OSPF Support for Forwarding Adjacencies over MPLS TE Tunnels

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The OSPF Support for Forwarding Adjacencies over MPLS Traffic Engineered Tunnels feature adds Open Shortest Path First (OSPF) support to the Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Forwarding Adjacency feature, which allows a network administrator to handle a traffic engineering, label-switched path (LSP) tunnel as a link in an Interior Gateway Protocol (IGP) network based on the shortest path first (SPF) algorithm. An OSPF forwarding adjacency can be created between routers in the same area.

History for the OSPF Support for Forwarding Adjacencies over MPLS Traffic Engineered Tunnels Feature

Release	Modification
12.0(24)S	This feature was introduced.
12.2(25)S	This feature was integrated into Cisco IOS Release 12.2(25)S.
12.2(18)SXE	This feature was integrated into Cisco IOS Release 12.2(18)SXE.
12.2(27)SBC	This feature was integrated into Cisco IOS Release 12.2(27)SBC.
Cisco IOS XE Release 2.1	This feature was implemented on Cisco ASR 1000 series routers.

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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

Prerequisites for OSPF Forwarding Adjacency

- OSPF must be configured in your network.
- Cisco Express Forwarding (CEF) must be enabled.
- You should understand MPLS TE tunnels for forwarding adjacency as described in the " MPLS Traffic Engineering Forwarding Adjacency" module.

Information About OSPF Forwarding Adjacency

OSPF includes MPLS TE tunnels in the OSPF link-state database in the same way that other links appear for purposes of routing and forwarding traffic. When an MPLS TE tunnel is configured between networking devices, that link is considered a forwarding adjacency. The user can assign a cost to the tunnel to indicate the link's preference. Other networking devices will see the tunnel as a link in addition to the physical link.

How to Configure OSPF Forwarding Adjacency

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Configuring OSPF Forwarding Adjacency

Note Configure a forwarding adjacency on two LSP tunnels bidirectionally, from A to B and B to A. Otherwise, the forwarding adjacency is advertised, but not used in the IGP network.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip cef distributed**
4. **mpls traffic-eng tunnels**
5. **interface loopback** *number*
6. **ip address** *ip-address mask*
7. **no shutdown**
8. **exit**
9. **interface tunnel** *number*
10. **tunnel mode mpls traffic-eng**
11. **tunnel mpls traffic-eng forwarding-adjacency** {**holdtime** *value*}
12. **ip ospf cost** *cost*
13. **exit**
14. **router ospf** *process-id*
15. **mpls traffic-eng router-id** *interface*
16. **mpls traffic-eng area** *number*
17. **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 cef distributed** **Example:** `Router(config)# ip cef distributed`	Enables Cisco Express Forwarding (CEF).

	Command or Action	Purpose
Step 4	**mpls traffic-eng tunnels** **Example:** `Router(config)# mpls traffic-eng tunnels`	Enables MPLS traffic engineering tunnel signaling on a device.
Step 5	**interface loopback** *number* **Example:** `Router(config)# interface loopback0`	Configures a loopback interface and enters interface configuration mode. • Set up a loopback interface with a 32-bit mask, enable CEF, enable MPLS traffic engineering, and set up a routing protocol (OSPF) for the MPLS network.
Step 6	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.1.1.1 255.255.255.255`	Configures the IP address and subnet mask of the loopback interface.
Step 7	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Enables the interface.
Step 8	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 9	**interface tunnel** *number* **Example:** `Router(config)# interface tunnel 1`	Designates a tunnel interface for the forwarding adjacency and enters interface configuration mode.
Step 10	**tunnel mode mpls traffic-eng** **Example:** `Router(config-if)# tunnel mode mpls traffic-eng`	Sets the mode of a tunnel to MPLS for traffic engineering.

