



Load Sharing MPLS VPN Traffic

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Load sharing distributes traffic so that no individual router is overburdened. In a Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) network, you can achieve load sharing through the following methods:

- BGP multipath options
- Directly connected loopback peering

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 for Load Sharing MPLS VPN Traffic”](#) section on page 51.

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.

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- [Command Reference, page 50](#)
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Prerequisites for Load Sharing MPLS VPN Traffic

Before configuring load sharing, ensure that your MPLS VPN network (including MPLS VPN carrier supporting carrier or interautonomous system) is configured and working properly. See the “[Related Documents](#)” section on [page 49](#) for references related to MPLS VPNs.

Restrictions for Load Sharing MPLS VPN Traffic

- Configuring BGP multipath for eBGP and iBGP is only for basic MPLS Layer 3 VPNs. MPLS VPN Inter-AS and MPLS VPN carrier supporting carrier do not support this multipath configuration.
- With multiple iBGP paths installed in a routing table, a route reflector advertises only one of the paths (one next hop). If a router is behind a route reflector, all routers that are connected to multihomed sites are not advertised unless separate VRFs with different RDs are configured for each VRF.
- Each IP routing table entry for a BGP prefix that has multiple iBGP paths uses additional memory. We recommend not using this feature on a router with a low amount of available memory and especially when the router is carrying a full Internet routing table.
- eBGP Multipath is not supported on MPLS VPN Inter-AS with ASBRs that exchange VPNv4 routes.
- Load sharing using directly connected loopback peering does not apply to CSC networks that use LDP and an IGP to distribute routes and MPLS labels.

When you configure static routes in an MPLS or MPLS VPN environment, some variations of the **ip route** and **ip route vrf** commands are not supported. These variations of the commands are not supported in Cisco IOS releases that support the Tag Forwarding Information Base (TFIB), specifically Cisco IOS Releases 12.nT, 12.nM, and 12.0S. The TFIB cannot resolve prefixes when the recursive route over which the prefixes travel disappears and then reappears. However, the command variations are supported in Cisco IOS releases that support the MPLS Forwarding Infrastructure (MFI), specifically Cisco IOS Release 12.2(25)S and later releases. Use the following guidelines when configuring static routes.

Supported Static Routes in an MPLS Environment

The following **ip route** command is supported when you configure static routes in an MPLS environment:

```
ip route destination-prefix mask interface next-hop-address
```

The following **ip route** commands are supported when you configure static routes in an MPLS environment and configure load sharing with static nonrecursive routes and a specific outbound interface:

```
ip route destination-prefix mask interface1 next-hop1  
ip route destination-prefix mask interface2 next-hop2
```

Unsupported Static Routes in an MPLS Environment That Uses the TFIB

The following **ip route** command is not supported when you configure static routes in an MPLS environment:

ip route *destination-prefix mask next-hop-address*

The following **ip route** command is not supported when you configure static routes in an MPLS VPN environment and enable load sharing where the next hop can be reached through two paths:

ip route *destination-prefix mask next-hop-address*

The following **ip route** command is not supported when you configure static routes in an MPLS VPN environment and enable load sharing where the destination can be reached through two next hops:

ip route *destination-prefix mask next-hop1*

ip route *destination-prefix mask next-hop2*

Use the *interface* and *next-hop* arguments when specifying static routes.

Supported Static Routes in an MPLS VPN Environment

The following **ip route vrf** commands are supported when you configure static routes in an MPLS VPN environment, and the next hop and interface are associated with the same virtual routing and forwarding (VRF) instance:

- **ip route vrf** *vrf-name destination-prefix mask next-hop-address*
- **ip route vrf** *vrf-name destination-prefix mask interface next-hop-address*
- **ip route vrf** *vrf-name destination-prefix mask interface1 next-hop1*
ip route vrf *vrf-name destination-prefix mask interface2 next-hop2*

The following **ip route vrf** commands are supported when you configure static routes in an MPLS VPN environment, and the next hop is in the global table in the MPLS cloud in the global routing table. For example, these commands are supported when the next hop is pointing to the internet gateway.

- **ip route vrf** *vrf-name destination-prefix mask next-hop-address global*
- **ip route vrf** *vrf-name destination-prefix mask interface next-hop-address*
(This command is supported when the next hop and the interface are in the core.)

The following **ip route** commands are supported when you configure static routes in an MPLS VPN environment and enable load sharing with static nonrecursive routes and a specific outbound interfaces:

ip route *destination-prefix mask interface1 next-hop1*

ip route *destination-prefix mask interface2 next-hop2*

Unsupported Static Routes in an MPLS VPN Environment That Uses the TFIB

The following **ip route** command is not supported when you configure static routes in an MPLS VPN environment, the next hop is in the global table in the MPLS cloud within the core, and you enable load sharing where the next hop can be reached through two paths:

ip route vrf *destination-prefix mask next-hop-address global*

The following **ip route** commands are not supported when you configure static routes in an MPLS VPN environment, the next hop is in the global table in the MPLS cloud within the core, and you enable load sharing where the destination can be reached through two next hops:

ip route vrf *destination-prefix mask next-hop1 global*

ip route vrf *destination-prefix mask next-hop2 global*

The following **ip route vrf** commands are not supported when you configure static routes in an MPLS VPN environment, and the next hop and interface are in the same VRF:

ip route vrf *vrf-name destination-prefix mask next-hop1*

ip route vrf *vrf-name destination-prefix mask next-hop2*

Supported Static Routes in an MPLS VPN Environment Where the Next Hop Resides in the Global Table on the CE Router

The following **ip route vrf** command is supported when you configure static routes in an MPLS VPN environment, and the next hop is in the global table on the customer edge (CE) side. For example, the following command is supported when the destination-prefix is the CE router's loopback address, as in EBGp multihop cases.

```
ip route vrf vrf-name destination-prefix mask interface next-hop-address
```

The following **ip route** commands are supported when you configure static routes in an MPLS VPN environment, the next hop is in the global table on the CE side, and you enable load sharing with static nonrecursive routes and a specific outbound interfaces:

```
ip route destination-prefix mask interface1 nexthop1
ip route destination-prefix mask interface2 nexthop2
```

Information About Load Sharing MPLS VPN Traffic

Before configuring load sharing features, you should understand the following concepts:

- [Overview of Load Sharing Using BGP Multipath Options, page 4](#)
- [Load Sharing Using Directly Connected Loopback Peering, page 6](#)

Overview of Load Sharing Using BGP Multipath Options

A variety of Border Gateway Protocol (BGP) multipath options exist that enable you to configure load sharing on your MPLS VPN that uses BGP.

To load share traffic at the iBGP multipath level, it is recommended that you configure BGP labeling using the **neighbor send-label** command in router configuration mode. When you configure the iBGP multipath feature, the following message is displayed as a reminder to use the neighbor send-label command functionality:

```
WARNING: Using iBGP multipath feature with LDP or TE based LSPs towards the BGP nexthop,
paths taken by forwarding may not be as expected. Please consider configuring BGP labeling
(RFC 3107) for proper forwarding behavior.
```

The following sections describe some BGP multipath options:

- [Internal BGP Multipath Load Sharing, page 4](#)
- [BGP Multipath for eBGP and iBGP, page 5](#)
- [eBGP Multipath Load Sharing, page 6](#)

Internal BGP Multipath Load Sharing

When a BGP-speaking router with no local policy configured receives multiple network layer reachability information (NLRI) from the internal BGP (iBGP) for the same destination, the router chooses one iBGP path as the best path. The best path is then installed in the IP routing table of the router. The iBGP multipath feature enables the BGP-speaking router to select multiple iBGP paths as the best paths to a destination. The best paths are then installed in the IP routing table of the router. To enable iBGP multipath load sharing, you issue the **maximum-paths ibgp** command in router configuration mode. For more information about iBGP multipath load sharing, see [Configuring BGP](#).

BGP Multipath for eBGP and iBGP

The BGP multipath load sharing for both eBGP and iBGP in an MPLS VPN feature allows multihomed autonomous systems and provider edge (PE) routers to be configured to distribute traffic across both external BGP (eBGP) and iBGP paths.

BGP installs up to the maximum number of paths allowed (configured using the **maximum-paths** command). BGP uses the best path algorithm to select one multipath as the best path, inserts the best path into the routing information base (RIB), and advertises the best path to BGP peers. Other multipaths can be inserted into the RIB, but only one path is selected as the best path.

Cisco Express Forwarding uses mutlipaths to perform load balancing on a per-packet or per-source or destination pair basis. To enable the load sharing feature, configure the router with MPLS VPNs that contain VPN routing and forwarding instances (VRFs) that import both eBGP and iBGP paths. You can configure the number of multipaths separately for each VRF.



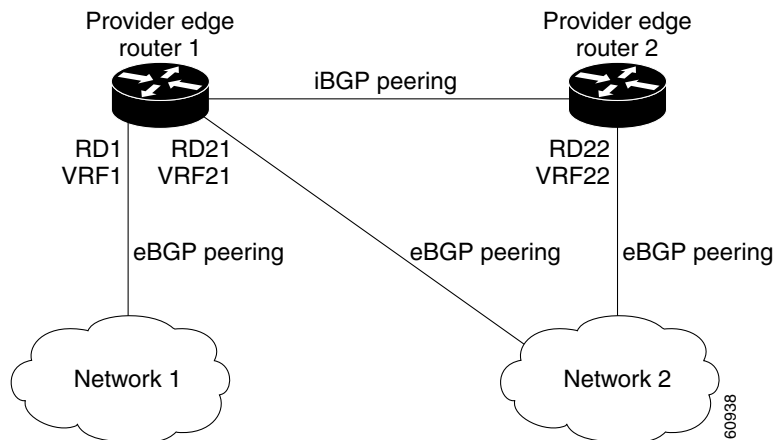
Note

This feature operates within the configuration parameters of the existing outbound routing policy.

eBGP and iBGP Multipath Load Sharing in an MPLS Network Using BGP

Figure 1 shows an MPLS service provider network using BGP that connects two remote networks to PE1 and PE2, which are both configured for VPNv4 unicast iBGP peering. Network 2 is a multihomed network that is connected to PE1 and PE2. Network 2 also has extranet VPN services configured with Network 1. Both Network 1 and Network 2 are configured for eBGP peering with the PE routers.

