MPLS VPN Multipath Support for Inter-AS VPNs

The MPLS VPN Multipath Support for Inter-AS VPNs feature supports Virtual Private Network (VPN)v4 multipath for Autonomous System Boundary Routers (ASBRs) in the interautonomous system (Inter-AS) Multiprotocol Label Switching (MPLS) VPN environment. It allows load balancing of VPN traffic when you use the VPNv4 peering model for Inter-AS VPNs.

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Finding Feature Information

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

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

Restrictions for MPLS VPN Multipath Support for Inter-AS VPNs

The following restrictions apply to configuring multipath load sharing for Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) interautonomous system (Inter-AS) Autonomous System Boundary Routers (ASBRs) exchanging VPN-IPv4 routes:
Per-packet load balancing is not supported for this feature. Load balancing for this feature works on the IP source and destination hash or on the bottom label in the label stack, depending on the platform and depth of the MPLS label stack.

If MPLS scalability is an issue for you, we recommend that you do not enable VPNv4 multipath on ASBRs.

Information About MPLS VPN Multipath Support for Inter-AS VPNs

Load Sharing with MPLS VPN Inter-AS ASBRs

Before the MPLS VPN Interautonomous System Support feature, if multiple paths existed across Autonomous System Boundary Routers (ASBRs), the Border Gateway Protocol (BGP) executed the best path algorithm and marked only one of the paths as the best path. This path was added to the routing table and became the only path that was used for forwarding traffic between ASBRs.

The MPLS VPN Multipath Support for Inter-AS VPNs feature extends the functionality of BGP so that it can pick one path as the best path and mark the other legitimate paths between ASBRs as multipath. This allows the load sharing of traffic among the different multipaths and the best path to reach the destination. No Routing Information Base (RIB) or Cisco Express Forwarding entries are associated with the Virtual Private Network (VPN)-IPv4 prefixes.

The MPLS VPN Multipath Support for Inter-AS VPNs feature applies to ASBRs that do not have a VPN routing and forwarding (VRF) instance configuration. BGP installs a number of learned VPN-IPv4 prefixes into the Multiprotocol Label Switching (MPLS) forwarding table (LFIB). VPN-IPv4 entries in the LFIB consist of the Route Distinguisher (RD) and the IPv4 prefix and are called VPNv4 entries.

The MPLS VPN Multipath Support for Inter-AS VPNs feature requires that you configure the `maximum-paths number-of-paths` command in address family configuration mode. This command is used to set the number of parallel (equal-cost) routes that BGP installs in the routing table to configure multipath load sharing. The number of paths that can be configured is determined by the version of Cisco software.

Note

The `maximum-paths` command cannot be configured with the `maximum-paths eibgp` command for the same BGP routing process.
The figure below shows an example of VPNv4 load balancing for ASBRs in an Inter-AS network. In this example, ASBR1 load balances the traffic from the CE device CE1 to CE2 using the two available links—ASBR2 and ASBR3.

Figure 1: Example of VPNv4 Load Balancing for ASBRs in an Inter-AS Network

When you configure an ASBR for VPNv4 load balancing, you must configure the `next-hop-self` command for the iBGP peers. Without this command, the next hop that is propagated to the iBGP peer is the ASBR2 address or the ASBR3 address, depending on which one BGP selects as the best path. Configuring the `next-hop-self` command provides direct VPNv4 forwarding entries in the MPLS forwarding table for the VPNv4 prefixes learned from the remote ASBRs. VPNv4 forwarding entries are not created if you do not configure the `next-hop-self` command.

If the number of forwarding entries in the MPLS forwarding table on the system or on a line card is a concern for your network, we recommend that you do not enable VPNv4 multipath on ASBRs.

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**How to Configure MPLS VPN Multipath Support for Inter-AS VPNs**

**Configuring eBGP Multipath Load Sharing for MPLS VPN Inter-AS ASBRs**

Perform this task to configure the external Border Gateway Protocol (eBGP) multipath load sharing for MPLS VPN Inter-AS ASBRs exchanging Virtual Private Network (VPN)-IPv4 routes. This allows for more efficient use of the label switched paths (LSPs) in an interautonomous system network because you can set up the load sharing of traffic among the different multipaths and the best path to reach the destination.
The figure below shows an eBGP multipath configuration for three VPN-IPv4 ASBRs. The links from ASBR1 to ASBR2 and ASBR3 have an eBGP VPN-IPv4 session configured. In the figure below, eBGP multipath load sharing is configured on ASBR1.

