# MPLS VPN--L3VPN over GRE

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The MPLS VPN--L3VPN over GRE feature provides a mechanism for tunneling Multiprotocol Label Switching (MPLS) packets over a non-MPLS network.

The MPLS VPN--L3VPN over GRE feature utilizes MPLS over generic routing encapsulation (MPLSoGRE) to encapsulate MPLS packets inside IP tunnels. This action creates a virtual point-to-point link across non-MPLS networks.

# 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 MPLS VPN--L3VPN over GRE

Before you configure the MPLS VPN--L3VPN over GRE feature, ensure that your MPLS Virtual Private Network (VPN) is configured and working properly. See the Configuring MPLS Layer 3 VPNs module for information about setting up MPLS VPNs.

Ensure that the following routing protocols are configured and working properly:

- Label Distribution Protocol (LDP)--for MPLS label distribution. See MPLS Label Distribution Protocol Overview
- Multiprotocol Border Gateway Protocol (MP-BGP)--for VPN route and label distribution. See Configuring MPLS Layer 3 VPNs

# Restrictions for MPLS VPN--L3VPN over GRE

The MPLS VPN--L3VPN over GRE feature does not support the following:

- Quality of service (QoS) service policies configured on the tunnel interface; they are supported on the physical or subinterface
- GRE options: sequencing, checksum, and source route
- IPv6 GRE
- Advanced features such as Carrier Supporting Carrier (CSC) and Interautonomous System (Inter-AS)
- For PE-to-PE tunneling, configure tunnels with the same source address if you are running a release earlier than Cisco IOS Release 15.2(1)S.
- For PE-to-PE tunneling, configure tunnels with the same destination address

# Information About MPLS VPN--L3VPN over GRE

The MPLS VPN--L3VPN over GRE feature provides a mechanism for tunneling MPLS packets over non-MPLS networks.

MPLS VPN--L3VPN over GRE allows you to create a GRE tunnel across a non-MPLS network. The MPLS packets are encapsulated within the GRE tunnel packets, and the encapsulated packets traverse the non-MPLS network through the GRE tunnel. When GRE tunnel packets are received at the other side of the non-MPLS network, the GRE tunnel packet header is removed and the inner MPLS packet is forwarded to its final destination.

The MPLS VPN--L3VPN over GRE feature supports three GRE tunnel configurations:

## PE-to-PE Tunneling

The provider edge-to-provider edge (PE-to-PE) tunneling configuration provides a scalable way to connect multiple customer networks across a non-MPLS network. With this configuration, traffic that is destined to multiple customer networks is multiplexed through a single GRE tunnel.

**Note** A similar nonscalable alternative is to connect each customer network through separate GRE tunnels (for example, connecting one customer network for each GRE tunnel).

As shown in the figure below, the PE routers assign VPN routing and forwarding (VRF) numbers to the customer edge (CE) routers on each side of the non-MPLS network.

The PE routers use routing protocols such as BGP, OSPF, or Routing Information Protocol (RIP) to learn about the IP networks behind the CE routers. The routes to the IP networks behind the CE routers are stored in the associated CE router's VRF routing table.

The PE router on one side of the non-MPLS network uses the routing protocols (that are operating within the non-MPLS network) to learn about the PE router on the other side of the non-MPLS network. The learned routes that are established between the PE routers are then stored in the main or default routing table.

The opposing PE router uses BGP to learn about the routes that are associated with the customer networks behind the PE routers. These learned routes are not known to the non-MPLS network.

For this example, BGP defines a static route to the BGP neighbor (the opposing PE router) through the GRE tunnel that spans the non-MPLS network. Because the routes that are learned by the BGP neighbor include the GRE tunnel next hop, all customer network traffic is sent using the GRE tunnel.

**Figure 1     PE-to-PE Tunneling**
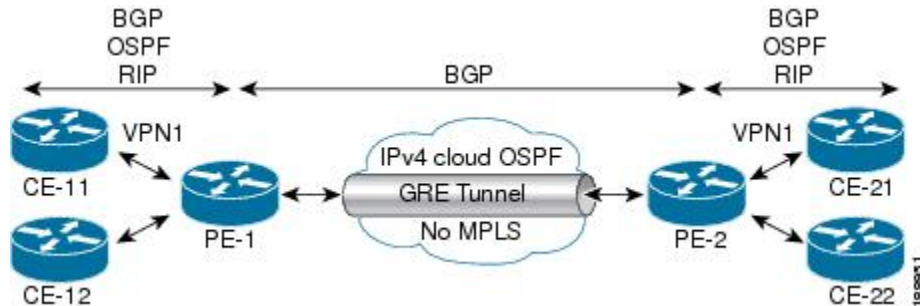


## P-to-PE Tunneling

As shown in the figure below, the provider-to-provider edge (P-to-PE) tunneling configuration provides a way to connect a PE router (P1) to an MPLS segment (PE-2) across a non-MPLS network. In this configuration, MPLS traffic that is destined to the other side of the non-MPLS network is sent through a single GRE tunnel.