Figure 1 A Service Provider MPLS Network Using BGP



You can configure PE1 so that both iBGP and eBGP paths can be selected as multipaths and imported into the VRF of Network 1. Cisco Express Forwarding uses the mutlipaths to perform load balancing. Traffic is distributed as follows:

- IP traffic that is sent from Network 2 to PE1 and PE2 is sent across the eBGP paths as IP traffic.
- IP traffic that is sent from PE1 to PE2 is sent across the iBGP path as MPLS traffic.
- MPLS traffic that is sent across an eBGP path is sent as IP traffic.

Any prefix that is advertised from Network 2 will be received by PE1 through route distinguisher (RD) 21 and RD22.

- The advertisement through RD21 is carried in IP packets.

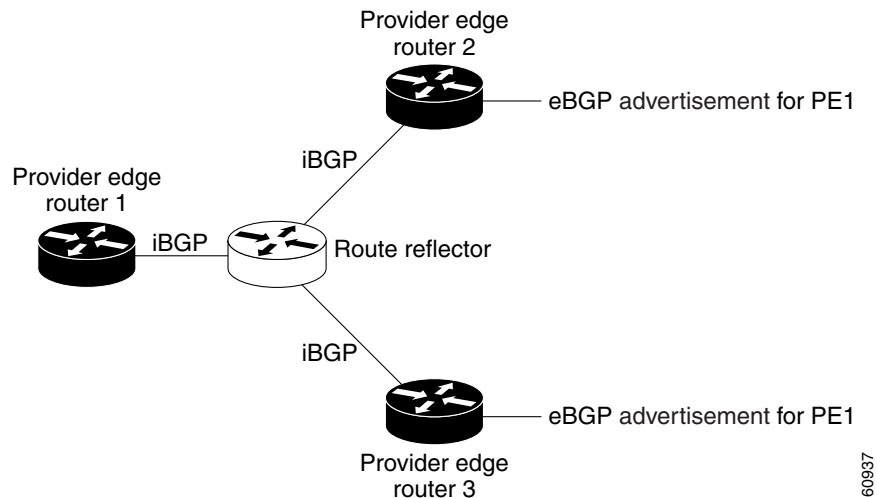
- The advertisement through RD22 is carried in MPLS packets.

Both paths can be selected as multipaths for VRF1 and inserted into the VRF1 RIB.

eBGP and iBGP Multipath Load Sharing with Route Reflectors

Figure 2 shows a topology that contains three PE routers and a route reflector, all configured for iBGP peering. PE2 and PE3 each advertise an equal preference eBGP path to PE1. By default, the route reflector chooses only one path and advertises PE1.

Figure 2 Topology with a Route Reflector



For all equal preference paths to PE1 to be advertised through the route reflector, you must configure each VRF with a different RD. The prefixes received by the route reflector are recognized differently and advertised to PE1.

eBGP Multipath Load Sharing

When a router learns two identical eBGP paths for a prefix from a neighboring autonomous system, it chooses the path with the lower route ID as the best path. This best path is installed in the IP routing table. You can enable eBGP multipath, which installs multiple paths in the IP routing table when the eBGP paths are learned from a neighboring autonomous system, instead of picking one best path.

During packet switching, depending on the switching mode, either per-packet or per-destination load sharing is performed among the multiple paths. The **maximum-paths** router configuration command controls the number of paths allowed. By default, BGP installs only one path to the IP routing table.

Load Sharing Using Directly Connected Loopback Peering

You use this feature with MPLS VPN Inter-AS and MPLS VPN carrier supporting carrier (CSC) networks to load share traffic between adjacent label switched routers (LSRs) that are connected by multiple links. The LSRs could be a pair of autonomous system boundary routers (ASBRs) or a CSC-PE and a CSC-CE.

Using directly connected loopback peering allows load sharing at the IGP level, so more than one BGP session is not needed between the LSRs. No other label distribution mechanism is needed between the adjacent LSRs than BGP.

Directly connected loopback peering enables load sharing of traffic as follows:

- A BGP session is established, using the loopback addresses of the LSRs.
- MPLS is enabled on the connecting links.
- Multiple static routes to the loopback address of the adjacent LSR allow IGP load sharing.
- The outgoing label to the loopback address of the adjacent LSR is an implicit null label and is inferred by the LSR.
- Because IGP load sharing is enabled on the loopback address of the adjacent LSR, any traffic destined to a prefix that is learned over the BGP session (and recurses over the loopback) is load shared.

How to Configure Load Sharing

This section contains the following procedures:

- [Configuring BGP Multipath Load Sharing for eBGP and iBGP, page 7](#) (required)
- [Verifying BGP Multipath Load Sharing for eBGP and iBGP, page 8](#) (optional)
- [Configuring eBGP Multipath Load Sharing with MPLS VPN Inter-AS, page 9](#) (required)
- [Configuring eBGP Multipath Load Sharing with MPLS VPN Carrier Supporting Carrier on the CSC-PE Routers, page 11](#) (required)
- [Configuring eBGP Multipath Load Sharing with MPLS VPN Carrier Supporting Carrier on the CSC-CE Routers, page 13](#)
- [Configuring Directly Connected Loopback Peering for MPLS VPN Inter-AS using ASBRs to Exchange VPN-IPv4 Addresses, page 16](#) (required)
- [Configuring Directly Connected Loopback Peering for MPLS VPN Inter-AS Using ASBRs to Exchange IPv4 Routes and Labels, page 23](#) (required)
- [Configuring Directly Connected Loopback Peering on MPLS VPN Carrier Supporting Carrier, page 31](#) (required)

Configuring BGP Multipath Load Sharing for eBGP and iBGP

To configure iBGP and eBGP routes for multipath load sharing, perform the following task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *as-number*
4. **address-family ipv4** [**multicast** | **unicast** | **vrf** *vrf-name*]
5. **maximum-paths eibgp** *number-of-paths*

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	router bgp as-number Example: Router(config)# router bgp 1	Enters router configuration mode and configures the router to run a BGP routing process.
Step 4	address-family ipv4 [multicast unicast vrf vrf-name] Example: Router(config-router)# address-family ipv4 vrf vrf1	Enters address family configuration mode for configuring routing sessions such as BGP that use standard IPv4 address prefixes. Note For this task you must create the VRF and specify the vrf keyword. <ul style="list-style-type: none"> The multicast keyword specifies IPv4 multicast address prefixes. The unicast keyword specifies IPv4 unicast address prefixes. The vrf vrf-name keyword and argument specify the name of the VRF to associate with subsequent IPv4 address family configuration mode commands.
Step 5	maximum-paths eibgp number-of-paths Example: Router(config-router-af)# maximum-paths eibgp 6	Configures the number of parallel iBGP and eBGP routes that can be installed into a routing table.

Verifying BGP Multipath Load Sharing for eBGP and iBGP

To verify the configuration of iBGP and eBGP routes for multipath load sharing, perform this task.

SUMMARY STEPS

- enable**
- show ip bgp vpnv4 {all | rd route-distinguisher | vrf vrf-name} [rib-failure] [ip-prefix/length [longer-prefixes]] [network-address [mask] [longer-prefixes]] [cidr-only] [community] [community-list] [dampened-paths] [filter-list] [flap-statistics] [inconsistent-as] [neighbors] [paths [line]] [peer-group] [quote-regexp] [regexp] [summary] [labels]**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>(Optional) Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>show ip bgp vpnv4 {all rd route-distinguisher vrf vrf-name} [rib-failure] [ip-prefix/length] [longer-prefixes] [network-address [mask]] [longer-prefixes] [cidr-only] [community] [community-list] [dampened-paths] [filter-list] [flap-statistics] [inconsistent-as] [neighbors] [paths [line]] [peer-group] [quote-regexp] [regexp] [summary] [labels]</p> <p>Example: Router# show ip bgp vpnv4 all</p>	<p>Displays attributes and multipaths for a specific network in an MPLS VPN.</p> <ul style="list-style-type: none"> Enter one or more keywords or arguments.

Configuring eBGP Multipath Load Sharing with MPLS VPN Inter-AS

Perform this task on the ASBRs to configure eBGP Multipath for MPLS VPN interautonomous systems with ASBRs exchanging IPv4 routes and MPLS labels.

