



VRF Steering for Cisco CMTS Routers

First Published: June 20, 2011

The virtual routing and forwarding (VRF) steering feature allows provisioning of data traffic from cable modems to be contained to a specified VRF instance. This enables all traffic from and to a particular set of cable modems to be constrained to a VRF instance.

Finding Feature Information

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

Contents

- [Prerequisites for VRF Steering, page 1](#)
- [Restrictions for VRF Steering, page 2](#)
- [Information About VRF Steering, page 3](#)
- [How to Configure VRF Steering, page 3](#)
- [Configuration Examples for VRF Steering, page 7](#)
- [Additional References, page 8](#)
- [Feature Information for VRF Steering, page 10](#)

Prerequisites for VRF Steering

The table shows the hardware compatibility prerequisites for this feature.

**Note**

The hardware components introduced in a given Cisco IOS Release are supported in all subsequent releases unless otherwise specified.

Table 1: Cable Hardware Compatibility Matrix for VRF Steering

Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	<p>Cisco IOS Release 12.2(33)SCF and later releases</p> <ul style="list-style-type: none"> • PRE2 • PRE4 <p>Cisco IOS Release 12.2(33)SCH and later releases</p> <ul style="list-style-type: none"> • PRE5 	<p>Cisco IOS Release 12.2(33)SCF and later releases</p> <ul style="list-style-type: none"> • Cisco uBR10-MC5X20H • Cisco UBR-MC20X20V • Cisco uBR-MC3GX60V¹
Cisco uBR7246VXR Universal Broadband Router	<p>Cisco IOS Release 12.2(33)SCF and later releases</p> <ul style="list-style-type: none"> • NPE-G1 • NPE-G2 	<p>Cisco IOS Release 12.2(33)SCF and later releases</p> <ul style="list-style-type: none"> • Cisco uBR-MC28U/X • Cisco uBR-MC88V
Cisco uBR7225VXR Universal Broadband Router	<p>Cisco IOS Release 12.2(33)SCF and later releases</p> <ul style="list-style-type: none"> • NPE-G1 • NPE-G2 	<p>Cisco IOS Release 12.2(33)SCF and later releases</p> <ul style="list-style-type: none"> • Cisco uBR-MC28U/X • Cisco uBR-MC88V

¹ The Cisco uBR-MC3GX60V line card is not compatible with PRE2.

Restrictions for VRF Steering

- Customer premise equipment (CPE) cannot specify a VRF instance unlike the cable modem.
- Only a single instance of the cable vrf-steering cable-modem command is supported.
- Only IPv4 is supported.

Information About VRF Steering

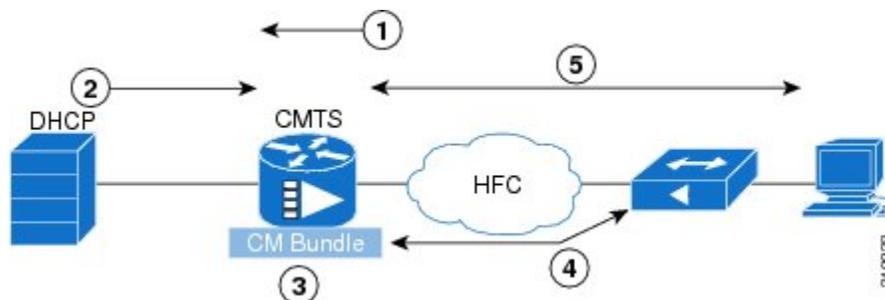
The VRF steering feature is developed to address the need for accommodating more IPv4 addresses when customers run out of IPv4 addresses for their CPE. This solution helps customers expand their existing IP address space until they move to the IPv6 address mode.

The availability of new IPv4 addresses is quickly coming to an end. In order to continue provisioning new subscribers, operators must switch to IPv6. This feature is designed to give the operators additional time to switch to IPv6 by expanding the use of non-traditional IPv4 addresses within their network. This feature allows the operator to create a private VRF for cable modems that are not routable outside of the operator network and choose any address since the CM addresses will not be routed externally. The CPE devices will continue to be provisioned with globally routable addresses, allowing them to peruse the internet.

VRF Steering Process

The figure and the following sequence of events describe the VRF steering process.

Figure 1: VRF Steering Process



- 1 The master bundle interface has at least 2 sub-bundles configured. The CPE is routed using the global sub-bundle interface. The CM is routed using the private VRF sub-bundle interface.
- 2 CM address negotiation happens using helper-address of the private VRF sub-bundle interface.
- 3 CPE address negotiation happens using helper-address of the global sub-bundle interface.
- 4 The Cisco CMTS steers all cable modem data traffic into the VRF. CM traffic that is punted to the route processor (RP) is forwarded only on the CM VRF.
- 5 At this point the CPE is able to get an IP address using the global Dynamic Host Configuration Protocol (DHCP) server. Since the CPE traffic is not classified, it uses the global routing table and is routable.

