls traffic-eng auto-bw** command in global configuration mode. • The **max-bw** *kbps* keyword-argument pair is the maximum automatic bandwidth, in kbps, for this tunnel. The value can be from 0 to 4294967295. • The **min-bw** *kbps* keyword-argument pair is the minimum automatic bandwidth, in kbps, for this tunnel. The value can be from 0 to 4294967295.

	Command or Action	Purpose

Step 9	`tunnel mpls traffic-eng path-option` *number* `{`**dynamic** `|` **explicit** `{`**name** *path-name* `|` *path-number*`}}` `[`**lockdown**`]`
	
	Example:
	`Router(config-if)# tunnel mpls traffic-eng path-option 1 dynamic`
		Configures a path option for an MPLS TE tunnel.
		
		• The *number* argument is the number of the path option. When multiple path options are configured, lower numbered options are preferred.
		
		• The **dynamic** keyword specifies that the path of the LSP is dynamically calculated.
		
		• The **explicit** keyword specifies that the path of the LSP is an IP explicit path.
		
		• The **name** *path-name* keyword-argument pair is the path name of the IP explicit path that the tunnel uses with this option.
		
		• The *path-number* argument is the path number of the IP explicit path that the tunnel uses with this option.
		
		• The **lockdown** keyword specifies that the LSP cannot be reoptimized.
		
		Note The only meaningful keyword to use within an explicit-path that is linked to an Auto-Template is **exclude-address**.

Step 10	`tunnel destination access-list` *num* **Example:** `Router(config-if)# tunnel destination access-list 1`	Specifies the access list that the template interface uses for obtaining the mesh tunnel interface destination address. • The *num* argument is the number of the access list.

Step 11	`end`
	
	Example:
	`Router(config)# end`
		Exits to privileged EXEC mode.

Specifying the Range of Mesh Tunnel Interface Numbers

Perform the following task to specify the range of mesh tunnel interface numbers.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng auto-tunnel mesh tunnel-num min** *num* **max** *num*
4. **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 auto-tunnel mesh tunnel-num`
	`min num max num`
	
	Example:
	`Router(config)# mpls traffic-eng auto-tunnel`
	`mesh tunnel-num min 1000 max 2000`
		Configures the range of mesh tunnel interface numbers.
		
		• The **min** *num* keyword-argument pair specifies the beginning number of the range of mesh tunnel interface numbers. Valid values are from 1 to 65535.
		
		• The **max** *num* keyword-argument pair specifies the ending number of the range of mesh tunnel interface numbers. Valid values are from 1 to 65535.

Step 4	`end`
	
	Example:
	`Router(config)# end`
		Exits to privileged EXEC mode.

Showing Configuration Information About Tunnels

Perform the following task to show tunnel configuration information, such as tunnel interface and mesh tunnel configuration.

SUMMARY STEPS

1. **enable**
2. **show running interface auto-template** *num*
3. **show interface tunnel** *num* **configuration**
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 running interface auto-template** *num*

Use this command to display interface configuration information for a tunnel interface. For example:

```
Router# show running interface auto-template 1
```

```
interface auto-template1
 ip unnumbered Loopback0
 no ip directed-broadcast
 no keepalive
 tunnel destination access-list 1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng path-option 1 dynamic
```

This output shows that autotunnel template interface auto-template1 uses an access list (access-list 1) to determine the destination addresses for the mesh tunnel interfaces.

Step 3   **show interface tunnel** *num* **configuration**

Use this command to display the configuration of the mesh tunnel interface. For example:

```
Router# show interface tunnel 5 configuration

interface tunnel 5
 ip unnumbered Loopback0
 no ip directed-broadcast
 no keepalive
 tunnel destination access-list 1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng path-option 1 dynamic
```

Step 4   **exit**

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

```
Router# exit
Router>
```

Monitoring Your Autotunnel Mesh Network

Perform the following task to monitor your autotunnel mesh network.