Figure 2: eBGP Multipath Configuration for Three VPN-IPv4 ASBRs

The configurations in the figure above is used as an example for this task.

**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} update-source interface-type interface-number
7. neighbor {ip-address | peer-group-name} next-hop-self
8. neighbor {ip-address | peer-group-name} remote-as as-number
9. Repeat Step 8 for each BGP neighbor.
10. address-family vpnv4 [unicast]
11. neighbor {ip-address | peer-group-name} activate
12. neighbor {ip-address | peer-group-name} next-hop-self
13. neighbor {ip-address | peer-group-name} send-community [both | standard | extended]
14. neighbor {ip-address | peer-group-name | ipv6-address} activate
15. neighbor {ip-address | peer-group-name | ipv6-address} send-community [both | standard | extended]
16. Repeat Steps 14 and 15 for each BGP neighbor.
17. maximum-paths number-paths
18. exit-address-family
19. end
# DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> router bgp as-number</td>
<td>Configures an eBGP routing process and places the device in router configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# router bgp 1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> no bgp default route-target filter</td>
<td>Disables BGP route-target community filtering.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-router)# no bgp default route-target filter</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> neighbor {ip-address</td>
<td>peer-group-name} remote-as as-number</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-router)# neighbor 10.1.0.4 remote-as 1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> neighbor {ip-address</td>
<td>peer-group-name} update-source interface-type interface-number</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-router)# neighbor 10.1.0.4 update-source loopback 0</td>
<td></td>
</tr>
<tr>
<td>Step 7</td>
<td><strong>Command or Action</strong></td>
</tr>
<tr>
<td>--------</td>
<td>----------------------</td>
</tr>
<tr>
<td><strong>neighbor</strong> {ip-address</td>
<td>peer-group-name} <strong>next-hop-self</strong></td>
</tr>
</tbody>
</table>
| **Example:** | Device(config-router)# neighbor 10.1.0.4 next-hop-self | - *ip-address*—IP address of the BGP neighbor.  
- *peer-group-name*—Name of a BGP peer group. |

<table>
<thead>
<tr>
<th>Step 8</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>neighbor</strong> {ip-address</td>
<td>peer-group-name} <strong>remote-as</strong> <strong>as-number</strong></td>
<td>Adds an entry to the BGP or multiprotocol BGP neighbor table.</td>
</tr>
</tbody>
</table>
| **Example:** | Device(config-router)# neighbor 172.16.1.9 remote-as 2 | - *ip-address*—IP address of the neighbor.  
- *peer-group-name*—Name of a BGP peer group.  
- *as-number*—Autonomous system to which the neighbor belongs. |

| Step 9 | **Step 8 for each BGP neighbor.** | |

<table>
<thead>
<tr>
<th>Step 10</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>address-family</strong> <strong>vpnv4</strong> [unicast]</td>
<td>Enters address family configuration mode.</td>
<td></td>
</tr>
</tbody>
</table>
| **Example:** | Device(config-router)# address-family vpnv4 | - **unicast**—Specifies a unicast prefix.  
This command configures a routing session to carry VPN-IPv4 addresses across the VPN backbone. Each address is globally unique by the addition of an 8-byte RD. |

<table>
<thead>
<tr>
<th>Step 11</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>neighbor</strong> {ip-address</td>
<td>peer-group-name} <strong>activate</strong></td>
<td>Enables the exchange of information with a neighboring device.</td>
</tr>
</tbody>
</table>
| **Example:** | Device(config-router-af)# neighbor 10.1.0.4 activate | - *ip-address*—IP address of the neighbor.  
- *peer-group-name*—Name of a BGP peer group. |

<table>
<thead>
<tr>
<th>Step 12</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>neighbor</strong> {ip-address</td>
<td>peer-group-name} <strong>next-hop-self</strong></td>
<td>Configures the device as the next hop for a BGP neighbor or peer group.</td>
</tr>
</tbody>
</table>
| **Example:** | Device(config-router-af)# neighbor 10.1.0.4 next-hop-self | - *ip-address*—IP address of the BGP neighbor.  
- *peer-group-name*—Name of a BGP peer group. |

