



## MPLS VPN Half-Duplex VRF

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The MPLS VPN Half-Duplex VRF feature provides scalable hub-and-spoke connectivity for subscribers of an Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN) service. This feature addresses the limitations of hub-and-spoke topologies by removing the requirement of one virtual routing and forwarding (VRF) instance per spoke. This feature also ensures that subscriber traffic always traverses the central link between the wholesale service provider and the Internet service provider (ISP), whether the subscriber traffic is being routed to a remote network by way of the upstream ISP or to another locally or remotely connected subscriber.

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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.

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](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Prerequisites for MPLS VPN Half-Duplex VRF

Half-Duplex VRF is supported with either an MPLS core network or an IP core (VRF lite) network.

# Restrictions for MPLS VPN Half-Duplex VRF

The following features are not supported on interfaces configured with the MPLS VPN Half-Duplex VRF feature:

- Multicast
- MPLS VPN Carrier Supporting Carrier
- MPLS VPN Interautonomous Systems

## Information About MPLS VPN Half-Duplex VRF

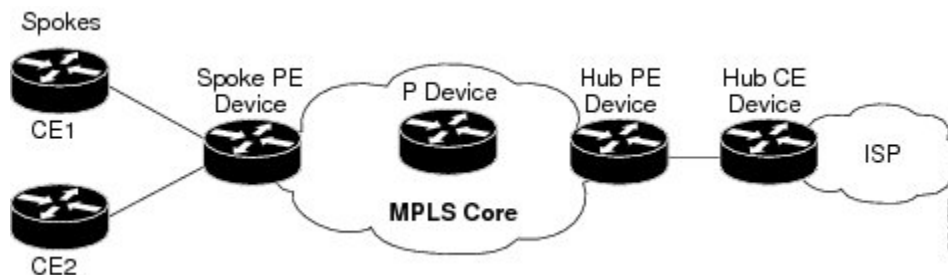
### MPLS VPN Half-Duplex VRF Overview

The MPLS VPN Half-Duplex VRF feature provides:

- The MPLS VPN Half-Duplex VRF feature prevents local connectivity between subscribers at the spoke provider edge (PE) device and ensures that a hub site provides subscriber connectivity. Any sites that connect to the same PE device must forward intersite traffic using the hub site. This ensures that the routing done at the spoke site moves from the access-side interface to the network-side interface or from the network-side interface to the access-side interface, but never from the access-side interface to the access-side interface.
- The MPLS VPN Half-Duplex VRF feature prevents situations where the PE device locally switches the spokes without passing the traffic through the upstream Internet service provider (ISP). This prevents subscribers from directly connecting to each other, which causes the wholesale service provider to lose revenue.
- The MPLS VPN Half-Duplex VRF feature improves scalability by removing the requirement of one virtual routing and forwarding (VRF) instance per spoke. If the feature is not configured, when spokes are connected to the same PE device each spoke is configured in a separate VRF to ensure that the traffic between the spokes traverses the central link between the wholesale service provider and the ISP. However, this configuration is not scalable. When many spokes are connected to the same PE device, configuration of VRFs for each spoke becomes quite complex and greatly increases memory usage. This is especially true in large-scale wholesale service provider environments that support high-density remote access to Layer 3 Virtual Private Networks (VPNs).

The figure below shows a sample hub-and-spoke topology.

**Figure 1: Hub-and-Spoke Topology**



## Upstream and Downstream VRFs

The MPLS VPN Half-Duplex VRF feature uses two unidirectional virtual routing and forwarding (VRF) instances to forward IP traffic between the spokes and the hub PE device:

- The upstream VRF forwards IP traffic from the spokes toward the hub provider edge (PE) device. This VRF typically contains only a default route but might also contain summary routes and several default routes. The default route points to the interface on the hub PE device that connects to the upstream Internet service provider (ISP). The device dynamically learns about the default route from the routing updates that the hub PE device or home gateway sends.



### Note

Although the upstream VRF is typically populated from the hub, it is possible also to have a separate local upstream interface on the spoke PE for a different local service that would not be required to go through the hub: for example, a local Domain Name System (DNS) or game server service.