SUMMARY STEPS

1. **enable**
2. **show mpls traffic-eng tunnels property auto-tunnel mesh** [**brief**]
3. **show mpls traffic-eng auto-tunnel mesh**
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 tunnels property auto-tunnel mesh** [**brief**]

Use this command to monitor mesh tunnel interfaces. This command restricts the output of the **show mpls traffic-eng tunnels** command to display only mesh tunnel interfaces. For example:

```
Router# show mpls traffic-eng tunnels property auto-tunnel mesh brief

Signalling Summary:
    LSP Tunnels Process:           running
    RSVP Process:                  running
    Forwarding:                    enabled
    Periodic reoptimization:       every 3600 seconds, next in 491 seconds
    Periodic FRR Promotion:        Not Running
    Periodic auto-bw collection:   disabled
TUNNEL NAME                    DESTINATION      UP IF    DOWN IF
STATE/PROT
router_t64336                  10.2.2.2         -        Se2/0
up/up
router_t64337                  10.3.3.3         -        Se2/0
up/up
Displayed 2 (of 2) heads, 0 (of 0) midpoints, 0 (of 0) tails
```

Step 3 **show mpls traffic-eng auto-tunnel mesh**

Use this command to display the cloned mesh tunnel interfaces of each autotemplate interface and the current range of mesh tunnel interface numbers. For example:

```
Router# show mpls traffic-eng auto-tunnel mesh

Auto-Template1:

 Using access-list 1 to clone the following tunnel interfaces:

  Destination  Interface
  -----------  ---------
  10.2.2.2     Tunnel64336
  10.3.3.3     Tunnel64337

Mesh tunnel interface numbers: min 64336 max 65337
```

Step 4 **exit**

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

```
Router# exit
Router>
```

Troubleshooting Tips

You can configure mesh tunnel interfaces directly. However, you cannot delete them manually, and manual configuration is not permanent. The configuration is overwritten when the template changes or the mesh tunnel interface is deleted and recreated. If you attempt to manually delete a mesh tunnel interface, an error message appears.

You can enter the **show mpls traffic-eng tunnels destination** *address* command to display information about tunnels that are destined for a specified IP address.

Enter the **show mpls traffic-eng tunnels property auto-tunnel mesh** command to display information about mesh tunnel interfaces.

Configuring IGP Flooding for Autotunnel Mesh Groups

Perform the following task to configure IGP flooding for autotunnel mesh groups. Use this task to configure an OSPF-based discovery for identifying mesh group members and advertising the mesh group IDs to all LSRs.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls traffic-eng auto-tunnel mesh**
4. **router ospf** *process-id*
5. **mpls traffic-eng mesh-group** *mesh-group-id interface-type interface-number* **area** *area-id*
6. **exit**
7. Repeat steps 4 and 5 at other LSRs to advertise the mesh group numbers to which they belong.
8. **interface auto-template** *interface-num*
9. **tunnel destination mesh-group** *mesh-group-id*
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.
Step 3	**mpls traffic-eng auto-tunnel mesh** **Example:** `Router(config)# mpls traffic-eng auto-tunnel mesh`	Enables autotunnel mesh groups globally.

	Command or Action	Purpose
Step 4	`router ospf` *process-id* **Example:** `Router(config)# router ospf 100`	Enters router configuration mode and configures an OSPF routing process. • The *process-id* argument is an internally used identification parameter for an OSPF routing process. It is locally assigned and can be any positive integer. A unique value is assigned for each OSPF routing process.
Step 5	`mpls traffic-eng mesh-group` *mesh-group-id* *interface-type interface-number* **area** *area-id* **Example:** `Router(config-router)# mpls traffic-eng mesh-group 10 loopback 0 area 100`	Advertises the autotunnel mesh group number of an LSR. • The *mesh-group-id* is a number that identifies a specific mesh group. • The *interface-type* and *interface-number* arguments specify a type of interface and an interface number. • The **area** *area-id* keyword-argument pair identifies the area.

Step 6	`exit`
	
	Example:
	`Router(config-router)# exit`
		Exits to global configuration mode.