<table>
<thead>
<tr>
<th>Step 13</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>neighbor</strong> {ip-address</td>
<td>peer-group-name} <strong>send-community</strong> {both</td>
<td>standard</td>
</tr>
</tbody>
</table>
| **Example:** | Device(config-router-af)# neighbor 10.1.0.4 send-community extended | - *ip-address*—IP address of the neighboring device.  
- *peer-group-name*—Name of a BGP peer group.  
- **both**—Specifies that both standard and extended communities will be sent.  
- **standard**—Specifies that only standard communities will be sent. |
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>• extended — Specifies that only extended communities will be sent.</td>
<td></td>
</tr>
</tbody>
</table>

### Step 14

**neighbor** {ip-address | peer-group-name | ipv6-address} **activate**

**Example:**

```plaintext
Device(config-router-af)# neighbor 172.16.1.9 activate
```

- Enables the exchange of information with a BGP neighbor.
  - **ip-address** — IP address of the neighboring device.
  - **peer-group-name** — Name of a BGP peer group.
  - **ipv6-address** — 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.

### Step 15

**neighbor** {ip-address | peer-group-name} **send-community** [both | standard | extended]

**Example:**

```plaintext
Device(config-router-af)# neighbor 172.16.1.9 send-community extended
```

- Specifies that a communities attribute should be sent to a BGP neighbor.
  - **ip-address** — IP address of the neighboring device.
  - **peer-group-name** — Name of a BGP peer group.
  - **both** — Specifies that both standard and extended communities will be sent.
  - **standard** — Specifies that only standard communities will be sent.
  - **extended** — Specifies that only extended communities will be sent.

### Step 16

Repeat Steps 14 and 15 for each BGP neighbor.

### Step 17

**maximum-paths** **number-paths**

**Example:**

```plaintext
Device(config-router-af)# maximum-paths 2
```

- Configures the maximum number of parallel routes that an IP routing protocol will install into the routing table.
  - **number-paths** — Number of routes to install to the routing table.

### Step 18

**exit-address-family**

**Example:**

```plaintext
Device(config-router-af)# exit-address-family
```

- Exits from address family configuration mode.

### Step 19

**end**

**Example:**

```plaintext
Device(config-router)# end
```

- (Optional) Exits to privileged EXEC mode.
Example

The following example shows the configuration for external Border Gateway Protocol (eBGP) multipath for VPNv4 sessions on the ASBR1 device:

```
configure terminal
router bgp 1
  no bgp default route-target filter
  neighbor 10.1.0.4 remote-as 1
  neighbor 10.1.0.4 update-source Loopback 0
  neighbor 10.1.0.4 next-hop-self
  neighbor 172.16.1.9 remote-as 2
  neighbor 172.16.2.8 remote-as 2

  !
  address-family vpnv4
  neighbor 10.1.0.4 activate
  neighbor 10.1.0.4 next-hop-self
  neighbor 10.1.0.4 send-community extended
  neighbor 172.16.1.9 activate
  neighbor 172.16.1.9 activate
  neighbor 172.16.2.8 activate
  neighbor 172.16.2.8 send-community extended
  neighbor 172.16.2.8 send-community extended
  maximum-paths 2
  exit-address-family
end
```

Verifying eBGP Multipath Load Sharing for MPLS VPN Inter-AS ASBRs

Perform the following task to verify that the external Border Gateway Protocol (eBGP) multipath load sharing for Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) interautonomous system (Inter-AS) Autonomous System Boundary Routers (ASBRs) is operating as you expect.

The configurations in the figure above are used as an example for the task that follows.

**SUMMARY STEPS**

1. enable
2. show ip bgp vpnv4 all [summary]
3. show ip bgp vpnv4 all
4. show ip bgp vpnv4 [network]
5. show mpls forwarding-table
6. exit

**DETAILED STEPS**

**Step 1** enable
Enables privileged EXEC mode. Enter your password if required.
Verifying eBGP Multipath Load Sharing for MPLS VPN Inter-AS ASBRs

Example:

Device> enable
Device#

Step 2  show ip bgp vpnv4 all [summary]
Verifies that all peers are up.