SUMMARY STEPS

- enable**
- configure terminal**
- router bgp** *as-number*
- neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
- address-family ipv4** [**multicast** | **unicast** | **vrf vrf-name**]
- maximum paths** *number-paths*
- neighbor** {*ip-address* | *peer-group-name*} **activate**
- neighbor** *ip-address* **send-label**
- exit-address-family**
- end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p>router bgp <i>as-number</i></p> <p>Example: Router(config)# router bgp 100</p>	<p>Configures a BGP routing process and places the router in router configuration mode.</p> <ul style="list-style-type: none"> The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along. Valid numbers are from 0 to 65535. Private autonomous system numbers that can be used in internal networks range from 64512 to 65535.
Step 4	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>} remote-as <i>as-number</i></p> <p>Example: Router(config-router)# neighbor 10.0.0.1 remote-as 200</p>	<p>Adds an entry to the BGP or multiprotocol BGP neighbor table.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighbor. The <i>peer-group-name</i> argument specifies the name of a BGP peer group. The <i>as-number</i> argument specifies the autonomous system to which the neighbor belongs.
Step 5	<p>address-family ipv4 [multicast unicast vrf <i>vrf-name</i>]</p> <p>Example: Router(config-router)# address-family ipv4</p>	<p>Enters address family configuration mode for configuring routing sessions such as BGP that use standard IPv4 address prefixes.</p> <ul style="list-style-type: none"> The multicast keyword specifies IPv4 multicast address prefixes. The unicast keyword specifies IPv4 unicast address prefixes. The vrf <i>vrf-name</i> keyword and argument specify the name of the VRF to associate with subsequent IPv4 address family configuration mode commands.
Step 6	<p>maximum-paths <i>number-paths</i></p> <p>Example: Router(config-router-af)# maximum-paths 2</p>	<p>(Optional) Controls the maximum number of parallel routes an IP routing protocol can support.</p> <ul style="list-style-type: none"> The <i>number-paths</i> argument specifies the maximum number of parallel routes an IP routing protocol installs in a routing table.

	Command or Action	Purpose
Step 7	neighbor { <i>ip-address</i> <i>peer-group-name</i> } activate Example: Router(config-router-af)# neighbor 10.0.0.1 activate	Enables the exchange of information with a neighboring router. <ul style="list-style-type: none"> • The <i>ip-address</i> argument specifies the IP address of the neighbor. • The <i>peer-group-name</i> argument specifies the name of a BGP peer group.
Step 8	neighbor <i>ip-address</i> send-label Example: Router(config-router-af)# neighbor 10.0.0.1 send-label	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router. <ul style="list-style-type: none"> • The <i>ip-address</i> argument specifies the IP address of the neighboring router.
Step 9	exit-address-family Example: Router(config-router-af)# exit-address-family	Exits address family configuration mode.
Step 10	end Example: Router(config-router-af)# end	(Optional) Exits to privileged EXEC mode.

Configuring eBGP Multipath Load Sharing with MPLS VPN Carrier Supporting Carrier on the CSC-PE Routers

Perform this task to configure eBGP Multipath load sharing on the CSC-PE routers that distribute BGP routes with MPLS labels.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *as-number*
4. **address-family ipv4** [**multicast** | **unicast** | **vrf** *vrf-name*]
5. **maximum paths** *number-paths*
6. **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
7. **neighbor** {*ip-address* | *peer-group-name*} **activate**
8. **neighbor** *ip-address* **as-override**
9. **neighbor** *ip-address* **send-label**
10. **exit-address-family**
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p>router bgp <i>as-number</i></p> <p>Example: Router(config)# router bgp 100</p>	<p>Configures a BGP routing process and enters router configuration mode.</p> <ul style="list-style-type: none"> The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along. Valid numbers are from 0 to 65535. Private autonomous system numbers that can be used in internal networks range from 64512 to 65535.
Step 4	<p>address-family ipv4 [multicast unicast vrf <i>vrf-name</i>]</p> <p>Example: Router(config-router)# address-family ipv4 vrf vpn1</p>	<p>Specifies the IPv4 address family type and enters address family configuration mode.</p> <ul style="list-style-type: none"> The multicast keyword specifies IPv4 multicast address prefixes. The unicast keyword specifies IPv4 unicast address prefixes. The vrf <i>vrf-name</i> keyword and argument specify the name of the VRF to associate with subsequent IPv4 address family configuration mode commands.
Step 5	<p>maximum-paths <i>number-paths</i></p> <p>Example: Router(config-router-af)# maximum-paths 2</p>	<p>(Optional) Controls the maximum number of parallel routes an IP routing protocol can support.</p> <ul style="list-style-type: none"> On the CSC-PE router, this command is enabled in address family configuration mode. The <i>number-paths</i> argument specifies the maximum number of parallel routes an IP routing protocol installs in a routing table.
Step 6	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>} remote-as <i>as-number</i></p> <p>Example: Router(config-router-af)# neighbor 10.0.0.1 remote-as 200</p>	<p>Adds an entry to the BGP or multiprotocol BGP neighbor table.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighbor. The <i>peer-group-name</i> argument specifies the name of a BGP peer group. The <i>as-number</i> argument specifies the autonomous system to which the neighbor belongs.

	Command or Action	Purpose
Step 7	neighbor { <i>ip-address</i> <i>peer-group-name</i> } activate Example: Router(config-router-af)# neighbor 10.0.0.1 activate	Enables the exchange of information with a neighboring BGP router. <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighbor. The <i>peer-group-name</i> argument specifies the name of a BGP peer group.
Step 8	neighbor <i>ip-address</i> as-override Example: Router(config-router-af)# neighbor 10.0.0.1 as-override	Configures a PE router to override the autonomous system number (ASN) of a site with the ASN of a provider. <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the router that is to be overridden with the ASN provided.
Step 9	neighbor <i>ip-address</i> send-label Example: Router(config-router-af)# neighbor 10.0.0.1 send-label	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router. <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighboring router.
Step 10	exit-address-family Example: Router(config-router-af)# exit-address-family	Exits address family configuration mode.
Step 11	end Example: Router(config-router)# end	(Optional) Exits to privileged EXEC mode.

Configuring eBGP Multipath Load Sharing with MPLS VPN Carrier Supporting Carrier on the CSC-CE Routers

Perform this task to configure eBGP Multipath load sharing on the CSC-CE routers.

SUMMARY STEPS

- enable**
- configure terminal**
- router bgp** *as-number*
- maximum paths** *number-paths*
- address-family ipv4** [**multicast** | **unicast** | **vrf** *vrf-name*]
- redistribute** *protocol*
- neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
- neighbor** {*ip-address* | *peer-group-name*} **activate**
- neighbor** *ip-address* **send-label**
- exit-address-family**

11. end

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	router bgp <i>as-number</i> Example: Router(config)# router bgp 200	Configures a BGP routing process and enters router configuration mode. <ul style="list-style-type: none"> The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along. Valid numbers are from 0 to 65535. Private autonomous system numbers that can be used in internal networks range from 64512 to 65535.
Step 4	maximum-paths <i>number-paths</i> Example: Router(config-router)# maximum-paths 2	(Optional) Controls the maximum number of parallel routes an IP routing protocol can support. <ul style="list-style-type: none"> On the CSC-CE routers, this command is issued in router configuration mode. The <i>number-paths</i> argument specifies the maximum number of parallel routes an IP routing protocol installs in a routing table.
Step 5	address-family ipv4 [multicast unicast vrf <i>vrf-name</i>] Example: Router(config-router)# address-family ipv4	Specifies the IPv4 address family type and enters address family configuration mode. <ul style="list-style-type: none"> The multicast keyword specifies IPv4 multicast address prefixes. The unicast keyword specifies IPv4 unicast address prefixes. The vrf <i>vrf-name</i> keyword and argument specify the name of the VRF to associate with subsequent IPv4 address family configuration mode commands.

	Command or Action	Purpose
Step 6	<p>redistribute <i>protocol</i></p> <p>Example: Router(config-router-af)# redistribute static</p>	<p>Redistributes routes from one routing domain into another routing domain.</p> <ul style="list-style-type: none"> The <i>protocol</i> argument specifies the source protocol from which routes are being redistributed. It can be one of the following keywords: bgp, connected, egp, igrp, isis, mobile, ospf, rip, and static [ip]. <ul style="list-style-type: none"> The static [ip] keyword redistributes IP static routes. <p>Note The optional ip keyword is used when you redistribute static routes into Intermediate System-to-Intermediate System (IS-IS).</p> <ul style="list-style-type: none"> The connected keyword refers to routes that are established automatically when IP is enabled on an interface. For routing protocols such as Open Shortest Path First (OSPF) and IS-IS, these routes are redistributed as external to the autonomous system.
Step 7	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>}</p> <p>remote-as <i>as-number</i></p> <p>Example: Router(config-router-af)# neighbor 10.0.0.2 remote-as 100</p>	<p>Adds an entry to the BGP or multiprotocol BGP neighbor table.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighbor. The <i>peer-group-name</i> argument specifies the name of a BGP peer group. The <i>as-number</i> argument specifies the autonomous system to which the neighbor belongs.
Step 8	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>}</p> <p>activate</p> <p>Example: Router(config-router-af)# neighbor 10.0.0.2 activate</p>	<p>Enables the exchange of information with a neighboring BGP router.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighbor. The <i>peer-group-name</i> argument specifies the name of a BGP peer group.
Step 9	<p>neighbor <i>ip-address</i> send-label</p> <p>Example: Router(config-router-af)# neighbor 10.0.0.2 send-label</p>	<p>Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument specifies the IP address of the neighboring router.
Step 10	<p>exit-address-family</p> <p>Example: Router(config-router-af)# exit-address-family</p>	<p>Exits address family configuration mode.</p>
Step 11	<p>end</p> <p>Example: Router(config-router)# end</p>	<p>(Optional) Exits to privileged EXEC mode.</p>

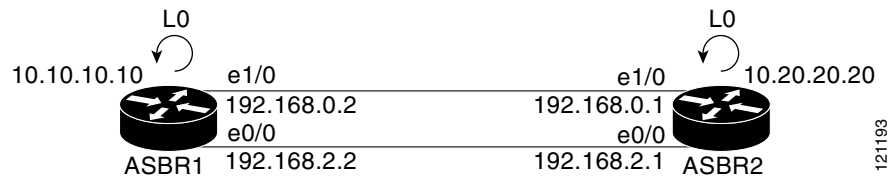
Configuring Directly Connected Loopback Peering for MPLS VPN Inter-AS using ASBRs to Exchange VPN-IPv4 Addresses

This section describes the following tasks you need to do to configure peering of loopback interfaces of directly connected ASBRs:

- [Configuring Loopback Interface Addresses for Directly Connected ASBRs, page 16](#) (required)
- [Configuring /32 Static Routes to the eBGP Neighbor Loopback, page 17](#) (required)
- [Configuring Forwarding on Connecting Loopback Interfaces, page 18](#) (required)
- [Configuring an eBGP Session Between the Loopbacks, page 19](#) (required)
- [Verifying That Load Sharing Occurs Between Loopbacks, page 22](#) (optional)

Figure 3 shows the loopback configuration for directly connected ASBR1 and ASBR2. This configuration is used as the example in the tasks that follow.