Step 7	Repeat steps 4 and 5 at other LSRs to advertise the mesh group numbers to which they belong.	—
Step 8	`interface auto-template` *interface-num* **Example:** `Router(config)# interface auto-template 1`	Creates a template interface and enters interface configuration mode. • The *interface-num* argument identifies the interface number. Valid values are 1 to 25.
Step 9	`tunnel destination mesh-group` *mesh-group-id* **Example:** `Router(config-if)# tunnel destination mesh-group 10`	Specifies a mesh group that a template interface uses to signal tunnels for all mesh group members. • The *mesh-group-id* is a number that identifies a specific mesh group.

Step 10	`end`
	
	Example:
	`Router(config-if)# end`
		Exits to privileged EXEC mode.

Configuration Examples for MPLS Traffic Engineering—Autotunnel Mesh Groups

This section provides the following configuration examples for the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature:

Configuring a Mesh of TE Tunnel LSPs: Examples

This section contains the following configuration examples for configuring a mesh of TE tunnel LSP:

Enabling Autotunnel Mesh Groups Globally: Example

The following example shows how to enable autotunnel mesh groups globally:

```
configure terminal
!

mpls traffic-eng auto-tunnel mesh
end
```

Creating an Access List Using a Name: Example

The following examples shows how to create an access list using a name to determine the destination addresses for the mesh tunnel interfaces:

```
configure terminal
!
ip access-list standard a1
 permit 10.0.0.0 0.255.255.255
end
```

In this example, any IP address in the TE topology database that matches access list a1 causes the creation of a mesh tunnel interface with that destination address.

Creating a Template Interface: Example

This example shows how to create a template interface. In the following example, a template is created and configured with a typical set of TE commands. The mesh group created from the template consists of mesh tunnel interfaces with destination addresses that match access list a1.

> **Note** You can enter various commands. The following commands show a typical configuration.

```
configure terminal
!
interface Auto-Template 1
 ip unnumbered Loopback0
 tunnel mode mpls
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 1 1
 tunnel mpls traffic-eng auto-bw
 tunnel mpls traffic-eng path-option 1 dynamic
 tunnel destination access-list a1
 end
```

Specifying the Range of Mesh Tunnel Interface Numbers: Example

In the following example, the lowest mesh tunnel interface number can be 1000, and the highest mesh tunnel interface number can be 2000:

```
configure terminal
!
mpls traffic-eng auto-tunnel mesh tunnel-num min 1000 max 2000
end
```

Configuring IGP Flooding for Autotunnel Mesh Groups: Example

In the following example, OSPF is configured to advertise the router membership in mesh group 10:

```
configure terminal
!
mpls traffic-eng auto-tunnel mesh
router ospf 100
 mpls traffic-eng mesh-group 10 loopback 0 area 100
 exit
!
interface auto-template 1
 tunnel destination mesh-group 10
 end
```

Additional References

The following sections provide references related to the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature.

Related Documents

Related Topic	Document Title
Configuration tasks for MPLS traffic engineering	Part 3: MPLS Traffic Engineering in the *Cisco IOS Multiprotocol Label Switching Configuration Guide*, Release 12.4
MPLS traffic engineering command descriptions	*Cisco IOS Multiprotocol Label Switching Command Reference*, Release 12.2 SR

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.

- **clear mpls traffic-eng auto-tunnel mesh**
- **interface auto-template**
- **mpls traffic-eng auto-tunnel mesh**
- **mpls traffic-eng auto-tunnel mesh tunnel-num**
- **mpls traffic-eng mesh-group**
- **show interface tunnel configuration**
- **show mpls traffic-eng auto-tunnel mesh**
- **show mpls traffic-eng tunnels**
- **show running interface auto-template**
- **tunnel destination access-list**
- **tunnel destination mesh-group**

clear mpls traffic-eng auto-tunnel mesh

To remove all the mesh tunnel interfaces and re-create them, use the **clear mpls traffic-eng auto-tunnel mesh** command in privileged EXEC mode.

clear mpls traffic-eng auto-tunnel mesh

Syntax Description   This command has no arguments or keywords.

Command Default   No default behavior or values.

