Multi-VRF Selection Using Policy-Based Routing

The Multi-VRF Selection Using Policy-Based Routing (PBR) feature allows a specified interface on a provider edge (PE) device to route packets to Virtual Private Networks (VPNs) based on packet length or match criteria defined in an IP access list.

You can enable VPN routing and forwarding (VRF) selection by policy routing packets through a route map, through the global routing table, or to a specified VRF.

You can enable policy-routing packets for VRF instances by using route map commands with `set` commands.

On supported hardware, you can configure both the Multi-VRF Selection Using Policy-Based Routing feature and the MPLS VPN VRF Selection Based on a Source IP Address feature on the same interface.

- Finding Feature Information, page 1
- Prerequisites for Multi-VRF Selection Using Policy-Based Routing, page 2
- Restrictions for Multi-VRF Selection Using Policy-Based Routing, page 2
- Information About Multi-VRF Selection Using Policy-Based Routing, page 3
- How to Configure Multi-VRF Selection Using Policy-Based Routing, page 6
- Configuration Examples for Multi-VRF Selection Using Policy-Based Routing, page 15
- Additional References, page 16
- Feature Information for Multi-VRF Selection Using Policy-Based Routing, page 16
- Glossary, page 18

Finding Feature Information

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Prerequisites for Multi-VRF Selection Using Policy-Based Routing

- The device must support policy-based routing (PBR) in order for you to configure this feature. For platforms that do not support PBR, use the MPLS VPN VRF Selection Based on a Source IP Address feature.

- A Virtual Private Network (VPN) virtual routing and forwarding (VRF) instance must be defined before you configure this feature. An error message is displayed on the console if no VRF exists.

Restrictions for Multi-VRF Selection Using Policy-Based Routing

- All commands that aid in routing also support hardware switching, except for the `set ip next-hop verify availability` command because Cisco Discovery Protocol information is not available in the line cards.

- Protocol Independent Multicast (PIM) and multicast packets do not support policy-based routing (PBR) and cannot be configured for a source IP address that is a match criterion for this feature.

- The `set vrf` and `set ip global next-hop` commands can be configured with the `set default interface`, `set interface`, `set ip default next-hop`, and `set ip next-hop` commands. But the `set vrf` and `set ip global next-hop` commands take precedence over the `set default interface`, `set interface`, `set ip default next-hop`, and `set ip next-hop` commands. No error message is displayed if you attempt to configure the `set vrf` command with any of these three `set` commands.

- The Multi-VRF Selection Using Policy-Based Routing feature cannot be configured with IP prefix lists.

- The `set global` and `set vrf` commands cannot be simultaneously applied to a route map.

- The Multi-VRF Selection Using Policy-Based Routing feature supports VRF-lite; that is, only IP routing protocols run on the device. Multiprotocol Label Switching (MPLS) and Virtual Private Networks (VPNs) cannot be configured. However, the `set vrf` command will work in MPLS VPN scenarios.

- If you delete one VRF using `no vrf definition vrf-name` command, then other VRFs in the VRF routing table are also removed unexpectedly; when `ip vrf receive` command is configured with receive entries above 400, and IPv4 and IPv6 routes above 2000. This is applicable only for Cisco ASR 1000 platform.

- In a VRF receive scenario, the memory requirements are proportional to the number of VRF receives that are configured multiplied by the number of directly connected neighbours (Cisco Express Forwarding adjacencies). When the `ip vrf receive` command is configured, Cisco Express Forwarding adjacency prefixes are copied to the VRF. Network resources might be exhausted based on number of bytes per each adjacency prefix, number of adjacency prefixes, number of VRF receives configured, and the platform-specific route processor memory restrictions applicable to Cisco Express Forwarding entries.
Information About Multi-VRF Selection Using Policy-Based Routing

Policy Routing of VPN Traffic Based on Match Criteria

The Multi-VRF Selection Using Policy-Based Routing feature is an extension of the MPLS VPN VRF Selection Based on a Source IP Address feature. The Multi-VRF Selection Using Policy-Based Routing feature allows you to policy route Virtual Private Network (VPN) traffic based on match criteria. Match criteria are defined in an IP access list and/or are based on packet length. The following match criteria are supported in Cisco software:

- **IP access lists**—Define match criteria based on IP addresses, IP address ranges, and other IP packet access list filtering options. Named, numbered, standard, and extended access lists are supported. All IP access list configuration options in Cisco software can be used to define match criteria.