Figure 3 Loopback Interface Configuration for Directly Connected ASBR1 and ASBR2



Configuring Loopback Interface Addresses for Directly Connected ASBRs

Perform this task to configure loopback interface addresses for directly connected ASBRs.



Note

Loopback addresses need to be configured for each directly connected ASBR. That is, configure a loopback address for ASBR1 and for ASBR2 in the example shown in [Figure 3](#).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface loopback** *interface-number*
4. **ip address** *ip-address mask* [**secondary**]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface loopback <i>interface-number</i> Example: Router(config)# interface loopback 0	Configures a software-only virtual interface that emulates an interface that is always up and enters interface configuration mode. <ul style="list-style-type: none"> The interface-number argument is the number of the loopback interface that you want to create or configure. There is no limit on the number of loopback interfaces that you can create.
Step 4	ip address <i>ip-address mask [secondary]</i> Example: Router(config-if)# ip address 10.10.10.10 255.255.255.255	Sets a primary or secondary IP address for an interface. <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address. The <i>mask</i> argument is the mask for the associated IP subnet. The secondary keyword specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 5	end Example: Router(config-if)# end	Exits to privileged EXEC mode.

Configuring /32 Static Routes to the eBGP Neighbor Loopback

Perform this task to configure /32 static routes to the eBGP neighbor loopback.

**Note**

You need to configure /32 static routes on each of the directly connected ASBRs.

SUMMARY STEPS

- enable**
- configure terminal**
- ip route** *prefix mask {ip-address | interface-type interface-number [ip-address]}*
[distance] [name] [permanent] [tag tag]
- end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p>ip route <i>prefix mask</i> {<i>ip-address</i> <i>interface-type interface-number</i> [<i>ip-address</i>]} [<i>distance</i>] [<i>name</i>] [permanent] [tag tag]</p> <p>Example: Router(config)# ip route 10.20.20.20 255.255.255.255 Ethernet 1/0 172.16.0.1</p>	<p>Establishes static routes.</p> <ul style="list-style-type: none"> The <i>prefix</i> argument is the IP route prefix for the destination. The <i>mask</i> argument is the prefix mask for the destination. The <i>ip-address</i> argument is the IP address of the next hop that you can use to reach the specified network. The <i>interface-type</i> and <i>interface-number</i> arguments are the network interface type and interface number. The <i>distance</i> argument is an administrative distance. The <i>name</i> argument applies a name to the specified route. The permanent keyword specifies that the route is not to be removed, even if the interface shuts down. The tag tag keyword and argument name a tag value that can be used as a “match” value for controlling redistribution through the use of route maps.
Step 4	<p>end</p> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Configuring Forwarding on Connecting Loopback Interfaces

Perform this task to configure forwarding on the connecting loopback interfaces.

This task is required for sessions between loopbacks. In the “[Configuring /32 Static Routes to the eBGP Neighbor Loopback](#)” task, Ethernet 1/0 and Ethernet 0/0 are the connecting interfaces.

SUMMARY STEPS

- enable**
- configure terminal**
- interface** *type slot/port*

4. `mpls bgp forwarding`
5. `exit`
6. Repeat Steps 3 and 4 for another connecting interface (Ethernet 0/0).
7. `end`

DETAILED STEPS

	Command or Action	Purpose
Step 1	<code>enable</code> Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	<code>configure terminal</code> Example: Router# configure terminal	Enters global configuration mode.
Step 3	<code>interface type slot/port</code> Example: Router(config)# interface ethernet 1/0	Configures an interface type and enters interface configuration mode. <ul style="list-style-type: none"> • The <i>type</i> argument is the type of interface to be configured. • The <i>slot</i> argument is the slot number. Refer to the appropriate hardware manual for slot and port information. • The <i>port</i> argument is the port number. Refer to the appropriate hardware manual for slot and port information.
Step 4	<code>mpls bgp forwarding</code> Example: Router(config-if)# mpls bgp forwarding	Configures BGP to enable MPLS forwarding on connecting interfaces.
Step 5	<code>exit</code> Example: Router(config-if)# exit	Exits to global configuration mode.
Step 6	Repeat Steps 3 and 4 for another connecting interface (Ethernet 0/0).	—
Step 7	<code>end</code> Example: Router(config)# end	Exits to privileged EXEC mode.

Configuring an eBGP Session Between the Loopbacks

Perform this task to configure an eBGP session between the loopbacks.

**Note**

You need to configure an eBGP session between loopbacks on each directly connected ASBR.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *as-number*
4. **no bgp default route-target filter**
5. **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
6. **neighbor** {*ip-address* | *peer-group-name*} **disable-connected-check**
7. **neighbor** {*ip-address* | *ipv6-address* | *peer-group-name*} **update-source** *interface-type interface-number*
8. **address-family vpnv4** [**unicast**]
9. **neighbor** {*ip-address* | *peer-group-name* | *ipv6-address*} **activate**
10. **neighbor** {*ip-address* | *peer-group-name*} **send-community** [**both** | **standard** | **extended**]
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	router bgp <i>as-number</i> Example: Router(config)# router bgp 200	Configures the BGP routing process. <ul style="list-style-type: none"> • The <i>as-number</i> indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along.
Step 4	no bgp default route-target filter Example: Router(config)# no bgp default route-target filter	Disables BGP route-target filtering, and enters router configuration mode. <ul style="list-style-type: none"> • All received BGP VPN-IPv4 routes are accepted by the router.

	Command or Action	Purpose
Step 5	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>} remote-as <i>as-number</i></p> <p>Example: Router(config-router)# neighbor 10.20.20.20 remote-as 100</p>	<p>Adds an entry to the BGP or multiprotocol BGP neighbor table.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>as-number</i> argument is the autonomous system to which the neighbor belongs.
Step 6	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>} disable-connected-check</p> <p>Example: Router(config-router)# neighbor 10.20.20.20 disable-connected-check</p>	<p>Allows peering between loopbacks.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group.
Step 7	<p>neighbor {<i>ip-address</i> <i>ipv6-address</i> <i>peer-group-name</i>} update-source <i>interface-type</i> <i>interface-number</i></p> <p>Example: Router(config-router)# neighbor 10.20.20.20 update-source Loopback 0</p>	<p>Allows BGP sessions to use any operational interface for TCP connections.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IPv4 address of the BGP-speaking neighbor. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p> <ul style="list-style-type: none"> The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>interface-type</i> argument is the interface type. The <i>interface-number</i> argument is the interface number.
Step 8	<p>address-family vpn4 [unicast]</p> <p>Example: Router(config-router)# address-family vpn4</p>	<p>Enters address family configuration mode for configuring routing protocols such as BGP, Routing Information Protocol (RIP), and static routing.</p> <ul style="list-style-type: none"> The unicast keyword specifies unicast prefixes.
Step 9	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i> <i>ipv6-address</i>} activate</p> <p>Example: Router(config-router-af)# neighbor 10.20.20.20 activate</p>	<p>Enables the exchange of information with a BGP neighbor.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router. The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>Note This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p>

	Command or Action	Purpose
Step 10	<pre>neighbor {ip-address peer-group-name} send-community [both standard extended]</pre> <p>Example: Router(config-router-af)# neighbor 10.20.20.20 send-community extended</p>	<p>Specifies that a communities attribute should be sent to a BGP neighbor.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router. The <i>peer-group-name</i> argument is the name of a BGP peer group. The both keyword specifies that both standard and extended communities will be sent. The standard keyword specifies that only standard communities will be sent. The extended keyword specifies that only extended communities will be sent.
Step 11	<pre>end</pre> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Verifying That Load Sharing Occurs Between Loopbacks

Perform this task to verify that load sharing occurs between loopbacks. You need to ensure that the MPLS Label Forwarding Information Base (LFIB) entry for the neighbor route lists the available paths and interfaces.

SUMMARY STEPS

- enable**
- show mpls forwarding-table** [*network {mask | length}*] | **labels** *label* [- *label*] | **interface** *interface* | **next-hop** *address* | **lsp-tunnel** [*tunnel-id*] [**vrf** *vrf-name*] [**detail**]
- disable**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	(Optional) Enables privileged EXEC mode. <ul style="list-style-type: none">Enter your password if prompted.
Step 2	show mpls forwarding-table [network {mask length} labels label [-label] interface interface next-hop address lsp-tunnel [tunnel-id]] [vrf vrf-name] [detail] Example: Router# show mpls forwarding-table	Displays the contents of the MPLS LFIB. <ul style="list-style-type: none">Enter an optional keyword or argument if desired.
Step 3	disable Example: Router# disable	Exits to user EXEC mode.