Example:

Device# show ip bgp vpnv4 all summary

<table>
<thead>
<tr>
<th>Neighbor</th>
<th>V</th>
<th>AS</th>
<th>MsgRcvd</th>
<th>MsgSent</th>
<th>TblVer</th>
<th>InQ</th>
<th>OutQ</th>
<th>Up/Down</th>
<th>State/PfxRcd</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1.0.4</td>
<td>4</td>
<td>1</td>
<td>87</td>
<td>86</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>01:24:56</td>
<td>2</td>
</tr>
<tr>
<td>172.16.1.9</td>
<td>4</td>
<td>2</td>
<td>88</td>
<td>88</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>01:25:49</td>
<td>2</td>
</tr>
<tr>
<td>172.16.2.8</td>
<td>4</td>
<td>2</td>
<td>88</td>
<td>88</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>01:25:49</td>
<td>2</td>
</tr>
</tbody>
</table>

The output shows that all peers expected to be up are up and sending and receiving messages.

Step 3  show ip bgp vpnv4 all
Verifies that BGP has paths from both remote ASBRs.

Example:

Device# show ip bgp vpnv4 all

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Route Distinguisher: 1:105
*>192.168.0.1/32 | 10.1.0.3 | 11    | 100    | 0      | ?    |
*> 192.168.0.2/32 | 172.16.2.8 | 0    | 2      | ?      |      |
* 192.168.1.0 | 10.1.0.3 | 0    | 100    | 0      | ?    |
*> 192.168.2.0 | 172.16.1.9 | 0    | 2      | ?      |      |
* 172.16.1.9 |           | 0    | 2      | ?      |      |

The bold entries in the output confirm that BGP has a path to ASBR2 (172.16.2.8) and to ASBR3 (172.16.1.9).

Step 4  show ip bgp vpnv4 [network]
Verifies that paths are marked as multipath.

Example:

Device# show ip bgp vpnv4 192.168.2.0

BGP routing table entry for 1:105:192.168.2.0/24, version 3
Paths: (2 available, best #1, no table)
Advertised to update-groups:
  2
  3
  2
  172.16.2.8 from 172.16.2.8 (10.2.0.8)
  Origin incomplete, localpref 100, valid, external, multipath
  best
  Extended Community: RT:1:100 OSPF DOMAIN ID:0x0005:0x0000000A0200
  OSPF RT:0.0.0.0:2:0 OSPF ROUTER ID:192.168.2.2:512,
  mpls labels in/out 21/25
  2
  172.16.1.9 from 172.16.1.9 (10.2.0.9)
  Origin incomplete, localpref 100, valid, external, multipath
  Extended Community: RT:1:100 OSPF DOMAIN ID:0x0005:0x0000000A0200
OSPF RT: 0.0.0.0:2:0 OSPF ROUTER ID: 192.168.2.2:512, mpls labels in/out 21/25

In the output, the “multipath” and “mpls labels in/out 21/25” are in bold text for example purposes only.

**Step 5**

**show mpls forwarding-table**

Verifies that MPLS forwarding is properly set up and counters are increasing when traffic is present.

**Example:**

```
Device# show mpls forwarding-table

Local Outgoing Prefix Bytes Label Outgoing Next Hop
Label Label or VC or Tunnel Id Switched interface
.
16  Pop Label 172.16.1.9/32 0 Et1/0 172.16.1.9
17  Pop Label 172.16.2.8/32 0 Et2/0 172.16.2.8
18  Pop Label 10.1.1.0/24 0 Et0/0 10.1.2.4
19  16 10.1.0.3/32 0 Et0/0 10.1.2.4
20  Pop Label 10.1.0.4/32 0 Et0/0 10.1.2.4
21  25 1:105:192.168.24/24 26658Et1/0 172.16.1.9
25  1:105:192.168.24/24 1180Et2/0 172.16.2.8
22  24 1:105:192.168.0.2/32 15740Et1/0 172.16.1.9
24  1:105:192.168.0.2/32 15740Et2/0 172.16.2.8
23  19 1:105:192.168.0.1/32 15638Et0/0 10.1.2.4
24  20 1:105:192.168.1.0/24 32740Et0/0 10.1.2.4

```

**Step 6**

**exit**

Exits to user EXEC mode. For example:

```
Device# exit
Device>
```

---

**Configuration Examples for MPLS VPN Multipath Support for Inter-AS VPNs**

**Example: Configuring eBGP Multipath Load Sharing for MPLS VPN Inter-AS ASBRs**

This section includes examples that show how to configure the external Border Gateway Protocol (eBGP) multipath load sharing for Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) interautonomous system (Inter-AS) Autonomous System Boundary Routers (ASBRs) that exchange VPN-IPv4 routes.
The network topology in the figure below shows two autonomous systems, which are configured as follows:

- Autonomous system 1 contains PE1, P1, and ASBR1.
- Autonomous system 2 contains PE2, P2, ASBR2, and ASBR3.
- CE1 and CE2 belong to the same VPN, which is called VPN1.
- The P devices are route reflectors.
- ASBR1 and ASBR2 are configured with the `neighbor next-hop-self` command for the internal BGP (iBGP) neighbors.
- ASBR1 and ASBR2 are configured with the `maximum paths` commands to set up eBGP multipath load sharing.