- **Packet lengths**—Define match criteria based on the length of a packet, in bytes. The packet length filter is defined in a route map with the `match length` route-map configuration command.

Policy routing is defined in the route map. The route map is applied to the incoming interface with the `ip policy route-map` interface configuration command. An IP access list is applied to the route map with the `match ip address` route-map configuration command. Packet length match criteria are applied to the route map with the `match length` route-map configuration command. The `set` action is defined with the `set vrf` route-map configuration command. The match criteria are evaluated, and the appropriate VRF is selected by the `set` command. This combination allows you to define match criteria for incoming VPN traffic and policy route VPN packets out to the appropriate virtual routing and forwarding (VRF) instance.

Policy-Based Routing set Commands

**Policy-routing Packets for VRF Instances**

To enable policy-routing packets for virtual routing and forwarding (VRF) instances, you can use route map commands with the following `set` commands. They are listed in the order in which the device uses them during the routing of packets.

- **set tos**—Sets the Type of Service (TOS) bits in the header of an IP packet.

- **set df**—Sets the Don’t Fragment (DF) bit in the header of an IP packet.

- **set vrf**—Routes packets through the specified interface. The destination interface can belong only to a VRF instance.

- **set global**—Routes packets through the global routing table. This command is useful for routing ingress packets belonging to a specific VRF through the global routing table.

- **set ip vrf next-hop**—Indicates where to output IPv4 packets that pass a match criteria of a route map for policy routing when the IPv4 next hop must be under a specified VRF.
• set ipv6 vrf next-hop—Indicates where to output IPv6 packets that pass a match criteria of a route map for policy routing when the IPv6 next hop must be under a specified VRF.

• set ip global next-hop—Indicates where to forward IPv4 packets that pass a match criterion of a route map for policy routing and for which the Cisco software uses the global routing table. The global keyword explicitly defines that IPv4 next-hops are under the global routing table.

• set ipv6 global next-hop—Indicates where to forward IPv6 packets that pass a match criterion of a route map for policy routing and for which the Cisco software uses the global routing table. The global keyword explicitly defines that IPv6 next-hops are under the global routing table.

• set interface—When packets enter a VRF, routes the packets out of the egress interface under the same VRF according to the set interface policy, provided that the Layer 2 rewrite information is available.

• set ip default vrf—Provides IPv4 inherit-VRF and inter-VRF routing. With inherit-VRF routing, IPv4 packets arriving at a VRF interface are routed by the same outgoing VRF interface. With inter-VRF routing, IPv4 packets arriving at a VRF interface are routed through any other outgoing VRF interface.

• set ipv6 default vrf—Provides IPv6 inherit-VRF and inter-VRF routing. With inherit-VRF routing, IPv6 packets arriving at a VRF interface are routed by the same outgoing VRF interface. With inter-VRF routing, IPv6 packets arriving at a VRF interface are routed through any other outgoing VRF interface.

• set ip default global—Provides IPv4 VRF to global routing.

• set ipv6 default global—Provides IPv6 VRF to global routing.

• set default interface—Indicates where to output packets that pass a match criterion of a route map for policy routing and have no explicit route to the destination. The interface can belong to any VRF.

• set ip default next-hop—Indicates where to output IPv4 packets that pass a match criterion of a route map for policy routing and for which the Cisco software has no explicit route to a destination.

• set ipv6 default next-hop—Indicates where to IPv6 output packets that pass a match criterion of a route map for policy routing and for which the Cisco software has no explicit route to a destination.