	Command or Action	Purpose
Step 11	**tunnel mpls traffic-eng forwarding-adjacency** {**holdtime** *value*} **Example:** `Router(config-if)# tunnel mpls traffic-eng forwarding-adjacency holdtime 10000`	Advertises a TE tunnel as a link in an IGP network. • The **holdtime** *value* keyword argument combination is the time in milliseconds (ms) that a TE tunnel waits after going down before informing the network. The range is 0 to 4,294,967,295 ms. The default value is 0.
Step 12	**ip ospf cost** *cost* **Example:** `Router(config-if)# ip ospf cost 4`	(Optional) Configures the cost metric for a tunnel interface to be used as a forwarding adjacency.
Step 13	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 14	**router ospf** *process-id* **Example:** `Router(config)# router ospf 1`	Configures an OSPF routing process and enters router configuration mode.
Step 15	**mpls traffic-eng router-id** *interface* **Example:** `Router(config-router)# mpls traffic-eng router-id ethernet 1/0`	Specifies that the traffic engineering router identifier for the node is the IP address associated with a given interface.
Step 16	**mpls traffic-eng area** *number* **Example:** `Router(config-router)# mpls traffic-eng area 1`	Configures a router running OSPF MPLS so that it floods traffic engineering for the indicated OSPF area.
Step 17	**end** **Example:** `Router(config-router)# end`	Exits router configuration mode.

Configuration Examples for OSPF Forwarding Adjacency

Example OSPF Forwarding Adjacency

In the following example, the tunnel destination is the loopback interface on the other router. The router is configured with OSPF TE extensions and it floods traffic engineering link-state advertisements (LSAs) in OSPF area 0. The traffic engineering router identifier for the node is the IP address associated with Loopback 0. The last five lines of the example set up the routing protocol for the MPLS network, which is OSPF in this case.

Note Do not use the **mpls traffic-eng autoroute announce** command if you configure a forwarding adjacency in the tunnel.

```
ip routing
ip cef distributed
mpls traffic-eng tunnels
!
interface Loopback0
 ip address 127.0.0.1 255.255.255.255
 no shutdown
!
interface Tunnel1
 ip unnumbered Loopback0
 no ip directed-broadcast
 tunnel destination 10.1.1.1
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng forwarding-adjacency holdtime 10000
 ip ospf cost 4
 tunnel mpls traffic-eng priority 2 2
 tunnel mpls traffic-eng bandwidth  10
 tunnel mpls traffic-eng path-option 2 dynamic
router ospf 5
 log-adjacency-changes
 network 10.1.1.1 0.0.0.0 area 0
 mpls traffic-eng router-id loopback0
 mpls traffic-eng area 0
```

When you look at the self-generated router LSA, you will see it as one of the links in router LSA (shown in bold in the following output).

```
Router# show ip ospf database route self-originate
OSPF Router with ID (10.5.5.5) (Process ID 5)
                Router Link States (Area 0)
  LS age:332
  Options:(No TOS-capability, DC)
  LS Type:Router Links
  Link State ID:10.5.5.5
  Advertising Router:10.5.5.5
  LS Seq Number:80000004
  Checksum:0x1D24
  Length:72
  Number of Links:4
    Link connected to another Router (point-to-point)
     (Link ID) Neighboring Router ID:10.3.3.3
     (Link Data) Router Interface address:0.0.0.23
      Number of TOS metrics:0
       TOS 0 Metrics:1562
    Link connected to:a Transit Network
```

```
 (Link ID) Designated Router address:172.16.0.1
 (Link Data) Router Interface address:172.16.0.2
  Number of TOS metrics:0
   TOS 0 Metrics:10
Link connected to:a Transit Network
 (Link ID) Designated Router address:172.16.0.3
 (Link Data) Router Interface address:172.16.0.4
  Number of TOS metrics:0
   TOS 0 Metrics:10
Link connected to:a Stub Network
 (Link ID) Network/subnet number:10.5.5.5
 (Link Data) Network Mask:255.255.255.255
  Number of TOS metrics:0
   TOS 0 Metrics:1
```

Additional References

The following sections provide references related to OSPF Forwarding Adjacency.

Related Documents

Related Topic	Document Title
MPLS traffic engineering forwarding adjacency	MPLS Traffic Engineering Forwarding Adjacency
Configuring OSPF for MPLS traffic engineering	MPLS Traffic Engineering and Enhancements
MPLS Traffic Engineering - LSP Attributes	MPLS Traffic Engineering - LSP Attributes

Standards

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

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
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

Technical Assistance

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