**Figure 3: Configuring eBGP Multipath Load Sharing Between MPLS Inter-AS ASBRs Exchanging VPN-IPv4 Routes**

The following examples show how to configure eBGP multipath load sharing for MPLS VPN Inter-AS ASBRs that exchange VPN-IPv4 routes. This section includes sample configurations for P1, ASBR1, ASBR2, and P2 devices.

**Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 1 CE1**

The following example shows how to configure CE1 in VPN1:

```bash
hostname CE1
!
interface Loopback 1
 ip address 192.168.0.1 255.255.255.255
!
interface Ethernet 1/0
 description Link to PE1
 ip address 192.168.1.1 255.255.255.0
!
routing ospf 1
 log-adjacency-changes
 network 192.168.0.0 0.0.255.255 area 0
!
end
```
Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 1 PE1

The following example shows how to configure PE1 in autonomous system 1:

```conf
! hostname PE1
! ip cef
! ip vrf V1
  rd 1:105
  route-target export 1:100
  route-target import 1:100
! interface Loopback 0
  ip address 10.1.0.3 255.255.255.255
! interface Ethernet 0/0
  description Link to CE1
  ip vrf forwarding V1
  ip address 192.168.1.2 255.255.255.0
! interface Ethernet 1/0
  description Link to P1
  ip address 10.1.1.3 255.255.255.0
  mpls ip
! router ospf 10 vrf V1
  log-adjacency-changes
  redistribute bgp 1 metric 100 subnets
  network 192.168.0.0 0.0.255.255 area 0
! router ospf 1
  log-adjacency-changes
  network 10.0.0.0 0.255.255.255 area 0
! router bgp 1
  no synchronization
  bgp log-neighbor-changes
  neighbor 10.1.0.4 remote-as 1
  no neighbor 10.1.0.4 transport path-mtu-discovery
  neighbor 10.1.0.4 update-source Loopback 0
  no auto-summary
!  address-family vpnv4
  neighbor 10.1.0.4 activate
  neighbor 10.1.0.4 send-community extended
  exit-address-family
!  address-family ipv4 vrf V1
  redistribute ospf 10 vrf V1
  no auto-summary
  no synchronization
  exit-address-family
! end
```

Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 1 P1

The following example shows how to configure P1 in autonomous system 1:

```conf
! hostname P1
! ip cef
! interface Loopback 0
```
ip address 10.1.0.4 255.255.255.255
!
interface Ethernet 0/0
description Link to PE1
ip address 10.1.1.4 255.255.255.0
mpls ip
!
interface Ethernet 1/0
description Link to ASBR1
ip address 10.1.2.4 255.255.255.0
mpls ip
!
routing ospf 1
log-adjacency-changes
network 10.0.0.0 0.255.255.255 area 0
!
routing bgp 1
no synchronization
bgp log-neighbor-changes
neighbor R peer-group
neighbor R remote-as 1
no neighbor R transport path-mtu-discovery
neighbor R update-source Loopback 0
neighbor R route-reflector-client
neighbor 10.1.0.3 peer-group R
neighbor 10.1.0.5 peer-group R
no auto-summary
!
address-family vpnv4
neighbor R send-community extended
neighbor R route-reflector-client
neighbor 10.1.0.3 activate
neighbor 10.1.0.5 activate
exit-address-family
!
end

Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 1 ASBR1

The following example shows how to configure ASBR1 in autonomous system 1:

hostname ASBR1
!
ip cef
!
interface Loopback 0
ip address 10.1.0.5 255.255.255.255
!
interface Ethernet 0/0
description Core link to P1
ip address 10.1.2.5 255.255.255.0
mpls ip
!
interface Ethernet 1/0
description Link to ASBR2
ip address 172.16.2.5 255.255.255.0
mpls bgp forwarding
!
interface Serial 3/0
description Link to ASBR3
ip address 172.16.1.5 255.255.255.0
mpls bgp forwarding
serial restart-delay 0
!
routerospf 1
log-adjacency-changes
network 10.0.0.0 0.255.255.255 area 0
!
routing bgp 1
Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 2 ASBR2

