OSPF Support for Forwarding Adjacencies over MPLS TE Tunnels

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

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
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<tbody>
<tr>
<td>12.0(24)S</td>
<td>This feature was introduced.</td>
</tr>
<tr>
<td>12.2(25)S</td>
<td>This feature was integrated into Cisco IOS Release 12.2(25)S.</td>
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<tr>
<td>12.2(18)SXE</td>
<td>This feature was integrated into Cisco IOS Release 12.2(18)SXE.</td>
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<tr>
<td>12.2(27)SBC</td>
<td>This feature was integrated into Cisco IOS Release 12.2(27)SBC.</td>
</tr>
<tr>
<td>Cisco IOS XE Release 2.1</td>
<td>This feature was implemented on Cisco ASR 1000 series routers.</td>
</tr>
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</table>

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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.
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**

**Configuring OSPF Forwarding Adjacency**

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**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`
<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td><strong>enable</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Router&gt; enable</td>
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<tr>
<td>Step 2</td>
<td><strong>configure terminal</strong></td>
<td>Enters global configuration mode.</td>
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<td></td>
<td><strong>Example:</strong> Router# configure terminal</td>
<td></td>
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<tr>
<td>Step 3</td>
<td><strong>ip cef distributed</strong></td>
<td>Enables Cisco Express Forwarding (CEF).</td>
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<td></td>
<td><strong>Example:</strong> Router(config)# ip cef distributed</td>
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</tr>
<tr>
<td>Step 4</td>
<td><strong>mpls traffic-eng tunnels</strong></td>
<td>Enables MPLS traffic engineering tunnel signaling on a device.</td>
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<td></td>
<td><strong>Example:</strong> Router(config)# mpls traffic-eng tunnels</td>
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</tr>
<tr>
<td>Step 5</td>
<td><strong>interface loopback number</strong></td>
<td>Configures a loopback interface and enters interface configuration mode.</td>
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<td></td>
<td><strong>Example:</strong> Router(config)# interface loopback0</td>
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<tr>
<td>Step 6</td>
<td><strong>ip address ip-address mask</strong></td>
<td>Configures the IP address and subnet mask of the loopback interface.</td>
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<td><strong>Example:</strong> Router(config-if)# ip address 10.1.1.1 255.255.255.255</td>
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<tr>
<td>Step 7</td>
<td><strong>no shutdown</strong></td>
<td>Enables the interface.</td>
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<td></td>
<td><strong>Example:</strong> Router(config-if)# no shutdown</td>
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<tr>
<td>Step 8</td>
<td><strong>exit</strong></td>
<td>Exits interface configuration mode.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
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</table>
| **Router(config-if)# exit** | |}

**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.

**Step 11**

**tunnel mpls traffic-eng forwarding-adjacency **\(\text{holdtime value}\)**  
*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
```
Additional References

The following sections provide references related to OSPF Forwarding Adjacency.

**Related Documents**

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>MPLS traffic engineering forwarding adjacency</td>
<td>MPLS Traffic Engineering Forwarding Adjacency</td>
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<tr>
<td>Configuring OSPF for MPLS traffic engineering</td>
<td>MPLS Traffic Engineering and Enhancements</td>
</tr>
<tr>
<td>MPLS Traffic Engineering - LSP Attributes</td>
<td>MPLS Traffic Engineering - LSP Attributes</td>
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**Standards**

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**MIBs**

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<td>To locate and download MIBs for selected platforms, Cisco IOS releases,</td>
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<td>and feature sets, use Cisco MIB Locator found at the following URL:</td>
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<td></td>
<td><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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RFCs

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Technical Assistance

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<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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