- The downstream VRF forwards traffic from the hub PE device back to the spokes. This VRF can contain:
  - PPP peer routes for the spokes and per-user static routes received from the authentication, authorization, and accounting (AAA) server or from the Dynamic Host Control Protocol (DHCP) server
  - Routes imported from the hub PE device
  - Border Gateway Protocol (BGP), Open Shortest Path First (OSPF), Routing Information Protocol (RIP), or Enhanced Interior Gateway Routing Protocol (EIGRP) dynamic routes for the spokes

The spoke PE device redistributes routes from the downstream VRF into Multiprotocol Border Gateway Protocol (MP-BGP). That device typically advertises a summary route across the Multiprotocol Label Switching (MPLS) core for the connected spokes. The VRF configured on the hub PE device imports the advertised summary route.

A routing loop occurs when a per prefix label allocation mode is used, thereby not forwarding packets in downstream VRF. This can be prevented by using per VRF label allocation.

## Reverse Path Forwarding Check

The Reverse Path Forwarding (RPF) check ensures that an IP packet that enters a device uses the correct inbound interface. The MPLS VPN Half-Duplex VRF feature supports unicast RPF check on the spoke-side interfaces. Because different virtual routing and forwarding (VRF) instances are used for downstream and upstream forwarding, the RPF mechanism ensures that source address checks occur in the downstream VRF.

Unicast RPF is disabled by default. .

## How to Configure MPLS VPN Half-Duplex VRF

### Configuring the Upstream and Downstream VRFs on the Spoke PE Device

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vrf definition** *vrf-name*
4. **rd** *route-distinguisher*
5. **address-family** {*ipv4* | *ipv6*}
6. **route-target** {*import* | *export* | *both*} *route-target-ext-community*
7. **exit-address-family**
8. **end**

#### DETAILED STEPS

|               | Command or Action                                                                                   | Purpose                                                                                                                                                                                                    |
|---------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step 1</b> | <b>enable</b><br><br><b>Example:</b><br>Device> enable                                              | Enables privileged EXEC mode.<br><br><ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>                                                                                  |
| <b>Step 2</b> | <b>configure terminal</b><br><br><b>Example:</b><br>Device# configure terminal                      | Enters global configuration mode.                                                                                                                                                                          |
| <b>Step 3</b> | <b>vrf definition</b> <i>vrf-name</i><br><br><b>Example:</b><br>Device(config)# vrf definition vrf1 | Configures a virtual routing and forwarding (VRF) table and enters VRF configuration mode.<br><br><ul style="list-style-type: none"> <li>• The <i>vrf-name</i> argument is the name of the VRF.</li> </ul> |

|               | Command or Action                                                                                                                                                                 | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step 4</b> | <b>rd</b> <i>route-distinguisher</i><br><br><b>Example:</b><br>Device(config-vrf)# rd 100:1                                                                                       | Creates routing and forwarding tables for a VRF. <ul style="list-style-type: none"> <li>The <i>route-distinguisher</i> argument specifies to add an 8-byte value to an IPv4 prefix to create a Virtual Private Network (VPN) IPv4 prefix. You can enter a route distinguisher in either of these formats: <ul style="list-style-type: none"> <li>16-bit autonomous system number (ASN): your 32-bit number For example, 101:3.</li> <li>32-bit IP address: your 16-bit number For example, 192.168.122.15:1.</li> </ul> </li> </ul>                                                                                                                                                     |
| <b>Step 5</b> | <b>address-family</b> { <b>ipv4</b>   <b>ipv6</b> }<br><br><b>Example:</b><br>Device(config-vrf) address-family ipv4                                                              | Enters VRF address family configuration mode to specify an address family for a VRF. <ul style="list-style-type: none"> <li>The <b>ipv4</b> keyword specifies an IPv4 address family for a VRF.</li> <li>The <b>ipv6</b> keyword specifies an IPv6 address family for a VRF.</li> </ul> <p><b>Note</b> The MPLS VPN Half Duplex VRF feature supports only the IPv4 address family.</p>                                                                                                                                                                                                                                                                                                  |
| <b>Step 6</b> | <b>route-target</b> { <b>import</b>   <b>export</b>   <b>both</b> }<br><i>route-target-ext-community</i><br><br><b>Example:</b><br>Device(config-vrf-af)# route-target both 100:2 | Creates a route-target extended community for a VRF. <ul style="list-style-type: none"> <li>The <b>import</b> keyword specifies to import routing information from the target VPN extended community.</li> <li>The <b>export</b> keyword specifies to export routing information to the target VPN extended community.</li> <li>The <b>both</b> keyword specifies to import both import and export routing information to the target VPN extended community.</li> <li>The <i>route-target-ext-community</i> argument adds the route-target extended community attributes to the VRF's list of import, export, or both (import and export) route-target extended communities.</li> </ul> |
| <b>Step 7</b> | <b>exit-address-family</b><br><br><b>Example:</b><br>Device(config-vrf-af)# exit-address-family                                                                                   | Exits VRF address family configuration mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Step 8</b> | <b>end</b><br><br><b>Example:</b><br>Device(config-vrf)# end                                                                                                                      | Returns to privileged EXEC mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Associating a VRF with an Interface