Command Modes   Privileged EXEC

Command History

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

Examples   The following example shows how to remove all mesh tunnel interfaces and re-create them:

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

Related Commands

Command	Description
interface auto-template	Creates the template interface.

interface auto-template

To create the template interface, use the **interface auto-template** command in global configuration mode. To delete this interface, use the **no** form of this command.

>   **interface auto-template** *interface-num*

>   **no interface auto-template**

Syntax Description

interface-num	Interface number. Valid values are 1 to 25.

Command Default

No default behavior or values.

Command Modes

Global configuration

Command History

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

Usage Guidelines

The space before the *interface-num* argument is optional.

Use the **shutdown** command to disable mesh tunnel interface creation in this template.

Examples

The following example shows how to create template interface 1:

```
Router(config)# interface auto-template 1
```

Related Commands

Command	Description
clear mpls traffic-eng auto-tunnel mesh	Removes all the mesh tunnel interfaces and re-creates them.
mpls traffic-eng auto-tunnel mesh	Enables autotunnel mesh groups globally.
show mpls traffic-eng auto-tunnel mesh	Displays the cloned mesh tunnel interfaces of each autotemplate interface and the current range of mesh tunnel interface numbers.

mpls traffic-eng auto-tunnel mesh

To enable autotunnel mesh groups globally, use the **mpls traffic-eng auto-tunnel mesh** command in global configuration mode. To disable this feature, use the **no** form of this command.

mpls traffic-eng auto-tunnel mesh

no mpls traffic-eng auto-tunnel mesh

Syntax Description   This command has no arguments or keywords.

Command Default   Autotunnel mesh groups are not enabled globally.

Command Modes   Global configuration

Command History

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

Examples   The following example shows how to enable autotunnel mesh groups globally:

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

Related Commands

Command	Description
interface auto-template	Creates the template interface.

mpls traffic-eng auto-tunnel mesh tunnel-num

To configure a range of mesh tunnel interface numbers, use the **mpls traffic-eng auto-tunnel mesh tunnel-num** command in global configuration mode. To use the default values, use the **no** form of this command.

mpls traffic-eng auto-tunnel mesh tunnel-num min *num* **max** *num*

no mpls traffic-eng auto-tunnel mesh tunnel-num

Syntax Description

min *num*	Beginning number of the range of mesh tunnel interface numbers. Valid values are from 1 to 65535. The default value is 64336.
max *num*	Ending number of the range of mesh tunnel interface numbers. Valid values are from 1 to 65535. The default value is 65335.

Command Default   The **min** default is 64336. The **max** default is 65335.

Command Modes   Global configuration

Command History

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

Usage Guidelines   If you change an access control list (ACL) and tunnels are deleted because they no longer match the ACL, tunnels that are recreated might not be numbered sequentially; that is, the range of tunnel numbers might not be sequential.

Examples   The following example shows how to specify 1000 as the beginning number of the mesh tunnel interface and 2000 as the ending number:

```
Router(config)# mpls traffic-eng auto-tunnel mesh tunnel-num min 1000 max 2000
```

Related Commands

Command	Description
show mpls traffic-eng auto-tunnel mesh	Displays the cloned mesh tunnel interfaces of each autotemplate interface and the current range of mesh tunnel interface numbers.

mpls traffic-eng mesh-group

To configure a mesh group in an Interior Gateway Protocol (IGP) to allow Multiprotocol Label Switching (MPLS) traffic engineering (TE) label switch routers (LSRs) that belong to the same mesh group to signal tunnels to the local router, use the **mpls traffic-eng mesh-group** command in router configuration mode. To disable signaling of tunnels from LSRs in the same mesh group to the local router, use the **no** form of this command.

> **mpls traffic-eng mesh-group** *mesh-group-id interface-type interface-number* **area** *area-id*

> **no mpls traffic-eng mesh-group** *mesh-group-id interface-type interface-number* **area** *area-id*

Syntax Description

mesh-group-id	Number that identifies a specific mesh group.
interface-type	Type of interface.
interface-number	Interface number.
area *area-id*	Identifies an IGP area.