The following example shows how to configure ASBR2 in autonomous system 2:

```conf
hostname ASBR2

ip cef

interface Loopback 0
  ip address 10.2.0.8 255.255.255.255

interface Loopback 1
  no ip address
  shutdown

interface Ethernet 0/0
  description Link to ASBR1
  ip address 172.16.2.8 255.255.255.0
  mpls bgp forwarding

interface Serial 2/0
  description Link to P2
  ip address 10.2.2.8 255.255.255.0
  mpls ip
  no fair-queue
  serial restart-delay 0

router ospf 1
  log-adjacency-changes
  redistribute connected subnets
  network 10.0.0.0 0.255.255.255 area 0

router bgp 2
  no synchronization
  no bgp default route-target filter
  bgp log-neighbor-changes
  neighbor 10.2.0.7 remote-as 2
  neighbor 10.2.0.7 update-source Loopback 0
  neighbor 10.2.0.7 next-hop-self
  neighbor 172.16.2.5 remote-as 1
  no auto-summary

address-family vpnv4
  neighbor 10.2.0.7 activate
  neighbor 10.2.0.7 send-community extended
  neighbor 10.2.0.7 next-hop-self
  neighbor 172.16.2.5 activate
  neighbor 172.16.2.5 send-community extended
```
Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 2 ASBR3

The following example shows how to configure ASBR3 in autonomous system 2:

```
exit-address-family
!
end
```

Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 2 P2

The following example shows how to configure P2 in autonomous system 2:

```
! hostname ASBR3
!
ip cef
!
interface Loopback 0
  ip address 10.2.0.9 255.255.255.255
!
interface Ethernet 0/0
  description Link to ASBR1
  ip address 172.16.1.9 255.255.255.0
  mpls bgp forwarding
!
interface Serial 3/0
  description Link to P2
  ip address 10.2.3.9 255.255.255.0
  mpls ip
  no fair-queue
  serial restart-delay 0
!
router ospf 1
  log-adjacency-changes
  redistribute connected subnets
  network 10.0.0.0 0.255.255.255 area 0
!
router bgp 2
  no synchronization
  no bgp default route-target filter
  bgp log-neighbor-changes
  neighbor 10.2.0.7 remote-as 2
  neighbor 10.2.0.7 update-source Loopback 0
  neighbor 10.2.0.7 next-hop-self
  neighbor 172.16.1.5 remote-as 1
  no auto-summary
!
  address-family vpnv4
  neighbor 10.2.0.7 activate
  neighbor 10.2.0.7 send-community extended
  neighbor 10.2.0.7 next-hop-self
  neighbor 172.16.1.5 activate
  neighbor 172.16.1.5 send-community extended
!
exit-address-family
!
end
```
Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 2 PE2

The following example shows how to configure PE2 in autonomous system 2:

```
hostname PE2
!
ip cef
!
ip vrf V1
  rd 1:105
  route-target export 1:100
  route-target import 1:100
!
interface Loopback 0
  ip address 10.2.0.6 255.255.255.255
!
interface Ethernet 0/0
  description Link to P2
  ip address 10.2.1.6 255.255.255.0
  mpls ip
!
interface Serial 2/0
  description Link to CE2
  ip vrf forwarding V1
  ip address 192.168.2.2 255.255.255.0
  no fair-queue
```
serial restart-delay 0
!
router ospf 10 vrf V1
log-adjacency-changes
redistribute bgp 2 subnets
network 192.168.0.0 0.0.255.255 area 0
!
router ospf 1
log-adjacency-changes
network 10.0.0.0 0.255.255.255 area 0
!
router bgp 2
no synchronization
bgp log-neighbor-changes
neighbor 10.2.0.7 remote-as 2
neighbor 10.2.0.7 update-source Loopback 0
no auto-summary
!
address-family vpnv4
neighbor 10.2.0.7 activate
neighbor 10.2.0.7 send-community extended
exit-address-family
!
address-family ipv4 vrf V1
redistribute connected
redistribute ospf 10 vrf V1
no auto-summary
no synchronization
exit-address-family
!
end