Perform the following task to associate a virtual routing and forwarding (VRF) instance with an interface, which activates the VRF.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **vrf forwarding** *vrf-name* [**downstream** *vrf-name2*]
5. **ip address** *ip-address mask* [**secondary**]
6. **end**

### DETAILED STEPS

|               | Command or Action                                                                                                                                 | Purpose                                                                                                                                                                                                                                                                                                                              |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step 1</b> | <b>enable</b><br><br><b>Example:</b><br>Device> enable                                                                                            | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>                                                                                                                                                                                                                   |
| <b>Step 2</b> | <b>configure terminal</b><br><br><b>Example:</b><br>Device# configure terminal                                                                    | Enters global configuration mode.                                                                                                                                                                                                                                                                                                    |
| <b>Step 3</b> | <b>interface</b> <i>type number</i><br><br><b>Example:</b><br>Device(config)# interface Ethernet 0/1                                              | Configures an interface type and enters interface configuration mode. <ul style="list-style-type: none"> <li>• The <i>type</i> argument identifies the type of interface to be configured.</li> <li>• The <i>number</i> argument identifies the port, connector, or interface card number.</li> </ul>                                |
| <b>Step 4</b> | <b>vrf forwarding</b> <i>vrf-name</i> [ <b>downstream</b> <i>vrf-name2</i> ]<br><br><b>Example:</b><br>Device(config-if)# vrf forwarding vrf1     | Associates a VRF with an interface or subinterface. <ul style="list-style-type: none"> <li>• The <i>vrf-name</i> argument is the name of the VRF.</li> <li>• The <b>downstream</b> <i>vrf-name2</i> keyword and argument combination is the name of the downstream VRF into which peer and per-user routes are installed.</li> </ul> |
| <b>Step 5</b> | <b>ip address</b> <i>ip-address mask</i> [ <b>secondary</b> ]<br><br><b>Example:</b><br>Device(config-if)# ip address 10.24.24.24 255.255.255.255 | Sets a primary or secondary IP address for an interface. <ul style="list-style-type: none"> <li>• The <i>ip-address</i> argument is the IP address.</li> <li>• The <i>mask</i> argument is the mask of the associated IP subnet.</li> </ul>                                                                                          |

|               | Command or Action                                              | Purpose                                                                                                                                                                                                                       |
|---------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                                                | <ul style="list-style-type: none"> <li>The <b>secondary</b> keyword specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.</li> </ul> |
| <b>Step 6</b> | <b>end</b><br><br><b>Example:</b><br><br>Device(config-if) end | Returns to privileged EXEC mode.                                                                                                                                                                                              |

## Configuring the Downstream VRF for an AAA Server

To configure the downstream VRF for an AAA (RADIUS) server in broadband or remote access situations, enter the following Cisco attribute value:

**lcp:interface-config=ip vrf forwarding U downstream D**

In standard VPN situations, enter instead the following Cisco attribute value:

**ip:vrf-id=U downstream D**

## Verifying the MPLS VPN Half-Duplex VRF Configuration

### SUMMARY STEPS

1. **show vrf [ipv4 | ipv6] [brief | detail | id | interfaces | lock | select] [vrf-name]**
2. **show ip route vrf vrf-name**
3. **show running-config [interface type number]**

### DETAILED STEPS

**Step 1** **show vrf [ipv4 | ipv6] [brief | detail | id | interfaces | lock | select] [vrf-name]**

Displays information about all of the virtual routing and forwarding (VRF) instances configured on the device, including the downstream VRF for each associated interface or virtual access interface (VAI):

**Example:**

```
Device# show vrf
Name      Default RD      Interfaces
Down      100:1           POS3/0/3 [D]
           100:3       POS3/0/1 [D]
           100:3       Loopback2
           100:3       Virtual-Access3 [D]
           100:3       Virtual-Access4 [D]
Up        100:2           POS3/0/3
```

```

100:4          POS3/0/1
               Virtual-Access3

```

Use the **show vrf detail vrf-name** command to display detailed information about the VRF you specify, including all interfaces, subinterfaces, and VAIs associated with the VRF.