**Figure 2     P-to-PE Tunneling**
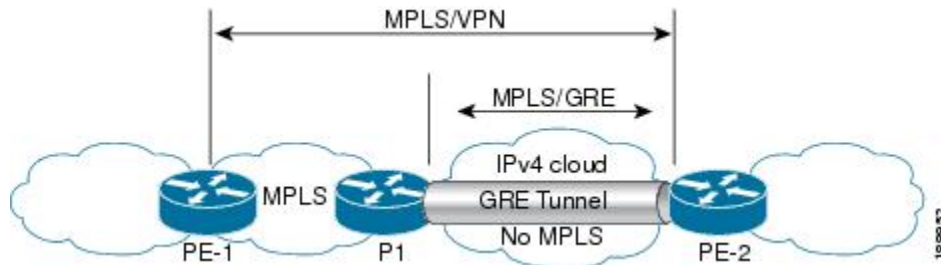
# P-to-P Tunneling

As shown in the figure below, the provider-to-provider (P-to-P) configuration provides a method of connecting two MPLS segments (P1 to P2) across a non-MPLS network. In this configuration, MPLS traffic that is destined to the other side of the non-MPLS network is sent through a single GRE tunnel.
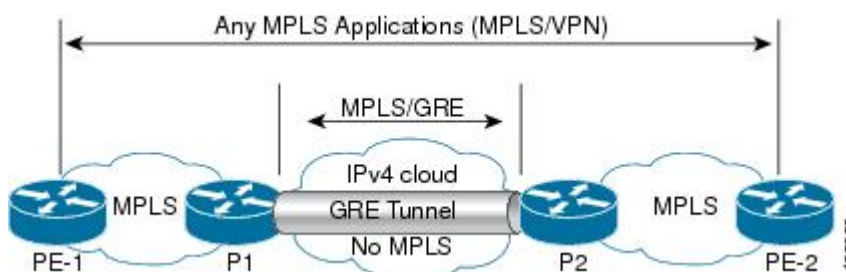
*Figure 3        P-to-P Tunneling*



# How to Configure MPLS VPN--L3VPN over GRE

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## Configuring the MPLS VPN--L3VPN over GRE Tunnel Interface

To configure the MPLS VPN--L3VPN over GRE feature, you must create a GRE tunnel to span the non-MPLS networks. You must perform this procedure on the devices located at both ends of the GRE tunnel.

Before configuring the MPLS VPN--L3VPN over GRE feature, ensure that your MPLS VPN and the appropriate routing protocols are configured and working properly. See the Prerequisites for MPLS VPN--L3VPN over GRE,  page 1.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **interface tunnel** *tunnel-number*
4. **ip address** *ip-address*
5. **tunnel source** *source-address*
6. **tunnel destination** *destination-address*
7. **mpls ip**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable** | Enables privileged EXEC mode. |
| | | • Enter your password if prompted. |
| | **Example:** | |
| | `Router> enable` | |
| **Step 2** | **configure terminal** | Enters global configuration mode. |
| | **Example:** | |
| | `Router# configure terminal` | |
| **Step 3** | **interface tunnel** *tunnel-number* | Creates a tunnel on the specified interface and enters interface configuration mode. |
| | **Example:** | |
| | `Router(config)# interface tunnel 1` | |
| **Step 4** | **ip address** *ip-address* | Assigns an IP address to the tunnel interface. |
| | **Example:** | |
| | `Router(config-if)# ip address 10.0.0.1 255.255.255.0` | |
| **Step 5** | **tunnel source** *source-address* | Specifies the tunnel's source IP address. |
| | **Example:** | |
| | `Router(config-if)# tunnel source 10.1.1.1` | |
| **Step 6** | **tunnel destination** *destination-address* | Specifies the tunnel's destination IP address. |
| | **Example:** | |
| | `Router(config-if)# tunnel destination 10.1.1.2` | |
| **Step 7** | **mpls ip** | Enables MPLS on the tunnel's physical interface. |
| | **Example:** | |
| | `Router(config-if)# mpls ip` | |

## Examples

The following example shows a GRE tunnel configuration that spans a non-MPLS network. This example shows the tunnel configuration on the PE devices (PE1 and PE2) located at both ends of the tunnel:

### PE1 Configuration

```
Router# configure terminal
Router(config)# interface Tunnel 1
Router(config-if)# ip address 10.1.1.1 255.255.255.0
Router(config-if)# tunnel source 10.0.0.1
Router(config-if)# tunnel destination 10.0.0.2
Router(config-if)# mpls ip
```

### PE2 Configuration

```
Router# configure terminal
Router(config)# interface Tunnel 1
Router(config-if)# ip address 10.1.1.2 255.255.255.0
Router(config-if)# tunnel source 10.0.0.2
Router(config-if)# tunnel destination 10.0.0.1
Router(config-if)# mpls ip
```

# Configuration Examples for MPLS VPN--L3VPN over GRE

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# MPLS Configuration with MPLS VPN--L3VPN over GRE Example

The following basic MPLS configuration example uses a GRE tunnel to span a non-MPLS network. This example is similar to the configuration shown in the first figure above.

### PE1 Configuration

```
!
mpls ip
!
ip vrf vpn1
rd 100:1
route-target import 100:1
route-target export 100:1
!
interface loopback 0
ip address 10.2.2.2 255.255.255.255
!
interface GigabitEthernet 0/1/2
ip address 10.1.1.1 255.255.255.0
!
interface Tunnel 1
ip address 10.0.0.1 255.255.255.0
tunnel source 10.1.1.1
tunnel destination 10.1.1.2
mpls ip
!
interface GigabitEthernet 0/1/3
ip vrf forwarding vpn1
ip address 10.10.0.1 255.255.255.0
!
```

```
router bgp 100
neighbor 10.5.5.5 remote-as 100
neighbor 10.5.5.5 update-source loopback0
!
address-family vpnv4
neighbor 10.5.5.5 activate
neighbor 10.5.5.5 send community-extended
!
address-family ipv4 vrf vpn1
neighbor 10.10.0.2 remote-as 20
neighbor 10.10.0.2 activate
!
```

### PE2 Configuration

```
!
mpls ip
!
ip vrf vpn1
rd 100:1
route-target import 100:1
route-target export 100:1
!
interface loopback 0
ip address 10.5.5.5 255.255.255.255
!
interface GigabitEthernet 0/1/1
ip address 10.1.1.2 255.255.255.0
!
interface Tunnel 1
ip address 10.0.0.2 255.255.255.0
tunnel source 10.1.1.2
tunnel destination 10.1.1.1
mpls ip
!
interface GigabitEthernet 0/0/5
ip vrf forwarding vpn1
ip address 10.1.2.1 255.255.255.0
!
router bgp 100
neighbor 10.2.2.2 remote-as 100
neighbor 10.2.2.2 update-source loopback0
!
address-family vpnv4
neighbor 10.2.2.2 activate
neighbor 10.2.2.2 send community-extended
!
address-family ipv4 vrf vpn1
neighbor 10.1.2.2 remote-as 30
neighbor 10.1.2.2 activate
!
```

# Additional References

### Related Documents

| Related Topic | Document Title |
| --- | --- |
| Cisco IOS commands | Cisco IOS Master Commands List, All Releases |
| Multiprotocol Label Switching (MPLS) commands | *Cisco IOS Multiprotocol Label Switching Command Reference* |

| Related Topic | Document Title |
|---|---|
| Setting up MPLS VPN networks | Configuring MPLS Layer 3 VPNs |
| Label Distribution Protocol | MPLS Label Distribution Protocol Overview |
| Multiprotocol Border Gateway Protocol (MP-BGP) | Configuring MPLS Layer 3 VPNs |
| Configuring L3 VPN over mGRE Tunnels | Dynamic Layer-3 VPNs with Multipoint GRE Tunnels |

**Standards**

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

**MIBs**

| MIB | MIBs Link |
|---|---|
| No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature. | To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs |

**RFCs**

| RFC | 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. | http://www.cisco.com/techsupport |
| To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. | |
| Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. | |

# Feature Information for MPLS VPN--L3VPN over GRE

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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.

*Table 1* *Feature Information for MPLS VPN--L3VPN over GRE*

| Feature Name | Releases | Feature Information |
| --- | --- | --- |
| MPLS VPN--L3VPN over GRE feature | 12.0(22)S<br><br>12.2(13)T<br><br>12.0(26)S<br><br>12.2(33)SRE<br><br>Cisco IOS XE Release 2.1<br><br>15.2(1)S | The MPLS VPN--L3VPN over GRE feature provides a mechanism for tunneling Multiprotocol Label Switching (MPLS) packets over a non-MPLS network.<br><br>In Cisco IOS Release 15.2(1)S, you can configure tunnels with the same source address in a PE-to-PE tunneling configuration.<br><br>This feature uses no new or modified commands. |