Change of Normal Routing and Forwarding Behavior

When you configure policy-based routing (PBR), you can use the following six set commands to change normal routing and forwarding behavior. Configuring any of these set commands, with the potential exception of the set ip next-hop command, overrides the routing behavior of packets entering the interface if the packets do not belong to a virtual routing and forwarding (VRF) instance. The packets are routed from the egress interface across the global routing table.

• set default interface—Indicates where to output packets that pass a match criterion of a route map for policy routing and have no explicit route to the destination.

• set interface—When packets enter a VRF interface, routes the packets out of the egress interface under the same VRF according to the set interface policy, provided that the Layer 2 rewrite information is available.

Note The interface must be a peer-to-peer (P2P) interface.

• set ip default next-hop—Indicates where to output IPv4 packets that pass a match criterion of a route map for policy routing and for which the Cisco software has no explicit route to a destination.
• **set ipv6 default next-hop**—Indicates where to output IPv6 packets that pass a match criterion of a route map for policy routing and for which the Cisco software has no explicit route to a destination.

• **set ip next-hop**—Indicates where to output IPv4 packets that pass a match criterion of a route map for policy routing. If an IPv4 packet is received on a VRF interface and is transmitted from another interface within the same VPN, the VRF context of the incoming packet is inherited from the interface.

• **set ipv6 next-hop**—Indicates where to output IPv6 packets that pass a match criterion of a route map for policy routing. If an IPv6 packet is received on a VRF interface and is transmitted from another interface within the same Virtual Private Network (VPN), the VRF context of the incoming packet is inherited from the interface.

**Support of Inherit-VRF Inter-VRF and VRF-to-Global Routing**

The Multi-VRF Selection Using Policy-Based Routing (PBR) feature supports inherit-VRF and inter-VRF. With inherit-VRF routing, packets arriving at a virtual routing and forwarding (VRF) interface are routed by the same outgoing VRF interface. With inter-VRF routing, packets arriving at a VRF interface are routed through any other outgoing VRF interface.

VRF-to-global routing causes packets that enter any VRF interface to be routed through the global routing table. When a packet arrives on a VRF interface, the destination lookup normally is done only in the corresponding VRF table. If a packet arrives on a global interface, the destination lookup is done in the global routing table.

The Multi-VRF Selection Using Policy-Based Routing feature modifies the following **set** commands to support inherit-VRF, inter-VRF, and VRF-to-global routing. The commands are listed in the order in which the device uses them during the routing of packets.

• **set global**—Routes packets through the global routing table. This command is useful for routing ingress packets belonging to a specific VRF through the global routing table.

• **set ip global next-hop**—Indicates where to forward IPv4 packets that pass a match criterion of a route map for policy routing and for which the Cisco software uses the global routing table.

• **set ipv6 global next-hop**—Indicates where to forward IPv6 packets that pass a match criterion of a route map for policy routing and for which the Cisco software uses the global routing table.

• **set ip vrf next-hop**—Causes the device to look up the IPv4 next hop in the VRF table. If an IPv4 packet arrives on an interface that belongs to a VRF and the packet needs to be routed through a different VRF, you can use the **set ip vrf next-hop** command.

• **set ipv6 vrf next-hop**—Causes the device to look up the IPv6 next hop in the VRF table. If an IPv6 packet arrives on an interface that belongs to a VRF and the packet needs to be routed through a different VRF, you can use the **set ipv6 vrf next-hop** command.

• **set ip default vrf**—Provides IPv4 inherit-VRF and inter-VRF routing. With IPv4 inherit-VRF routing, IPv4 packets arriving at a VRF interface are routed by the same outgoing VRF interface. With inter-VRF routing, IPv4 packets arriving at a VRF interface are routed through any other outgoing VRF interface.

• **set ipv6 default vrf**—Provides IPv6 inherit-VRF and inter-VRF routing. With IPv6 inherit-VRF routing, IPv6 packets arriving at a VRF interface are routed by the same outgoing VRF interface. With inter-VRF routing, IPv6 packets arriving at a VRF interface are routed through any other outgoing VRF interface.