Command Default No tunnels are signaled for routers in the same mesh group.

Command Modes Router configuration

Command History

Release	Modification
12.0(29)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 a mesh group in an IGP. This allows the MPLS TE LSRs that belong to the specified mesh group to signal tunnels to the local router. The IGP floods mesh group configuration to all routers belonging to the same mesh group. An autotemplate determines how a router participates in an autotunnel. A router can participate in a mesh group through two-way tunnels or one-way tunnels.

Open Shortest Path First (OSPF) is the only IGP supported in this release of the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature.

Examples The following example shows how to configure OSPF to allow LSRs that belong to the same mesh group (mesh group 10) to signal tunnels to the local router:

```
Router(config)# router ospf 100
Router(config-router)# mpls traffic-eng mesh-group 10 loopback 0 area 100
```

Related Commands	**Command**	**Description**
	tunnel destination mesh-group	Configures an autotemplate to signal tunnels to all other members of a specified mesh group.

show interface tunnel configuration

To display the configuration of a mesh tunnel interface, use the **show interface tunnel configuration** command in privileged EXEC mode.

show interface tunnel *num* **configuration**

Syntax Description

num	Number of the mesh tunnel for which you want to display configuration information.

Command Default   No default behavior or values.

Command Modes   Privileged EXEC

Command History

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

Usage Guidelines   The space before the *num* argument is optional.

Use this command to show the running configuration of the mesh tunnel interface.

Examples   The following command output shows the configuration of mesh tunnel interface 5:

```
Router# show interface tunnel 5 configuration

interface tunnel 5
 ip unnumbered Loopback0
 no ip directed-broadcast
 no keepalive
 tunnel destination access-list 1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng path-option 1 dynamic
```

Table 1 describes the significant fields shown in the display.

Table 1   show interface tunnel configuration Field Descriptions

Field	Description
ip unnumbered Loopback0	Indicates the type and number of another interface on which the router has an assigned IP address. It cannot be another unnumbered interface.
no ip directed-broadcast	Indicates that no IP broadcast addresses are used for the mesh tunnel interface.
no keepalive	Indicates that no keepalives are set for the mesh tunnel interface.
tunnel destination access-list 1	Indicates that access-list 1 is the access list that the template interface will use for obtaining the mesh tunnel interface destination address.
tunnel mode mpls traffic-eng	Indicates that the mode of the mesh tunnel is set to Multiprotocol Label Switching (MPLS) for traffic engineering.
tunnel mpls traffic-eng autoroute announce	Indicates that the Interior Gateway Protocol (IGP) should use the tunnel (if the tunnel is up) in its enhanced shortest path first (SPF) calculation.
tunnel mpls traffic-eng path-option 1 dynamic	Indicates that a path option (path-option1) for the label switch router (LSR) for the MPLS traffic engineering (TE) mesh tunnel is configured dynamically.

Related Commands

Command	Description
tunnel destination access-list	Specifies the access list that the template interface will use for obtaining the mesh tunnel interface destination address.

show mpls traffic-eng auto-tunnel mesh

To display the cloned mesh tunnel interfaces of each autotemplate interface and the current range of mesh tunnel interface numbers, use the **show mpls traffic-eng auto-tunnel mesh** command in user EXEC mode or privileged EXEC mode.

show mpls traffic-eng auto-tunnel mesh

Syntax Description   This command has no arguments or keywords.

Command Default   No default behavior or values.

Command Modes   User EXEC
Privileged EXEC

Command History

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

Examples   The following is output of the **show mpls traffic-eng auto-tunnel mesh** command that shows the cloned mesh tunnel interfaces for autotemplate1 and shows the range of mesh tunnel interface numbers. Information for only one autotemplate is displayed because only one autotemplate was configured.

```
Router# show mpls traffic-eng auto-tunnel mesh

Auto-Template1:

 Using access-list 1 to clone the following tunnel interfaces:

  Destination  Interface
  -----------  ---------
  10.2.2.2     Tunnel64336
  10.3.3.3     Tunnel64337

Mesh tunnel interface numbers: min 64336 max 65337
```

Table 2 describes the significant fields shown in the display.