If you do not specify a value for the *vrf-name* argument, detailed information about all of the VRFs configured on the device appears.

The following example shows how to display detailed information for the VRF called vrf1, in a broadband or remote access case:

#### Example:

```

Device# show vrf detail vrf1
VRF D; default RD 2:0; default VPNID <not set>
  Interfaces:
    Loopback2          Virtual-Access3 [D]  Virtual-Access4 [D]
  Connected addresses are not in global routing table
  Export VPN route-target communities
    RT:2:0
  Import VPN route-target communities
    RT:2:1
  No import route-map
  No export route-map
VRF U; default RD 2:1; default VPNID <not set>
  Interfaces:
    Virtual-Access3      Virtual-Access4
  Connected addresses are not in global routing table
  No Export VPN route-target communities
  Import VPN route-target communities
    RT:2:1
  No import route-map
  No export route-map

```

The following example shows the VRF detail in a standard Virtual Private Network (VPN) situation:

#### Example:

```

Device# show vrf detail
VRF Down; default RD 100:1; default VPNID <not set> VRF Table ID = 1
  Description: import only from hub-pe
  Interfaces:
    Pos3/0/3 [D]          Pos3/0/1:0.1 [D]
  Connected addresses are not in global routing table
  Export VPN route-target communities
    RT:100:0
  Import VPN route-target communities
    RT:100:1
  No import route-map
  No export route-map
  VRF label distribution protocol: not configured
VRF Up; default RD 100:2; default VPNID <not set> VRF Table ID = 2
  Interfaces:
    Pos3/0/1              Pos3/0/3
  Connected addresses are not in global routing table
  No Export VPN route-target communities
  Import VPN route-target communities
    RT:100:1
  No import route-map
  No export route-map
  VRF label distribution protocol: not configured

```

## Step 2 show ip route vrf vrf-name



Displays the IP routing table for the VRF you specify, and information about the per-user routes installed in the downstream VRF.

The following example shows how to display the routing table for the downstream VRF named D, in a broadband or remote access situation:

**Example:**

```
Device# show ip route vrf D

Routing Table: D
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       I - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS interarea
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
Gateway of last resort is not set
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
U   10.0.0.2/32 [1/0] via 10.0.0.1
S   10.0.0.0/8 is directly connected, Null0
U   10.0.0.5/32 [1/0] via 10.0.0.2
C   10.8.1.2/32 is directly connected, Virtual-Access4
C   10.8.1.1/32 is directly connected, Virtual-Access3
```

The following example shows how to display the routing table for the downstream VRF named Down, in a standard VPN situation:

**Example:**

```
Device# show ip route vrf Down

Routing Table: Down
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       I - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is 10.13.13.13 to network 0.0.0.0
C   10.2.0.0/8 is directly connected, Pos3/0/3
    10.3.0.0/32 is subnetted, 1 subnets
B       10.4.16.16 [200/0] via 10.13.13.13, 1w3d
B   10.6.0.0/8 [200/0] via 10.13.13.13, 1w3d
C   10.0.0.0/8 is directly connected, Pos3/0/1
    10.7.0.0/16 is subnetted, 1 subnets
B   10.7.0.0 [20/0] via 10.0.0.2, 1w3d
    10.0.6.0/32 is subnetted, 1 subnets
B       10.0.6.14 [20/0] via 10.0.0.2, 1w3d
    10.8.0.0/32 is subnetted, 1 subnets
B       10.8.15.15 [20/0] via 10.0.0.2, 1w3d
B*   0.0.0.0/0 [200/0] via 10.0.0.13, 1w3d
```

The following example shows how to display the routing table for the upstream VRF named U in a broadband or remote access situation:

**Example:**

```
Device# show ip route vrf U

Routing Table: U
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
```

```

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
I - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS interarea
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route
Gateway of last resort is 192.168.0.20 to network 0.0.0.0
 10.0.0.0/32 is subnetted, 1 subnets
C   10.0.0.8 is directly connected, Loopback2
B*   0.0.0.0/0 [200/0] via 192.168.0.20, 1w5d

```

The following example shows how to display the routing table for the upstream VRF named Up in a standard VPN situation:

#### Example:

```

Device# show ip route vrf Up
Routing Table: Up
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2
        I - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default, U - per-user static route
        o - ODR, P - periodic downloaded static route
Gateway of last resort is 10.13.13.13 to network 0.0.0.0
 10.2.0.0/32 is subnetted, 1 subnets
C   10.2.0.1 is directly connected, Pos3/0/3
 10.3.0.0/32 is subnetted, 1 subnets
B   10.3.16.16 [200/0] via 10.13.13.13, 1w3d
B  10.6.0.0/8 [200/0] via 10.13.13.13, 1w3d
 10.0.0.0/32 is subnetted, 1 subnets
C   10.0.0.1 is directly connected, Pos3/0/1
B*   0.0.0.0/0 [200/0] via 10.13.13.13, 1w3d

```

### Step 3

#### show running-config [interface type number]

Displays information about the interface you specify, including information about the associated upstream and downstream VRFs.

The following example shows how to display information about subinterface POS 3/0/1:

#### Example:

```

Device# show running-config interface POS 3/0/1
Building configuration...
Current configuration : 4261 bytes
!
interface POS3/0/1
ip vrf forwarding Up downstream Down
ip address 10.0.0.1 255.0.0.0
end

```

# Configuration Examples for MPLS VPN Half-Duplex VRF

## Examples: Configuring the Upstream and Downstream VRFs on the Spoke PE Device

The following example configures an upstream virtual routing and forwarding (VRF) instance named Up:

```
Device> enable
Device# configure terminal
Device(config)# vrf definition Up
Device(config-vrf)# rd 1:0
Device(config-vrf)# address-family ipv4
Device(config-vrf-af)# route-target import 1:0
Device(config-vrf-af)# exit-address-family
```

The following example configures a downstream VRF named Down:

```
Device> enable
Device# configure terminal
Device(config)# vrf definition Down
Device(config-vrf)# rd 1:8
Device(config-vrf)# address-family ipv4
Device(config-vrf-af)# route-target import 1:8
Device(config-vrf-af)# exit-address-family
```

## Example: Associating a VRF with an Interface

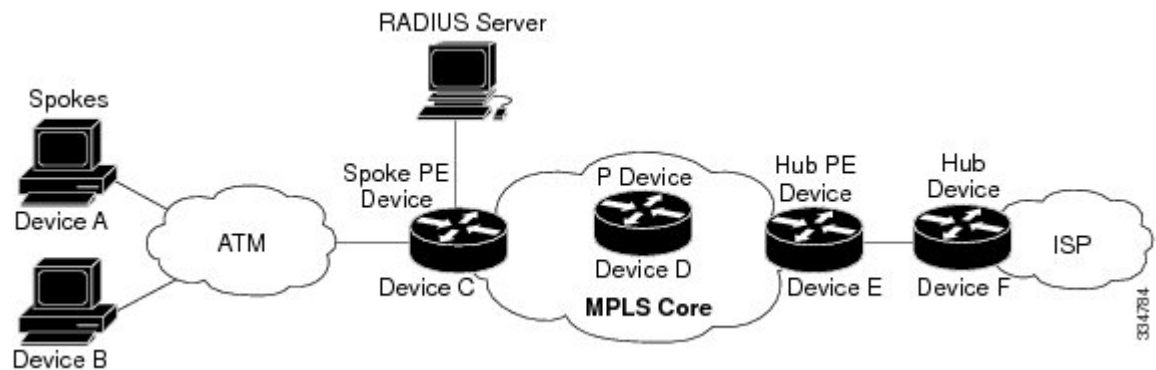
The following example associates the virtual routing and forwarding (VRF) instance named Up with POS 3/0/1 subinterface and specifies the downstream VRF named Down:

```
Device> enable
Device# configure terminal
Device(config)# interface POS 3/0/1
Device(config-if)# vrf forwarding Up downstream Down
Device(config-if)# ip address 10.0.0.1 255.0.0.0
```