• **set interface**—When packets enter a VRF, routes the packets out of the egress interface under the same VRF, according to the set interface policy, provided that the Layer 2 rewrite information is available.
How to Configure Multi-VRF Selection Using Policy-Based Routing

Defining the Match Criteria for Multi-VRF Selection Using Policy-Based Routing

Define the match criteria for the Multi-VRF Selection using Policy-Based Routing (PBR) feature so that you can selectively route the packets instead of using their default routing and forwarding.

The match criteria for the Multi-VRF Selection using Policy-Based Routing are defined in an access list. Standard, named, and extended access lists are supported.

You can define the match criteria based on the packet length by configuring the `match length` route-map configuration command. This configuration option is defined entirely within a route map.

The following sections explain how to configure PBR route selection:

Configuring Multi-VRF Selection Using Policy-Based Routing with a Standard Access List

**Before You Begin**

The tasks in the following sections assume that the virtual routing and forwarding (VRF) instance and associated IP address are already defined.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `access-list access-list-number {deny | permit} [source source-wildcard] [log]`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: Device&gt; enable</td>
<td>- Enter your password if prompted.</td>
</tr>
</tbody>
</table>

### Step 2

**configure terminal**

**Example:**

Device# configure terminal

Enters global configuration mode.

### Step 3

**access-list access-list-number {deny | permit} [source source-wildcard] [log]**

**Example:**

Device(config)# access-list 40 permit source 10.1.1.0/24 0.0.0.255

Creates an access list and defines the match criteria for the route map.

- Match criteria can be defined based on IP addresses, IP address ranges, and other IP packet access list filtering options. Named, numbered, standard, and extended access lists are supported. You can use all IP access list configuration options to define match criteria.
- The example creates a standard access list numbered 40. This filter permits traffic from any host with an IP address in the 10.1.1.0/24 subnet.

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**Configuring Multi-VRF Selection Using Policy-Based Routing with a Named Extended Access List**

To configure Multi-VRF Selection using Policy-Based Routing (PBR) with a named extended access list, complete the following steps.

**Before You Begin**

The tasks in the following sections assume that the virtual routing and forwarding (VRF) instance and associated IP address are already defined.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. ip access-list {standard | extended} [access-list-name | access-list-number]
4. [sequence-number] {permit | deny} protocol source source-wildcard destination destination-wildcard [option option-value] [precedence precedence] [tos tos] [ttl operator-value] [log] [time-range time-range-name] [fragments]
### 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>• Enter your password if prompted.</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> ip access-list {standard</td>
<td>extended} [access-list-name</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip access-list extended NAMEDACL</td>
<td>• You can specify a standard, extended, or named access list.</td>
</tr>
<tr>
<td><strong>Step 4</strong> [sequence-number] {permit</td>
<td>deny} protocol source source-wildcard destination destination-wildcard [option option-value] [precedence precedence] [tos tots] [ttl operator-value] [log] [time-range time-range-name] [fragments]</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-ext-nacl)# permit ip any any option any-options</td>
<td>• Match criteria can be defined based on IP addresses, IP address ranges, and other IP packet access list filtering options. Named, numbered, standard, and extended access lists are supported. You can use all IP access list configuration options to define match criteria.</td>
</tr>
<tr>
<td></td>
<td>• The example creates a named access list that permits any configured IP option.</td>
</tr>
</tbody>
</table>

### Configuring Multi-VRF Selection in a Route Map

Incoming packets are filtered through the match criteria that are defined in the route map. After a successful match occurs, the `set` command configuration determines the VRF through which the outbound Virtual Private Network (VPN) packets will be policy routed.

**Before You Begin**

You must define the virtual routing and forwarding (VRF) instance before you configure the route map; otherwise an error message appears on the console.