Example: Multipath Support for Inter-AS VPNs Configuration for Autonomous System 2 CE2

The following example shows how to configure CE2 in VPN1:

hostname CE2
!
interface Loopback 0
  ip address 192.168.0.2 255.255.255.255
!
interface Serial 2/0
  description Link to PE2
  ip address 192.168.2.1 255.255.255.0
  no fair-queue
  serial restart-delay 0
!
router ospf 1
log-adjacency-changes
network 192.168.0.0 0.0.255.255 area 0
end

Additional References

Related Documents

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<tr>
<th>Related Topic</th>
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<tr>
<td>Configuration tasks for MPLS VPN Inter-AS system exchanging IPv4 routes and MPLS labels</td>
<td>&quot;MPLS VPN Inter-AS with ASBRs Exchanging IPv4 Routes and MPLS Labels&quot; module in the <em>MPLS: Layer 3 VPNs Inter-AS and CSC Configuration Guide</em></td>
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<tr>
<td>Information about monitoring MPLS VPNs with MIBs</td>
<td>&quot;MPLS VPN SNMP MIB Notifications&quot; module in the <em>MPLS: Embedded Management and MIBs Configuration Guide</em></td>
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### RFCs

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<td>RFC 1164</td>
<td><em>Application of the Border Gateway Protocol in the Internet</em></td>
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<td>RFC 1965</td>
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<td>RFC 1966</td>
<td><em>BGP Route Reflection: An Alternative to Full Mesh iBGP</em></td>
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<td>RFC 2547</td>
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<td>RFC 2858</td>
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<td><em>Carrying Label Information in BGP-4</em></td>
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Technical Assistance

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

Feature Information for MPLS VPN Multipath Support for Inter-AS VPNs

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

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

Table 1: Feature Information for MPLS VPN Multipath Support for Inter-AS VPNs

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
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<tbody>
<tr>
<td>MPLS VPN Multipath Support for Inter-AS VPNs</td>
<td>12.2(30)S</td>
<td>The MPLS VPN Multipath Support for Inter-AS VPNs feature supports Virtual Private Network (VPN)v4 multipath for Autonomous System Boundary Routers (ASBRs) in the interautonomous system (Inter-AS) Multiprotocol Label Switching (MPLS) VPN environment. It allows load balancing of VPN traffic when you use the VPNv4 peering model for Inter-AS VPNs. No commands were introduced or modified.</td>
</tr>
<tr>
<td></td>
<td>12.2(33)SRA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.2(33)SXH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.4(20)T</td>
<td></td>
</tr>
</tbody>
</table>

Glossary

autonomous system—A collection of networks under a common administration sharing a common routing strategy.
BGP — Border Gateway Protocol. An interdomain routing protocol that exchanges network reachability information with other BGP systems (which may be within the same autonomous system or between multiple autonomous systems).

CE device — customer edge device. A device that is part of a customer network and that interfaces to a provider edge (PE) device. CE devices do not recognize associated MPLS VPNs.

eBGP — exterior Border Gateway Protocol. A BGP between devices located within different autonomous systems. When two devices, located in different autonomous systems, are more than one hop away from one another, the eBGP session between the two devices is considered a multihop BGP.

iBGP — interior Border Gateway Protocol. A BGP between devices within the same autonomous system.

LFIB — Label Forwarding Information Base. Data structure used in MPLS to hold information about incoming and outgoing labels and associated Forwarding Equivalence Class (FEC) packets.

MPLS — Multiprotocol Label Switching. The name of the IETF working group responsible for label switching, and the name of the label switching approach it has standardized.

PE device — provider edge device. A device that is part of a service provider’s network. It is connected to a customer edge (CE) device and all MPLS VPN processing occurs in the PE device.

RD — route distinguisher. An 8-byte value that is concatenated with an IPv4 prefix to create a unique VPN-IPv4 prefix.

VPN — Virtual Private Network. A secure MPLS-based network that shares resources on one or more physical networks (typically implemented by one or more service providers). A VPN contains geographically dispersed sites that can communicate securely over a shared backbone network.

VRF — VPN routing and forwarding instance. Routing information that defines a Virtual Private Network (VPN) site that is attached to a provider edge (PE) device. A VRF consists of an IP routing table, a derived forwarding table, a set of interfaces that use the forwarding table, and a set of rules and routing protocols that determine what goes into the forwarding table.