## Example Configuring MPLS VPN Half-Duplex VRF Using Static CE-PE Routing

This example uses the hub-and-spoke topology shown in the figure below with local authentication (that is, the RADIUS server is not used):

**Figure 2: Sample Topology**



```
vrf definition D
rd 1:8
address-family ipv4
route-target export 1:100
exit-address-family
!
vrf definition U
rd 1:0
address-family ipv4
route-target import 1:0
exit-address-family
!
ip cef
vpdn enable
!
vpdn-group U
accept-dialin
protocol pppoe
virtual-template 1
!
interface Loopback 2
vrf forwarding U
ip address 10.0.0.8 255.255.255.255
!
interface ATM 2/0
description Mze ATM3/1/2
no ip address
no atm ilmi-keepalive
pvc 0/16 ilmi
!
pvc 3/100
protocol pppoe
!
pvc 3/101
protocol pppoe
!
```

## Example: Configuring MPLS VPN Half-Duplex VRF Using RADIUS Server and Static CE-PE Routing

The following example shows how to connect two Point-to-Point Protocol over Ethernet (PPPoE) clients to a single virtual routing and forwarding (VRF) pair on the spoke provider edge (PE) device named Device C. Although both PPPoE clients are configured in the same VRF, all communication occurs using the hub PE device. Half-duplex VRFs are configured on the spoke PE. The client configuration is downloaded to the spoke PE from the RADIUS server.

This example uses the hub-and-spoke topology shown in the figure above.



### Note

The wholesale provider can forward the user authentication request to the corresponding ISP. If the ISP authenticates the user, the wholesale provider appends the VRF information to the request that goes back to the PE device.

```

aaa new-model
!
aaa group server radius R
  server 10.0.20.26 auth-port 1812 acct-port 1813
!
aaa authentication ppp default group radius
aaa authorization network default group radius
!
vrf definition D
  description Downstream VRF - to spokes
  rd 1:8
  address-family ipv4
    route-target export 1:100
  exit-address-family
!
vrf definition U
  description Upstream VRF - to hub
  rd 1:0
  address-family ipv4
    route-target import 1:0
  exit-address-family
!
ip cef
vpdn enable
!
vpdn-group U
  accept-dialin
  protocol pppoe
  virtual-template 1
!
interface Loopback2
  vrf forwarding U
  ip address 10.0.0.8 255.255.255.255
!
interface ATM2/0
  pvc 3/100
    protocol pppoe
  !
pvc 3/101
  protocol pppoe
!
interface virtual-template 1
  no ip address
  ppp authentication chap
!
router bgp 1
  no synchronization

```

```

neighbor 172.16.0.34 remote-as 1
neighbor 172.16.0.34 update-source Loopback0
no auto-summary
!
address-family vpnv4
neighbor 172.16.0.34 activate
neighbor 172.16.0.34 send-community extended
auto-summary
exit-address-family
!
address-family ipv4 vrf U
no auto-summary
no synchronization
exit-address-family
!
address-family ipv4 vrf D
redistribute static
no auto-summary
no synchronization
exit-address-family
!
ip local pool U-pool 10.8.1.1 2.8.1.100
ip route vrf D 10.0.0.0 255.0.0.0 Null0
!
radius-server host 10.0.20.26 auth-port 1812 acct-port 1813
radius-server key cisco

```

## Example: Configuring MPLS VPN Half-Duplex VRF Using Dynamic CE-PE Routing

The following example shows how to use Open Shortest Path First (OSPF) to dynamically advertise the routes on the spoke sites.

This example uses the hub-and-spoke topology shown in the figure above.

### Creating the VRFs

```

vrf definition Down
rd 100:1
address-family ipv4
route-target export 100:0
exit-address-family
!
vrf definition Up
rd 100:2
address-family ipv4
route-target import 100:1
exit-address-family

```

### Enabling MPLS

```

mpls ldp graceful-restart
mpls ldp router-id Loopback0 force
mpls label protocol ldp

```

### Configuring BGP Toward Core

```

router bgp 100
no bgp default ipv4-unicast
bgp log-neighbor-changes
bgp graceful-restart restart-time 120
bgp graceful-restart stalepath-time 360