A receive entry must be added to the VRF selection table with the `ip vrf receive` command. If a match and set operation occurs in the route map but there is no receive entry in the local VRF table, the packet will be dropped if the packet destination is local.
SUMMARY STEPS

1. enable
2. configure terminal
3. named-ordering-route-map enable ]
4. route-map map-tag [permit | deny] [sequence-number] [ 
5. Do one of the following:
   - set ip vrf vrf-name next-hop global-ipv4-address [...global-ipv4-address]
   - set ipv6 vrf vrf-name next-hop global-ipv6-address [...global-ipv6-address]
   - set ip next-hop recursive vrf global-ipv4-address [...global-ipv4-address]
   - set ip global next-hop global-ipv4-address [...global-ipv4-address]
   - set ipv6 global next-hop global-ipv6-address [...global-ipv6-address]

6. Do one of the following:
   - match ip address {acl-number [acl-name | acl-number]}
   - match length minimum-lengthmaximum-length

7. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
| Example: Device> enable | • Enter your password if prompted.  |
| **Step 2** configure terminal | Enters global configuration mode.  |
| Example: Device# configure terminal | |
| **Step 3** named-ordering-route-map enable ] | Enables ordering of route-maps based on a string provided by the user.  |
| Example: Device(config)# named-ordering-route-map enable | |
### Configuring Multi-VRF Selection in a Route Map

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 4**

- `route-map map-tag [permit|deny] [sequence-number]


Example:

```
Device(config)# route-map alpha permit ordering-seq
```

**Step 5**

Do one of the following:

- `set ip vrf vrf-name next-hop global-ipv4-address


Example:

```
Device(config-route-map)# set ip vrf myvrf next-hop 10.0.0.0
```

- `set ipv6 vrf vrf-name next-hop global-ipv6-address


Example:

```
Device(config-route-map)# set ipv6 vrf myvrf next-hop 2001.DB8:4:1::1/64
```

- `set ip next-hop recursive vrf global-ipv4-address


Example:

```
Device(config-route-map)# set ip next-hop recursive vrf 10.0.0.0
```

- `set ip global next-hop global-ipv4-address


Example:

```
Device(config-route-map)# set ip global next-hop 10.0.0.0
```

- `set ipv6 global next-hop global-ipv6-address


Example:

```
Device(config-route-map)# set ipv6 global next-hop 2001.DB8:4:1::1/64
```
### Configuring Multi-VRF Selection Using Policy-Based Routing and IP VRF Receive on the Interface

The route map is attached to the incoming interface with the `ip policy route-map` interface configuration command.

The source IP address must be added to the virtual routing and forwarding (VRF) selection table. VRF selection is a one-way (unidirectional) feature. It is applied to the incoming interface. If a `match` and `set` operation occurs in the route map but there is no receive entry in the local VRF table, the packet is dropped if the packet destination is local.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `interface type number [name-tag]`
4. `ip policy route-map map-tag`
5. `ip vrf receive vrf-name`
6. `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> interface <em>type number [name-tag]</em></td>
<td>Configures an interface and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# interface FastEthernet 0/1/0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip policy route-map <em>map-tag</em></td>
<td>Identifies a route map to use for policy routing on an interface.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# ip policy route-map map1</td>
<td>• The configuration example attaches the route map named map1 to the interface.</td>
</tr>
<tr>
<td><strong>Step 5</strong> ip vrf receive <em>vrf-name</em></td>
<td>Adds the IP addresses that are associated with an interface into the VRF table.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# ip vrf receive VRF-1</td>
<td>• This command must be configured for each VRF that will be used for VRF selection.</td>
</tr>
<tr>
<td><strong>Step 6</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# end</td>
<td></td>
</tr>
</tbody>
</table>

## Verifying the Configuration of Multi-VRF Selection Using Policy-Based Routing

To verify the configuration of the Multi-VRF Selection Using Policy-Based Routing (PBR) feature, perform the following steps. You can enter the commands in any order.
SUMMARY STEPS

1. show ip access-list [access-list-number | access-list-name]
2. show route-map [map-name]
3. show ip policy

DETAILED STEPS

Step 1  show ip access-list [access-list-number | access-list-name]
Verifies the configuration of match criteria for Multi-VRF Selection Using Policy-Based Routing. The command output displays three subnet ranges defined as match criteria in three standard access lists:

Example:

Device# show ip access-list
Standard IP access list 40
  10 permit 10.1.0.0, wildcard bits 0.0.255.255
Standard IP access list 50
  10 permit 10.2.0.0, wildcard bits 0.0.255.255
Standard IP access list 60
  10 permit 10.3.0.0, wildcard bits 0.0.255.255

Step 2  show route-map [map-name]
Verifies match and set commands within the route map:

Example:

Device# show route-map
The output displays the match criteria and set action for each route-map sequence. The output also displays the number of packets and bytes that have been policy routed per each route-map sequence.

Example:

Device# show route-map map1
route-map map1, permit, sequence 10
Match clauses:
Set clauses:
  ip next-hop vrf myvrf 10.5.5.5 10.6.6.6 10.7.7.7
  ip next-hop global 10.8.8.8 10.9.9.9
Policy routing matches: 0 packets, 0 bytes
Device# show route-map map2
route-map map2, permit, sequence 10
Match clauses:
Set clauses:
  vrf myvrf
Policy routing matches: 0 packets, 0 bytes
Device# show route-map map3
route-map map3, permit, sequence 10
Match clauses:
Set clauses:
  global
Policy routing matches: 0 packets, 0 bytes

The following show route-map command displays output from the set ip vrf next-hop command:
Example:

Device(config)# route-map test

Device(config-route-map)# set ip vrf myvrf next-hop
Device(config-route-map)# set ip vrf myvrf next-hop 192.168.3.2
Device(config-route-map)# match ip address 255 101
Device(config-route-map)# end

Device# show route-map

route-map test, permit, sequence 10
    Match clauses:
        ip address (access-lists): 101
    Set clauses:
        ip vrf myvrf next-hop 192.168.3.2
Policy routing matches: 0 packets, 0 bytes

The following show route-map command displays output from the set ip global command:

Example:

Device(config)# route-map test
Device(config-route-map)# match ip address 255 101
Device(config-route-map)# set ip global next-hop 192.168.4.2
Device(config-route-map)# end
Device# show route-map

*May 25 13:45:55.551: %SYS-5-CONFIG_I: Configured from console by consoleout-map
route-map test, permit, sequence 10
    Match clauses:
        ip address (access-lists): 101
    Set clauses:
        ip global next-hop 192.168.4.2
Policy routing matches: 0 packets, 0 bytes

Step 3

show ip policy

Verifies the Multi-VRF Selection Using Policy-Based Routing policy.

Example:

Device# show ip policy

The following show ip policy command output displays the interface and associated route map that is configured for policy routing:

Example:

Device# show ip policy

<table>
<thead>
<tr>
<th>Interface</th>
<th>Route map</th>
</tr>
</thead>
<tbody>
<tr>
<td>FastEthernet0/1/0</td>
<td>FBR-VRF-Selection</td>
</tr>
</tbody>
</table>
Configuration Examples for Multi-VRF Selection Using Policy-Based Routing

Example: Defining the Match Criteria for Multi-VRF Selection Using Policy-Based Routing

In the following example, three standard access lists are created to define match criteria for three different subnetworks. Any packets received on FastEthernet interface 0/1/0 will be policy routed through the PBR-VRF-Selection route map to the virtual routing and forwarding (VRF) that is matched in the same route-map sequence. If the source IP address of the packet is part of the 10.1.0.0/24 subnet, VRF1 will be used for routing and forwarding.

```bash
access-list 40 permit source 10.1.0.0 0.0.255.255
access-list 50 permit source 10.2.0.0 0.0.255.255
access-list 60 permit source 10.3.0.0 0.0.255.255
route-map PBR-VRF-Selection permit 10
  match ip address 40
  set vrf VRF1
!
route-map PBR-VRF-Selection permit 20
  match ip address 50
  set vrf VRF2
!
route-map PBR-VRF-Selection permit 30
  match ip address 60
  set vrf VRF3
!
interface FastEthernet 0/1/0
  ip address 192.168.1.6 255.255.255.252
  ip vrf forwarding VRF4
  ip policy route-map PBR-VRF-Selection
  ip vrf receive VRF1
  ip vrf receive VRF2
  ip vrf receive VRF3
```