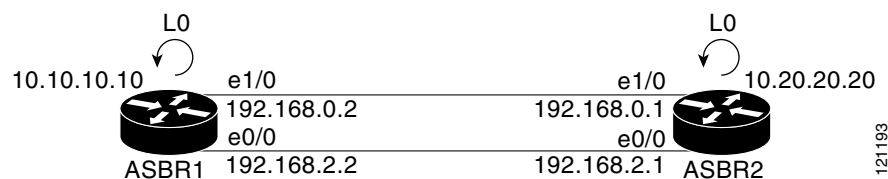
Configuring Directly Connected Loopback Peering for MPLS VPN Inter-AS Using ASBRs to Exchange IPv4 Routes and Labels

The following sections describe how to configure peering of loopback interfaces of directly connected ASBRs to achieve load sharing in an interautonomous system network:

- [Configuring Loopback Interface Addresses for Directly Connected ASBRs, page 24](#) (required)
- [Configuring /32 Static Routes to the eBGP Neighbor Loopback, page 25](#) (required)
- [Configuring Forwarding on Connecting Loopback Interfaces, page 26](#) (required)
- [Configuring an eBGP Session Between the Loopbacks, page 27](#) (required)
- [Verifying That Load Sharing Occurs Between Loopbacks, page 30](#) (optional)

Figure 4 shows the loopback configuration for directly connected ASBR1 and ASBR2. This configuration is used as the example in the tasks that follow.

Figure 4 Loopback Interface Configuration for Directly Connected ASBR1 and ASBR2



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Configuring Loopback Interface Addresses for Directly Connected ASBRs

Perform this task to configure loopback interface addresses.



Note

Loopback addresses need to be configured for each directly connected ASBR. That is, configure a loopback address for ASBR1 and for ASBR2 as in the example shown in [Figure 4](#).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface loopback** *interface-number*
4. **ip address** *ip-address mask* [**secondary**]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface loopback <i>interface-number</i> Example: Router(config)# interface loopback 0	Configures a software-only virtual interface that emulates an interface that is always up and enters interface configuration mode. <ul style="list-style-type: none"> • The <i>interface-number</i> argument is the number of the loopback interface that you want to create or configure. There is no limit on the number of loopback interfaces that you can create.

	Command or Action	Purpose
Step 4	<p><code>ip address ip-address mask [secondary]</code></p> <p>Example: Router(config-if)# ip address 10.10.10.10 255.255.255.255</p>	<p>Sets a primary or secondary IP address for an interface.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address. The <i>mask</i> argument is the mask for the associated IP subnet. The secondary keyword specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 5	<p><code>end</code></p> <p>Example: Router(config-if)# end</p>	<p>Exits to privileged EXEC mode.</p>

Configuring /32 Static Routes to the eBGP Neighbor Loopback

Perform this task to configure /32 static routes to the eBGP neighbor loopback.



Note

You need to configure /32 static routes on each of the directly connected ASBRs.

SUMMARY STEPS

- `enable`
- `configure terminal`
- `ip route prefix mask {ip-address | interface-type interface-number [ip-address]}`
`[distance] [name] [permanent] [tag tag]`
- `end`

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><code>enable</code></p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p><code>configure terminal</code></p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>

Command or Action	Purpose
<p>Step 3</p> <pre>ip route prefix mask {ip-address interface-type interface-number [ip-address]} [distance] [name] [permanent] [tag tag]</pre> <p>Example: Router(config)# ip route 10.20.20.20 255.255.255.255 Ethernet 1/0 172.16.0.1</p>	<p>Establishes static routes.</p> <ul style="list-style-type: none"> • The <i>prefix</i> argument is the IP route prefix for the destination. • The <i>mask</i> argument is the prefix mask for the destination. • The <i>ip-address</i> argument is the IP address of the next hop that you can use to reach the specified network. • The <i>interface-type</i> and <i>interface-number</i> arguments are the network interface type and interface number. • The <i>distance</i> argument is an administrative distance. • The <i>name</i> argument applies a name to the specified route. • The permanent keyword specifies that the route is not to be removed, even if the interface shuts down. • The tag tag keyword and argument name a tag value that can be used as a “match” value for controlling redistribution through the use of route maps.
<p>Step 4</p> <pre>end</pre> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Configuring Forwarding on Connecting Loopback Interfaces

Perform this task to configure forwarding on the connecting loopback interfaces.

This task is required for sessions between loopbacks. In the “[Configuring /32 Static Routes to the eBGP Neighbor Loopback](#)” task, Ethernet1/0 and Ethernet0/0 are the connecting interfaces.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface type slot/port**
4. **mpls bgp forwarding**
5. **exit**
6. Repeat Steps 3 and 4 for another connecting interface (Ethernet 0/0)
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface <i>type slot/port</i> Example: Router(config)# interface ethernet 1/0	Configures an interface type and enters interface configuration mode. <ul style="list-style-type: none"> The <i>type</i> argument is the type of interface to be configured. The <i>slot</i> argument is the slot number. Refer to the appropriate hardware manual for slot and port information. The <i>port</i> argument is the port number. Refer to the appropriate hardware manual for slot and port information.
Step 4	mpls bgp forwarding Example: Router(config-if)# mpls bgp forwarding	Configures BGP to enable MPLS forwarding on connecting interfaces.
Step 5	exit Example: Router(config-if)# exit	Exits to global configuration mode.
Step 6	Repeat Steps 3 and 4 for another connecting interface (Ethernet 0/0).	—
Step 7	end Example: Router(config)# end	Exits to privileged EXEC mode.

Configuring an eBGP Session Between the Loopbacks

Perform the following tasks to configure an eBGP session between the loopbacks.

**Note**

You need to configure an eBGP session between loopbacks on each directly connected ASBR.

SUMMARY STEPS

1. enable

2. **configure terminal**
3. **router bgp** *as-number*
4. **bgp log-neighbor-changes**
5. **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
6. **neighbor** {*ip-address* | *peer-group-name*} **disable-connected-check**
7. **neighbor** {*ip-address* | *ipv6-address* | *peer-group-name*} **update-source** *interface-type interface-number*
8. **address-family ipv4** [**unicast**] **vrf** *vrf-name*
9. **neighbor** {*ip-address* | *peer-group-name* | *ipv6-address*} **activate**
10. **neighbor** {*ip-address* | *peer-group-name*} **send-community** [**both** | **standard** | **extended**]
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	router bgp <i>as-number</i> Example: Router(config)# router bgp 200	Configures the BGP routing process, and enters router configuration mode. <ul style="list-style-type: none"> The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along.
Step 4	bgp log-neighbor-changes Example: Router(config-router)# bgp log-neighbor-changes	Enables logging of BGP neighbor resets.
Step 5	neighbor { <i>ip-address</i> <i>peer-group-name</i> } remote-as <i>as-number</i> Example: Router(config-router)# neighbor 10.20.20.20 remote-as 100	Adds an entry to the BGP or multiprotocol BGP neighbor table. <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>as-number</i> argument is the number of the autonomous system to which the neighbor belongs.

	Command or Action	Purpose
Step 6	<pre>neighbor {ip-address peer-group-name} disable-connected-check</pre> <p>Example: Router(config-router)# neighbor 10.20.20.20 disable-connected-check</p>	<p>Allows peering between loopbacks.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group.
Step 7	<pre>neighbor {ip-address ipv6-address peer-group-name} update-source interface-type interface-number</pre> <p>Example: Router(config-router)# neighbor 10.20.20.20 update-source Loopback 0</p>	<p>Allows BGP sessions to use any operational interface for TCP connections.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IPv4 address of the BGP-speaking neighbor. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>Note This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p> <ul style="list-style-type: none"> The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>interface-type</i> argument is the interface type. The <i>interface-number</i> argument is the interface number.
Step 8	<pre>address-family ipv4 [unicast] vrf vrf-name</pre> <p>Example: Router(config-router)# address-family ipv4</p>	<p>Enters address family configuration mode for configuring routing protocols such as BGP, Routing Information Protocol (RIP), and static routing.</p> <ul style="list-style-type: none"> The unicast keyword specifies unicast prefixes. The vrf vrf-name keyword and argument specify the name of a VPN routing/forwarding instance (VRF) to associate with submode commands.
Step 9	<pre>neighbor {ip-address peer-group-name ipv6-address} activate</pre> <p>Example: Router(config-router-af)# neighbor 10.20.20.20 activate</p>	<p>Enables the exchange of information with a BGP neighbor.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router. The <i>peer-group-name</i> argument is the name of the BGP peer group. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>Note This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p>

	Command or Action	Purpose
Step 10	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i>}</p> <p>send-community [both standard extended]</p> <p>Example: Router(config-router-af)# neighbor 10.20.20.20 send-community extended</p>	<p>Specifies that a communities attribute should be sent to a BGP neighbor.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router. The <i>peer-group-name</i> argument is the name of the BGP peer group. The both keyword specifies that both standard and extended communities will be sent. The standard keyword specifies that only standard communities will be sent. The extended keyword specifies that only extended communities will be sent.
Step 11	<p>end</p> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Verifying That Load Sharing Occurs Between Loopbacks

To verify that load sharing can occur between loopbacks, ensure that the MPLS LFIB entry for the neighbor route lists the available paths and interfaces.