Table 2   show mpls traffic-eng auto-tunnel mesh Field Descriptions

Field	Description
Auto-Template1	Name of the autotemplate.
Destination	Destination addresses for the mesh tunnel interface cloned from access list 1.

Table 2   show mpls traffic-eng auto-tunnel mesh Field Descriptions (continued)

Field	Description
Interface	Mesh tunnel interfaces cloned from access list 1.
min 64336 max 65337	Range of mesh tunnel interface numbers for this Auto-Template1—minimum (64336) and maximum (65337).

Related Commands

Command	Description
interface auto-template	Creates the template interface.
mpls traffic-eng auto-tunnel mesh tunnel-num	Configures the range of mesh tunnel interface numbers.

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 3 describes the significant fields shown in the displays.

Table 3   *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: 10.0.0.4
   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 10.1.0.2 172.16.0.1 192.168.0.4
      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 10.103.103.103; Name iou-100_t1)
 5 minute output rate 0 kbits/sec, 0 packets/sec
Tunnel2 (Destination 10.103.103.103; 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.

show running interface auto-template

To display configuration information for a tunnel's interface, use the **show running interface auto-template** command in privileged EXEC mode.

show running interface auto-template *num*

Syntax Description

num	Number of the tunnel interface for which you want to display information.

Command Default

No default behavior or values.

Command Modes

Privileged EXEC

Command History

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

Usage Guidelines

The space before the *num* argument is optional.

Examples

The following is output from the **show running interface auto-template** command:

```
Router# show running interface auto-template 1

interface auto-template1
 ip unnumbered Loopback0
 no ip directed-broadcast
 no keepalive
 tunnel destination access-list 1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng path-option 1 dynamic
```

Table 4 describes the significant fields shown in the display.

Table 4 show running interface auto-template Field Descriptions

Field	Description
ip unnumbered Loopback0	Indicates the type and number of another interface on which the router has an assigned IP address. It cannot be another unnumbered interface.
no ip directed-broadcast	Indicates that no IP broadcast addresses are used for the autotunnel interface.

Table 4 show running interface auto-template Field Descriptions (continued)

Field	Description
no keepalive	Indicates that no keepalives are set for the autotunnel interface.
tunnel destination access-list 1	Indicates that access list 1 is the access list that the template interface will use for obtaining the autotunnel interface destination address.
tunnel mode mpls traffic-eng	Indicates that the mode of the autotunnel is set to Multiprotocol Label Switching (MPLS) for traffic engineering.
tunnel mpls traffic-eng autoroute announce	Indicates that the Interior Gateway Protocol (IGP) should use the tunnel (if the tunnel is up) in its enhanced shortest path first (SPF) calculation.
tunnel mpls traffic-eng path-option 1 dynamic	Indicates that a path option (path-option1) for the label switch router (LSR) for the MPLS traffic engineering (TE) mesh tunnel is configured dynamically.

Related Commands

Command	Description
interface auto-template	Creates the template interface.
tunnel destination access-list	Specifies the access-list that the template interface will use for obtaining the mesh tunnel interface destination address.

tunnel destination access-list

To specify the access list that the template interface uses for obtaining the mesh tunnel interface destination address, use the **tunnel destination access-list** command in interface configuration mode. To remove the access list from this template interface, use the **no** form of this command.

> **tunnel destination access-list** *num*

> **no tunnel destination access-list** *num*

Syntax Description	*num* Number of the access list.

Command Default No default behavior or values.

Command Modes Interface configuration

Command History

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

Usage Guidelines This command can be used only on template interfaces.

If you specify an access list that does not exist, no tunnels are set up. You need an access list to set up the destination addresses for the mesh tunnel interfaces.

If you enter the **shutdown** command on the autotemplate interface, the command is executed on all the cloned tunnel interfaces. To delete all the cloned tunnel interfaces, enter **no tunnel destination** on the autotemplate. To delete tunnel interfaces for a particular autotemplate, go to the particular interface and enter **no tunnel destination**.