Example: Configuring Multi-VRF Selection in a Route Map

The following example shows a `set ip vrf next-hop` command that applies policy-based routing to the virtual routing and forwarding (VRF) interface named myvrf and specifies that the IP address of the next hop is 10.0.0.2:

```bash
Device(config)# route-map map1 permit
Device(config)# set vrf myvrf
Device(config-route-map)# set ip vrf myvrf next-hop 10.0.0.2
Device(config-route-map)# match ip address 101
Device(config-route-map)# end
```

The following example shows a `set ip global` command that specifies that the device should use the next hop address 10.0.0.1 in the global routing table:

```bash
Device(config-route-map)# set ip global next-hop 10.0.0.1
```
Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco Master Command List, All Releases</td>
</tr>
<tr>
<td>MPLS and MPLS applications commands</td>
<td>Cisco IOS Multiprotocol Label Switching Command Reference</td>
</tr>
<tr>
<td>IP access list commands</td>
<td>Cisco IOS Security Command Reference</td>
</tr>
</tbody>
</table>

Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

Feature Information for Multi-VRF Selection Using Policy-Based Routing

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/cfh. An account on Cisco.com is not required.
### Table 1: Feature Information for Multi-VRF Selection Using Policy-Based Routing

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-VRF Selection Using Policy-Based Routing (PBR)</td>
<td>12.2(33)SRB1, 12.2(33)SXH1, 12.4(24)T, Cisco IOS XE Release 2.2</td>
<td>The Multi-VRF Selection Using Policy-Based Routing (PBR) feature allows a specified interface on a provider edge (PE) router to route packets to Virtual Private Networks (VPNs) based on packet length or match criteria defined in an IP access list. This feature and the MPLS VPN VRF Selection Based on Source IP Address feature can be configured together on the same interface. In Cisco IOS Release 12.2(33)SRB1, this feature was introduced. In Cisco IOS Release 12.2(33)SXH1, support was added. In Cisco IOS Release 12.4(24)T, this feature was integrated. In Cisco IOS XE Release 2.2, this feature was implemented on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were modified: <code>set ip global next-hop</code> and <code>set ip vrf next-hop</code>.</td>
</tr>
<tr>
<td>IPv6 VRF-Aware PBR Next-hop Enhancement</td>
<td>15.2(2)S, Cisco IOS XE Release 3.6S</td>
<td>In Cisco IOS Release 15.2(2)S, this feature was introduced. In Cisco IOS XE Release 3.6S, this feature was implemented on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced: <code>set ipv6 default next-hop</code>, <code>set ipv6 next-hop (PBR)</code></td>
</tr>
</tbody>
</table>
Glossary

**CE device**—customer edge device. A device that is part of a customer network and that interfaces to a provider edge (PE) device.

**Inherit-VRF routing**—Packets arriving at a VRF interface are routed by the same outgoing VRF interface.

**Inter-VRF routing**—Packets arriving at a VRF interface are routed via any other outgoing VRF interface.

**IP**—Internet Protocol. Network layer protocol in the TCP/IP stack offering a connectionless internetwork service. IP provides features for addressing, type-of-service specification, fragmentation and reassembly, and security. Defined in RFC 791.

**PBR**—policy-based routing. PBR allows a user to manually configure how received packets should be routed.

**PE device**—provider edge device. A device that is part of a service provider’s network and that is connected to a CE device. It exchanges routing information with CE devices by using static routing or a routing protocol such as BGP, RIPv1, or RIPv2.

**VPN**—Virtual Private Network. A collection of sites sharing a common routing table. A VPN provides a secure way for customers to share bandwidth over an ISP backbone network.

**VRF**—A VPN routing and forwarding instance. 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.

**VRF-lite**—A feature that enables a service provider to support two or more VPNs, where IP addresses can be overlapped among the VPNs.