SUMMARY STEPS

- enable**
- show mpls forwarding-table** [*network* {*mask* | *length*} | **labels** *label* [-*label*] | **interface** *interface* | **next-hop** *address* | **lsp-tunnel** [*tunnel-id*]] [**vrf** *vrf-name*] [**detail**]
- disable**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>show mpls forwarding-table [<i>network</i> {<i>mask</i> <i>length</i>} labels <i>label</i> [-<i>label</i>] interface <i>interface</i> next-hop <i>address</i> lsp-tunnel [<i>tunnel-id</i>]] [vrf <i>vrf-name</i>] [detail]</p> <p>Example: Router# show mpls forwarding-table</p>	<p>Displays the contents of the MPLS LFIB.</p> <ul style="list-style-type: none"> Enter a keyword or argument, if desired.
Step 3	<p>disable</p> <p>Example: Router# disable</p>	<p>Exits to user EXEC mode.</p>

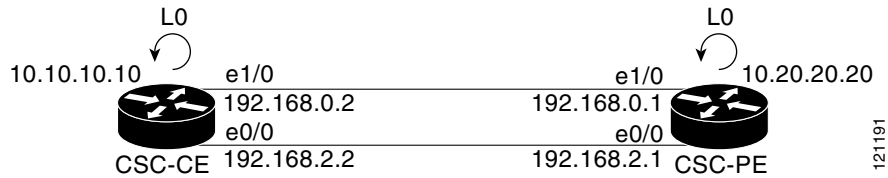
Configuring Directly Connected Loopback Peering on MPLS VPN Carrier Supporting Carrier

The following sections explain how to load balance CSC traffic by peering loopback interfaces of directly connected CSC-PE and CSC-CE routers:

- [Configuring Loopback Interface Addresses on CSC-PE Routers, page 32](#) (required)
- [Configuring Loopback Interface Addresses for CSC-CE Routers, page 33](#) (required)
- [Configuring /32 Static Routes to the eBGP Neighbor Loopback on the CSC-PE Router, page 34](#) (required)
- [Configuring /32 Static Routes to the eBGP Neighbor Loopback on the CSC-CE Router, page 36](#) (required)
- [Configuring Forwarding on CSC-PE Interfaces That Connect to the CSC-CE Loopback, page 37](#) (required)
- [Configuring Forwarding on CSC-CE Interfaces That Connect to the CSC-PE Loopback, page 39](#) (required)
- [Configuring an eBGP Session Between the CSC-PE Router and the CSC-CE Loopback, page 40](#) (required)
- [Configuring an eBGP Session Between the CSC-CE Router and the CSC-PE Loopback, page 43](#) (required)
- [Verifying That Load Sharing Occurs Between Loopbacks, page 46](#) (optional)

Figure 5 shows the loopback configuration for directly connected CSC-PE and CSC-CE routers. This configuration is used as the example in the tasks that follow.

Figure 5 Loopback Interface Configuration for Directly Connected CSC-PE and CSC-CE Routers



Configuring Loopback Interface Addresses on CSC-PE Routers

Perform this task to configure loopback interface addresses on the CSC-PE router.



Note

Configuration of a loopback interface address on the CSC-PE router requires the enabling of a VRF. The CSC-CE router loopback interface does not require the enabling of a VRF.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface loopback** *interface-number*
4. **ip vrf forwarding** *vrf-name*
5. **ip address** *ip-address mask* [secondary]
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface loopback <i>interface-number</i> Example: Router(config)# interface loopback 0	Configures a software-only virtual interface that emulates an interface that is always up, and enters interface configuration mode. <ul style="list-style-type: none"> • The <i>interface-number</i> argument is the number of the loopback interface that you want to create or configure. There is no limit on the number of loopback interfaces that you can create.

	Command or Action	Purpose
Step 4	ip vrf forwarding <i>vrf-name</i> Example: Router(config-if)# ip vrf forwarding vpn1	Associates a VRF with the specified interface or subinterface. <ul style="list-style-type: none"> The <i>vrf-name</i> argument is the name assigned to a VRF.
Step 5	ip address <i>ip-address mask [secondary]</i> Example: Router(config-if)# ip address 10.20.20.20 255.255.255.255	Sets a primary or secondary IP address for an interface. <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address. The <i>mask</i> argument is the mask for the associated IP subnet. The secondary keyword specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 6	end Example: Router(config)# end	Exits to privileged EXEC mode.

Configuring Loopback Interface Addresses for CSC-CE Routers

Perform this task to configure loopback interface addresses for CSC-CE routers.

SUMMARY STEPS

- enable
- configure terminal
- interface loopback *interface-number*
- ip address *ip-address mask [secondary]*
- end

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	interface loopback <i>interface-number</i> Example: Router(config)# interface loopback 0	Configures a software-only virtual interface that emulates an interface that is always up. <ul style="list-style-type: none"> The <i>interface-number</i> argument is the number of the loopback interface that you want to create or configure. There is no limit on the number of loopback interfaces that you can create.
Step 4	ip address <i>ip-address mask [secondary]</i> Example: Router(config-if)# ip address 10.10.10.10 255.255.255.255	Sets a primary or secondary IP address for an interface. <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address. The <i>mask</i> argument is the mask for the associated IP subnet. The secondary keyword specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 5	end Example: Router(config-if)# end	Exits to privileged EXEC mode.

Configuring /32 Static Routes to the eBGP Neighbor Loopback on the CSC-PE Router

Perform the following task to configure /32 static routes to the eBGP neighbor loopback on the CSC-PE router.

SUMMARY STEPS

- enable**
- configure terminal**
- ip route vrf** *vrf-name prefix mask {ip-address | interface-type interface-number [ip-address]}* [**global**] [*distance*] [*name*] [**permanent**] [**tag tag**]
- end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<pre>ip route vrf vrf-name prefix mask {ip-address interface-type interface-number [ip-address]} [global] [distance] [name] [permanent] [tag tag]</pre> <p>Example: Router(config)# ip route vrf vpn1 10.10.10.10 255.255.255.255 Ethernet 1/0 172.16.0.2</p>	<p>Establishes static routes for a VRF.</p> <ul style="list-style-type: none"> • The <i>vrf-name</i> argument is the name of the VRF for the static route. • The <i>prefix</i> argument is the IP route prefix for the destination. • The <i>mask</i> argument is the prefix mask for the destination. • The <i>ip-address</i> argument is the IP address of the next hop that you can use to reach the destination network. • The <i>interface-type</i> and <i>interface-number</i> arguments are the network interface type and interface number. • The global keyword specifies that the given next hop address is in the nonVRF routing table. • The <i>distance</i> argument is an administrative distance. • The <i>name</i> argument applies a name to the specified route. • The permanent keyword specifies that the route is not to be removed, even if the interface shuts down. • The tag tag keyword and argument name a tag value that can be used as a “match” value for controlling redistribution via route maps.
Step 4	<pre>end</pre> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Configuring /32 Static Routes to the eBGP Neighbor Loopback on the CSC-CE Router

Perform the following task to configure /32 static routes to the eBGP neighbor loopback for the CSC-CE router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip route** *prefix mask {ip-address | interface-type interface-number [ip-address]}*
[*distance*] [*name*] [**permanent**] [**tag tag**]
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<pre>ip route prefix mask {ip-address interface-type interface-number [ip-address]} [distance] [name] [permanent] [tag tag]</pre> <p>Example: Router(config)# ip route 10.20.20.20 255.255.255.255 Ethernet 1/0 172.16.0.1</p>	<p>Establishes static routes.</p> <ul style="list-style-type: none"> • The <i>prefix</i> argument is the IP route prefix for the destination. • The <i>mask</i> argument is the prefix mask for the destination. • The <i>ip-address</i> argument is the IP address of the next hop that you can use to reach the destination network. • The <i>interface-type</i> and <i>interface-number</i> arguments are the network interface type and interface number. • The <i>distance</i> argument is an administrative distance. • The <i>name</i> argument applies a name to the specified route. • The permanent keyword specifies that the route is not to be removed, even if the interface shuts down. • The tag tag keyword and argument name a tag value that can be used as a “match” value for controlling redistribution via route maps.
Step 4	<pre>end</pre> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Configuring Forwarding on CSC-PE Interfaces That Connect to the CSC-CE Loopback

Perform this task to configure forwarding on CSC-PE interfaces that connect to the CSC-CE loopback.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/port*
4. **ip vrf forwarding** *vrf-name*
5. **ip address** *ip-address mask* [**secondary**]
6. **mpls bgp forwarding**
7. **exit**
8. Repeat Steps 3 through 6 for another connecting interface (Ethernet 0/0).
9. **end**

DETAILED STEPS—CSC-PE

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	interface <i>type slot/port</i> Example: Router(config)# interface ethernet 1/0	Configures an interface type and enters interface configuration mode. <ul style="list-style-type: none"> The <i>type</i> argument is the type of interface to be configured. The <i>slot</i> argument is the slot number. Refer to the appropriate hardware manual for slot and port information. The <i>/port</i> argument is the port number. Refer to the appropriate hardware manual for slot and port information.
Step 4	ip vrf forwarding <i>vrf-name</i> Example: Router(config-if)# ip vrf forwarding vpn1	Associates a VRF with an interface or subinterface. <ul style="list-style-type: none"> The <i>vrf-name</i> argument is the name assigned to a VRF.
Step 5	ip address <i>ip-address mask [secondary]</i> Example: Router(config-if)# ip address 172.16.0.1 255.255.255.255	Sets a primary or secondary IP address for an interface. <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address. The <i>mask</i> argument is the mask for the associated IP subnet. The secondary keyword specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 6	mpls bgp forwarding Example: Router(config-if)# mpls bgp forwarding	Configures BGP to enable MPLS forwarding on connecting interfaces.
Step 7	exit Example: Router(config-if)# exit	Exits to global configuration mode.