Examples The following example shows how to configure the template interface to use access-list 1 to obtain the tunnel destination address:

```
Router (config)# interface auto-template 1
Router(config-if)# tunnel destination access-list 1
```

Related Commands

Command	Description
interface auto-template	Creates the template interface.
mpls traffic-eng auto-tunnel mesh tunnel-num	Configures a range of mesh tunnel interface numbers.

tunnel destination mesh-group

To specify a mesh group that an autotemplate interface uses to signal tunnels for all mesh group members, use the **tunnel destination mesh group** command in interface configuration mode. To remove a mesh group from the template, use the **no** form of this command.

tunnel destination mesh group *mesh-group-id*

no tunnel destination mesh group *mesh-group-id*

Syntax Description

mesh-group-id	Number that identifies a specific mesh group.

Command Default Mesh groups are not advertised.

Command Modes Interface configuration

Command History

Release	Modification
12.0(29)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 associate a specific mesh group with an autotemplate. When a mesh group is associated with an autotemplate, the template interface signals tunnels for all mesh group members.

Examples The following example shows how to configure an autotemplate to signal tunnels for mesh group 10:

```
Router(config)# interface autotemplate 1
Router(config-if)# tunnel destination mesh-group 10
```

Related Commands

Command	Description
mpls traffic-eng mesh-group	Configures an IGP to allow MPLS TE LSRs that belong to the same mesh group to signal tunnels to the local router.

Feature Information for MPLS Traffic Engineering—AutoTunnel Mesh Groups

Table 5 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 5 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 5   Feature Information for MPLS Traffic Engineering—AutoTunnel Mesh Groups

Feature Name	Releases	Feature Information
MPLS Traffic Engineering—AutoTunnel Mesh Groups	12.0(27)S 12.0(29)S 12.2(33)SRA 12.2(33)SXH	This document shows how to configure autotunnel mesh groups for Multiprotocol Label Switching (MPLS) traffic engineering (TE) label switch routers (LSRs).
		The MPLS Traffic Engineering—AutoTunnel Mesh Groups feature allows a network administrator to configure TE label-switched paths (LSPs) by using a few command-line interface (CLI) commands.
		In a network topology where edge TE LSRs are connected by core LSRs, the MPLS Traffic Engineering—AutoTunnel Mesh Groups feature automatically constructs a mesh of TE LSPs among the provider edge (PE) routers.
		In 12.2(27)S, this feature was introduced.
		In 12.0(29)S, this feature was updated to include Interior Gateway Protocol (IGP) flooding of autotunnel mesh groups.
		In 12.2(33)SRA, support was added for a Cisco IOS 12.2SR release.
		In 12.2(33)SXH, support was added for a Cisco IOS 12.2SX release.

Glossary

CE router—customer edge router. A router that is part of a customer's network and interfaces to a provider edge (PE) router.

customer network—A network that is under the control of an end customer. Private addresses can be used in a customer network. Customer networks are logically isolated from each other and from the service provider's network.

edge router—A router at the edge of the network that receives and transmits packets. It can define the boundaries of the Multiprotocol Label Switching (MPLS) network.

headend—The label switch router (LSR) where a tunnel originates. The tunnel's "head" or tunnel interface resides at this LSR as well.

label—A short, fixed-length data construct that tells switching nodes how to forward data (packets).

LSP—label switched path. A path that a labeled packet follows over several hops, starting at an ingress label switch router (LSR) and ending at an egress LSR.

label-switched path (LSP) tunnel—A configured connection between two routers, in which label switching is used to carry the packets.

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

mesh group—A set of label switch routers (LSRs) that are members of a full or partial network of traffic engineering (TE) label switched paths (LSPs).

P router—provider core router.

PE router—provider edge router. A router at the edge of the service provider's network that interfaces to customer edge (CE) routers.

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

tailend—The downstream, receive end of a tunnel.

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

tunnel—A secure communication path between two peers, such as two routers. A traffic engineering tunnel is a label-switched tunnel that is used for traffic engineering. Such a tunnel is set up through means other than normal Layer 3 routing.

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