```

```
bgp graceful-restart
neighbor 10.13.13.13 remote-as 100
neighbor 10.13.13.13 update-source Loopback0
!
address-family vpnv4
neighbor 10.13.13.13 activate
neighbor 10.13.13.13 send-community extended
bgp scan-time import 5
exit-address-family
```

### Configuring BGP Toward Edge

```
address-family ipv4 vrf Up
no auto-summary
no synchronization
exit-address-family
!
address-family ipv4 vrf Down
redistribute ospf 1000 vrf Down
no auto-summary
no synchronization
exit-address-family
```

### Spoke PE's Core-Facing Interfaces and Processes

```
interface Loopback 0
 ip address 10.11.11.11 255.255.255.255
!
interface POS 3/0/2
 ip address 10.0.1.1 255.0.0.0
 mpls label protocol ldp
 mpls ip
!
router ospf 100
 log-adjacency-changes
 auto-cost reference-bandwidth 1000
 nsf enforce global
 redistribute connected subnets
 network 10.11.11.11 0.0.0.0 area 100
 network 10.0.1.0 0.255.255.255 area 100
```

### Spoke PE's Edge-Facing Interfaces and Processes

```
interface Loopback 100
 vrf forwarding Down
 ip address 10.22.22.22 255.255.255.255
!
interface POS 3/0/1
 vrf forwarding Up downstream Down
 ip address 10.0.0.1 255.0.0.0
!
interface POS 3/0/3
 vrf forwarding Up downstream Down
 ip address 10.2.0.1 255.0.0.0
!
router ospf 1000 vrf Down
 router-id 10.22.22.22
 log-adjacency-changes
 auto-cost reference-bandwidth 1000
 nsf enforce global
 redistribute connected subnets
 redistribute bgp 100 metric-type 1 subnets
 network 10.22.22.22 0.0.0.0 area 300
 network 10.0.0.0 0.255.255.255 area 300
 network 10.2.0.0 0.255.255.255 area 300
 default-information originate
```

## Additional References

### Related Documents

| Related Topic                       | Document Title                                                            |
|-------------------------------------|---------------------------------------------------------------------------|
| Cisco IOS commands                  | <a href="#">Cisco Master Command List, All Releases</a>                   |
| MPLS and MPLS applications commands | <a href="#">Cisco IOS Multiprotocol Label Switching Command Reference</a> |
| MPLS VPNs                           | “MPLS Virtual Private Networks” module                                    |
| Configuring IPv4 and IPv6 VRFs      | “MPLS VPN VRF CLI for IPv4 and IPv6 VPNs” module                          |

### Standards and RFCs

| Standard/RFC | Title         |
|--------------|---------------|
| RFC 2547     | BGP/MPLS VPNs |

### Technical Assistance

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

## Feature Information for MPLS VPN Half-Duplex VRF

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](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.



**Table 1: Feature Information for MPLS VPN Half-Duplex VRF**

| Feature Name                                                   | Releases                                                            | Feature Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MPLS VPN - Half Duplex VRF (HDVRF) Support with Static Routing | 12.3(6)<br>12.3(11)T<br>12.2(28)SB<br>Cisco IOS XE Release 2.5      | <p>This feature ensures that VPN clients that connect to the same PE device at the edge of the MPLS VPN use the hub site to communicate.</p> <p>In Cisco IOS Release 12.3(6), this feature was introduced.</p> <p>In Cisco IOS Release 12.4(20)T, this feature was integrated.</p> <p>In Cisco IOS Release 12.2(28)SB, this feature was integrated.</p> <p>In Cisco IOS XE Release 2.5, this feature was implemented on the Cisco ASR 1000 Series Aggregation Services Routers.</p> |
| MPLS VPN Half-Duplex VRF                                       | 12.2(28)SB2<br>12.4(20)T<br>12.2(33)SRC<br>Cisco IOS XE Release 2.5 | <p>In Cisco IOS Release 12.2(28)SB2, support for dynamic routing protocols was added.</p> <p>In Cisco IOS Release 12.4(20)T, this feature was integrated.</p> <p>In Cisco IOS Release 12.2(33)SRC, this feature was integrated.</p> <p>In Cisco IOS XE Release 2.5, this feature was integrated.</p> <p>The following commands were introduced or modified: <b>ip vrf forwarding</b> (interface configuration), <b>show ip interface</b>, <b>show vrf</b>.</p>                      |