	Command or Action	Purpose
Step 8	Repeat Steps 3 through 6 for another connecting interface (Ethernet 0/0).	—
Step 9	<code>end</code> Example: <code>Router(config)# end</code>	Exits to privileged EXEC mode.

Configuring Forwarding on CSC-CE Interfaces That Connect to the CSC-PE Loopback

Perform this task to configure forwarding on CSC-CE interfaces that connect to the CSC-PE loopback.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface type slot/port`
4. `mpls bgp forwarding`
5. `exit`
6. Repeat Steps 3 and 4 for another connecting interface (Ethernet 0/0).
7. `end`

DETAILED STEPS

	Command or Action	Purpose
Step 1	<code>enable</code> Example: <code>Router> enable</code>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	<code>configure terminal</code> Example: <code>Router# configure terminal</code>	Enters global configuration mode.
Step 3	<code>interface type slot/port</code> Example: <code>Router(config)# interface ethernet 1/0</code>	Configures an interface type and enters interface configuration mode. <ul style="list-style-type: none"> • The <i>type</i> argument is the type of interface to be configured. • The <i>slot</i> argument is the slot number. Refer to the appropriate hardware manual for slot and port information. • The <i>/port</i> argument is the port number. Refer to the appropriate hardware manual for slot and port information.

	Command or Action	Purpose
Step 4	<code>mpls bgp forwarding</code> Example: Router(config-if)# <code>mpls bgp forwarding</code>	Configures BGP to enable MPLS forwarding on connecting interfaces.
Step 5	<code>exit</code> Example: Router(config-if)# <code>exit</code>	Exits to global configuration mode.
Step 6	Repeat Steps 3 and 4 for another connecting interface (Ethernet 0/0).	—
Step 7	<code>end</code> Example: Router(config)# <code>end</code>	Exits to privileged EXEC mode.

Configuring an eBGP Session Between the CSC-PE Router and the CSC-CE Loopback

Perform this task to configure an eBGP session between the CSC-PE router and the CSC-CE loopback.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `router bgp as-number`
4. `bgp log-neighbor-changes`
5. `neighbor {ip-address | peer-group-name} remote-as as-number`
6. `neighbor {ip-address | peer-group-name} disable-connected-check`
7. `neighbor {ip-address | ipv6-address | peer-group-name} update-source interface-type interface-number`
8. `address-family ipv4 [unicast] vrf vrf-name`
9. `ip vrf forwarding vrf-name`
10. `neighbor {ip-address | peer-group-name | ipv6-address} activate`
11. `neighbor ip-address send-label`
12. `end`

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<p>router bgp as-number</p> <p>Example: Router(config)# router bgp 200</p>	<p>Configures the BGP routing process.</p> <ul style="list-style-type: none"> The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along.
Step 4	<p>bgp log-neighbor-changes</p> <p>Example: Router(config-router)# bgp log-neighbor-changes</p>	<p>Enables logging of BGP neighbor resets.</p>
Step 5	<p>neighbor {ip-address peer-group-name} remote-as as-number</p> <p>Example: Router(config-router)# neighbor 10.10.10.10 remote-as 100</p>	<p>Adds an entry to the BGP or multiprotocol BGP neighbor table.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>as-number</i> argument is the autonomous system to which the neighbor belongs.
Step 6	<p>neighbor {ip-address peer-group-name} disable-connected-check</p> <p>Example: Router(config-router)# neighbor 10.10.10.10 disable-connected-check</p>	<p>Allows peering between loopbacks.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group.

Command or Action	Purpose
<p>Step 7</p> <pre>neighbor {<i>ip-address</i> <i>ipv6-address</i> <i>peer-group-name</i>} update-source <i>interface-type</i> <i>interface-number</i></pre> <p>Example: Router(config-router)# neighbor 10.10.10.10 update-source Loopback 0</p>	<p>Allows BGP sessions to use any operational interface for TCP connections.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IPv4 address of the BGP-speaking neighbor. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons. The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>interface-type</i> argument is the interface type. The <i>interface-number</i> argument is the interface number.
<p>Step 8</p> <pre>address-family ipv4 [unicast] vrf <i>vrf-name</i></pre> <p>Example: Router(config-router)# address-family ipv4 vrf vpn1</p>	<p>Enters address family configuration mode for configuring routing protocols such as BGP, Routing Information Protocol (RIP), and static routing.</p> <ul style="list-style-type: none"> The ipv4 keyword configures sessions that carry standard IPv4 address prefixes. The unicast keyword specifies unicast prefixes. The vrf <i>vrf-name</i> keyword and argument specify the name of a VRF to associate with submode commands.
<p>Step 9</p> <pre>ip vrf forwarding <i>vrf-name</i></pre> <p>Example: Router(config-router-af)# ip vrf forwarding vpn1</p>	<p>Associates a VRF with an interface or subinterface.</p> <ul style="list-style-type: none"> The <i>vrf-name</i> argument is the name assigned to a VRF.
<p>Step 10</p> <pre>neighbor {<i>ip-address</i> <i>peer-group-name</i> <i>ipv6-address</i>} activate</pre> <p>Example: Router(config-router-af)# neighbor 10.10.10.10 activate</p>	<p>Enables the exchange of information with a BGP neighbor.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router. The <i>peer-group-name</i> argument is the name of the BGP peer group. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>Note This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p>

	Command or Action	Purpose
Step 11	<pre>neighbor ip-address send-label</pre> <p>Example: Router(config-router-af)# neighbor 10.10.10.10 send-label</p>	Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router. <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router.
Step 12	<pre>end</pre> <p>Example: Router(config)# end</p>	Exits to privileged EXEC mode.

Configuring an eBGP Session Between the CSC-CE Router and the CSC-PE Loopback

Perform this task to configure an eBGP session between the CSC-CE router and the CSC-PE loopback.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *as-number*
4. **bgp log-neighbor-changes**
5. **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *as-number*
6. **neighbor** {*ip-address* | *peer-group-name*} **disable-connected-check**
7. **neighbor** {*ip-address* | *ipv6-address* | *peer-group-name*} **update-source** *interface-type interface-number*
8. **address-family ipv4** [**unicast**] [**vrf** *vrf-name*]
9. **neighbor** {*ip-address* | *peer-group-name* | *ipv6-address*} **activate**
10. **neighbor ip-address send-label**
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<pre>enable</pre> <p>Example: Router> enable</p>	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<pre>configure terminal</pre> <p>Example: Router# configure terminal</p>	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<pre>router bgp as-number</pre> <p>Example: Router(config)# router bgp 200</p>	<p>Configures the BGP routing process.</p> <ul style="list-style-type: none"> The <i>as-number</i> argument indicates the number of an autonomous system that identifies the router to other BGP routers and tags the routing information passed along.
Step 4	<pre>bgp log-neighbor-changes</pre> <p>Example: Router(config-router)# bgp log-neighbor-changes</p>	<p>Enables logging of BGP neighbor resets.</p>
Step 5	<pre>neighbor {ip-address peer-group-name} remote-as as-number</pre> <p>Example: Router(config-router)# neighbor 10.20.20.20 remote-as 100</p>	<p>Adds an entry to the BGP or multiprotocol BGP neighbor table.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>as-number</i> argument is the autonomous system to which the neighbor belongs.
Step 6	<pre>neighbor {ip-address peer-group-name} disable-connected-check</pre> <p>Example: Router(config-router)# neighbor 10.20.20.20 disable-connected-check</p>	<p>Allows peering between loopbacks.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighbor. The <i>peer-group-name</i> argument is the name of a BGP peer group.
Step 7	<pre>neighbor {ip-address ipv6-address peer-group-name} update-source interface-type interface-number</pre> <p>Example: Router(config-router)# neighbor 10.20.20.20 update-source Loopback 0</p>	<p>Allows BGP sessions to use any operational interface for TCP connections.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IPv4 address of the BGP-speaking neighbor. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p> <ul style="list-style-type: none"> The <i>peer-group-name</i> argument is the name of a BGP peer group. The <i>interface-type</i> argument is the interface type. The <i>interface-number</i> argument is the interface number.

	Command or Action	Purpose
Step 8	<p>address-family ipv4 [unicast] [vrf vrf-name]</p> <p>Example: Router(config-router)# address-family ipv4</p>	<p>Enters address family configuration mode for configuring routing protocols such as BGP, RIP, and static routing.</p> <ul style="list-style-type: none"> The ipv4 keyword configures sessions that carry standard IPv4 address prefixes. The unicast keyword specifies unicast prefixes. The vrf vrf-name keyword and argument specify the name of a VRF to associate with submode commands.
Step 9	<p>neighbor {<i>ip-address</i> <i>peer-group-name</i> <i>ipv6-address</i>} activate</p> <p>Example: Router(config-router-af)# neighbor 10.20.20.20 activate</p>	<p>Enables the exchange of information with a BGP neighbor.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router. The <i>peer-group-name</i> argument is the name of the BGP peer group. The <i>ipv6-address</i> argument is the IPv6 address of the BGP-speaking neighbor. <p>Note This argument must be in the form documented in RFC 2373, where the address is specified in hexadecimal using 16-bit values between colons.</p>
Step 10	<p>neighbor ip-address send-label</p> <p>Example: Router(config-router-af)# neighbor 10.20.20.20 send-label</p>	<p>Enables a BGP router to send MPLS labels with BGP routes to a neighboring BGP router.</p> <ul style="list-style-type: none"> The <i>ip-address</i> argument is the IP address of the neighboring router.
Step 11	<p>end</p> <p>Example: Router(config)# end</p>	<p>Exits to privileged EXEC mode.</p>

Verifying That Load Sharing Occurs Between Loopbacks

To verify that load sharing occurs between loopbacks, ensure that the MPLS LFIB entry for the neighbor route lists the available paths and interfaces.

SUMMARY STEPS

1. **enable**
2. **show mpls forwarding-table** [**vrf vrf-name**] [{*network* {*mask* | *length*} | **labels label** [- *label*] | **interface interface** | **next-hop address** | **lsp-tunnel [tunnel-id]**] [**detail**]
3. **disable**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	show mpls forwarding-table [vrf vrf-name] [{network {mask length} labels label [- label] interface interface next-hop address lsp-tunnel [tunnel-id]]] [detail]	Displays the contents of the MPLS LFIB.
Step 3	disable Example: Router# disable	Exits to user EXEC mode.

Configuration Examples for Load Sharing MPLS VPN Traffic

This section contains the following configuration examples for Load Sharing MPLS VPN Traffic:

- [Configuring a Router to Select eBGP or iBGP Paths as Multipaths: Example, page 47](#)
- [Configuring a /32 Static Route from an ASBR to the Loopback Address of Another ASBR: Examples, page 47](#)
- [Configuring BGP/MPLS Forwarding on the Interfaces Connecting ASBRs: Example, page 48](#)
- [Configuring VPNv4 Sessions on an ASBR: Example, page 48](#)
- [Verifying VPN NLRI for a Specified Network: Example, page 48](#)

Configuring a Router to Select eBGP or iBGP Paths as Multipaths: Example

The following example configures a router in address family configuration mode to select six eBGP or iBGP paths as multipaths:

```
Router(config)# router bgp 100
Router(config-router)# address-family ipv4 vrf try
Router(config-router-af)# maximum-paths eibgp 6
Router(config-router-af)# end
```

Configuring a /32 Static Route from an ASBR to the Loopback Address of Another ASBR: Examples

The following example configures a /32 static route from ASBR1 to the loopback address of ASBR2:

```
Router# configure terminal
Router(config)# ip route 10.20.20.20 255.255.255 e1/0 168.192.0.1
```

```
Router(config)# ip route 10.20.20.20 255.255.255 e0/0 168.192.2.1
```

The following example configures a /32 static route from ASBR2 to the loopback address of ASBR1:

```
Router# configure terminal
Router(config)# ip route vrf vpn1 10.10.10.10 255.255.255 e1/0 168.192.0.2
Router(config)# ip route vrf vpn1 10.10.10.10 255.255.255 e0/0 168.192.2.2
```

Configuring BGP/MPLS Forwarding on the Interfaces Connecting ASBRs: Example

The following example configures BGP/MPLS forwarding on the interfaces connecting ASBR2 with ASBR1:

```
Router# configure terminal
Router(config)# interface ethernet 1/0
Router(config-if)# ip vrf forwarding vpn1
Router(config-if)# ip address 168.192.0.1 255.255.255.255
Router(config-if)# mpls bgp forwarding
Router(config-if)# exit
Router(config)# interface ethernet 0/0
Router(config-if)# ip vrf forwarding vpn1
Router(config-if)# ip address 168.192.2.1 255.255.255.255
Router(config-if)# mpls bgp forwarding
Router(config-if)# exit
```

Configuring VPNv4 Sessions on an ASBR: Example

The following example configures VPNv4 sessions on ASBR2:

```
Router# configure terminal
Router(config)# router bgp 200
Router(config-router)# bgp log-neighbor-changes
Router(config-router)# neighbor 10.10.10.10 remote-as 100
Router(config-router)# neighbor 10.10.10.10 disable-connected-check
Router(config-router)# neighbor 10.10.10.10 update-source Loopback0
!
Router(config-router)# address-family vpnv4
Router(config-router-af)# neighbor 10.10.10.10 activate
Router(config-router-af)# neighbor 10.10.10.10 send-community extended
Router(config-router-af)# end
```

Verifying VPN NLRI for a Specified Network: Example

If you enter the **all** keyword with the **show ip bgp vpnv4** command, the output displays information about all VPN network layer reachability information (NLRI) for a specified network:

```
Router# show ip bgp vpnv4 all 10.22.22.0

BGP routing table entry for 10.1:22.22.22.0/24, version 19
Paths:(5 available, best #5)
Multipath: eiBGP
  Advertised to non peer-group peers:
    10.0.0.2 10.0.0.3 10.0.0.4 10.0.0.5
  22
    10.0.0.2 (metric 20) from 10.0.0.4 (10.0.0.4)
      Origin IGP, metric 0, localpref 100, valid, internal, multipath
```

```

Extended Community:0x0:0:0 RT:100:1 0x0:0:0
Originator:10.0.0.2, Cluster list:10.0.0.4
22
10.0.0.2 (metric 20) from 10.0.0.5 (10.0.0.5)
Origin IGP, metric 0, localpref 100, valid, internal, multipath
Extended Community:0x0:0:0 RT:100:1 0x0:0:0
Originator:10.0.0.2, Cluster list:10.0.0.5
22
10.0.0.2 (metric 20) from 10.0.0.2 (10.0.0.2)
Origin IGP, metric 0, localpref 100, valid, internal, multipath
Extended Community:RT:100:1 0x0:0:0
22
10.0.0.2 (metric 20) from 10.0.0.3 (10.0.0.3)
Origin IGP, metric 0, localpref 100, valid, internal, multipath
Extended Community:0x0:0:0 RT:100:1 0x0:0:0
Originator:10.0.0.2, Cluster list:10.0.0.3
22
10.1.1.12 from 10.1.1.12 (10.22.22.12)
Origin IGP, metric 0, localpref 100, valid, external, multipath, best
Extended Community:RT:100:1

```

Additional References

The following sections provide references related to MPLS VPNs.

Related Documents

Related Topic	Document Title
MPLS	Cisco IOS Multiprotocol Label Switching Configuration Guide, Release 15.0, MPLS VPN Carrier Supporting Carrier with BGP
BGP	Cisco IOS IP Routing: BGP Configuration Guide, Release 15.0, Configuring BGP

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 IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC 1164	<i>Application of the Border Gateway Protocol in the Internet</i>
RFC 1171	<i>A Border Gateway Protocol 4</i>
RFC 1700	<i>Assigned Numbers</i>
RFC 1966	<i>BGP Route Reflection: An Alternative to Full Mesh IBGP</i>
RFC 2283	<i>Multiprotocol Extensions for BGP-4</i>
RFC 2373	<i>IP Version 6 Addressing Architecture</i>
RFC 2547	<i>BGP/MPLS VPNs</i>
RFC 2842	<i>Capabilities Advertisement with BGP-4</i>
RFC 2858	<i>Multiprotocol Extensions for BGP-4</i>
RFC 3107	<i>Carrying Label Information in BGP-4</i>

Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	http://www.cisco.com/techsupport

Feature Information for Load Sharing MPLS VPN Traffic

Table 1 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 1 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 1 Feature Information for Load Sharing MPLS VPN Traffic

Feature Name	Releases	Feature Configuration Information
MPLS VPN—Load Balancing Support for Inter-AS and CSC VPNs	12.0(29)S 12.4(20)T	<p>This feature allows MPLS VPN Inter-AS and MPLS VPN CSC networks to load share traffic between adjacent LSRs that are connected by multiple links. The LSRs can be a pair of ASBRs or a CSC-PE and a CSC-CE. Using directly connected loopback peering allows load sharing at the IGP level, so more than one BGP session is not needed between the LSRs. No other label distribution mechanism is needed between the adjacent LSRs than BGP.</p> <p>The following sections provide information about this feature:</p> <ul style="list-style-type: none"> • Load Sharing Using Directly Connected Loopback Peering, page 6 • Configuring Directly Connected Loopback Peering for MPLS VPN Inter-AS using ASBRs to Exchange VPN-IPv4 Addresses, page 16
BGP Multipath Load Sharing for Both eBGP and iBGP in an MPLS VPN	12.2(4)T 12.2(14)S 12.0(24)S	<p>This feature allows multihomed autonomous systems and PE routers to be configured to distribute traffic across both external BGP (eBGP) and internal BGP (iBGP) paths.</p> <p>The following sections provide information about this feature:</p> <ul style="list-style-type: none"> • BGP Multipath for eBGP and iBGP, page 5 • Configuring BGP Multipath Load Sharing for eBGP and iBGP, page 7

Table 1 **Feature Information for Load Sharing MPLS VPN Traffic (continued)**

Feature Name	Releases	Feature Configuration Information
iBGP Multipath Load Sharing	12.2(2)T 12.2(14)S	<p>This feature enables the BGP speaking router to select multiple iBGP paths as the best paths to a destination.</p> <p>The following section provides information about this feature:</p> <ul style="list-style-type: none"> • Internal BGP Multipath Load Sharing, page 4
eBGP Multipath	12.0(27)S	<p>This feature installs multiple paths in the IP routing table when the eBGP paths are learned from a neighboring Autonomous System (AS), instead of picking one best path.</p> <p>The following sections provide information about this feature:</p> <ul style="list-style-type: none"> • eBGP Multipath Load Sharing, page 6 • Configuring eBGP Multipath Load Sharing with MPLS VPN Inter-AS, page 9 • Configuring eBGP Multipath Load Sharing with MPLS VPN Carrier Supporting Carrier, page 11

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