How to Configure VRF Steering

Configuring the VRF Steering

This section describes how to configure a VRF instance on the Cisco CMTS router.

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	ip vrf vrf-name Example: Router(config)# ip vrf CM-VRF Example: rd 100:100 Example: route-target export 100:100 Example: route-target import 100:100	Defines a VRF instance and enters the interface configuration mode. <ul style="list-style-type: none"> • vrf-name—Name assigned to a VRF.
Step 4	ip access-list extended access-list-name Example: Router(config)# ip access-list extended vrfcpe Example: permit ip 111.1.0.0 0.0.255.255 any Example: permit ip 112.1.0.0 0.0.255.255 any Example: permit ip 101.1.0.0 0.0.255.255 any	Specifies an extended IP access list to enable filtering for packets with IP helper-address destinations. <ul style="list-style-type: none"> • access-list-name—Name of the IP access list or object-group ACL. Names cannot contain a space or quotation mark, and must begin with an alphabetic character to prevent ambiguity with numbered access lists.

	Command or Action	Purpose
Step 5	<p>route-map map-tag permit sequence-number</p> <p>Example:</p> <pre>Router(config)# route-map cpe permit 10</pre> <p>Example:</p> <pre>Router(config)#route-map cpe permit 10</pre> <p>Example:</p> <pre>Router(config-route-map)# match ip address vrfcpe</pre> <p>Example:</p> <pre>Router(config-route-map)# set global</pre>	<p>Defines the conditions for redistributing routes from one routing protocol into another routing protocol, or to enable policy routing. The route map needs to reference the ACL.</p> <ul style="list-style-type: none"> map-tag—A meaningful name for the route map. sequence-number—Number that indicates the position a new route map will have in the list of route maps already configured with the same name.
Step 6	<p>interface bundle <i>n</i></p> <p>Example:</p> <pre>Router(config-if)# interface Bundle1</pre>	<p>Adds the selected interface to the virtual bundle. If this is the first interface on which the virtual bundle is configured, this command enables the bundle on the specified interface.</p> <ul style="list-style-type: none"> <i>n</i>—Interface bundle number. You can configure as many as 40 virtual interface bundles on the Cisco CMTS. The numeric identifiers may range from 1 to 255.
Step 7	<p>cable vrf-steering cable-modem <i>vrf-name</i></p> <p>Example:</p> <pre>Router(config-if)# cable vrf-steering cable-modem CM-VRF</pre>	<p>Steers or directs cable modems to the specified VRF in the cable interface configuration mode.</p> <ul style="list-style-type: none"> <i>vrf-name</i>—The VPN Routing/ Forwarding instance name.
Step 8	<p>interface bundle <i>n.l</i></p> <p>Example:</p> <pre>Router(config-if)# interface Bundle1.1</pre>	<p>Adds the selected interface to the virtual bundle. If this is the first interface on which the virtual bundle is configured, this command enables the bundle on the specified interface.</p> <ul style="list-style-type: none"> <i>n.l</i>—Interface sub-bundle number. You can configure as many as 40 virtual interface bundles on the Cisco CMTS. Numeric identifiers may range from 1 to 255.
Step 9	<p>ip address ip-address mask secondary</p> <p>Example:</p> <pre>Router(config-subif)# ip address 112.1.1.1 255.255.0.0 secondary</pre>	<p>Sets a secondary IP address for an interface.</p> <p>Note Create a primary interface address before setting a secondary IP address. If the secondary address is used for a VRF table configuration with the vrf keyword, the vrf keyword must be specified also.</p>

	Command or Action	Purpose
Step 10	cable dhcp-giaddr policy Example: <pre>Router(config-subif)# cable dhcp-giaddr policy</pre>	(Optional) Selects the control policy, so that the primary address is used for cable modems and the secondary addresses are used for hosts and other CPE devices.
Step 11	cable helper-address IP-address Example: <pre>Router(config-subif)# cable helper-address 72.10.10.2</pre>	Specifies a destination IP address for User Datagram Protocol (UDP) broadcast DHCP packets in cable subinterface configuration mode. <ul style="list-style-type: none"> • <i>IP-address</i>—The IP address of a DHCP server to which UDP broadcast packets will be sent.
Step 12	exit Example: <pre>Router(config-subif)# exit</pre>	Exits the subinterface configuration mode.
Step 13	interface bundle n.2 Example: <pre>Router(config-if)# interface Bundle1.2</pre>	Adds the selected interface to the virtual sub-bundle. If this is the first interface on which the virtual bundle is configured, this command enables the bundle on the specified interface. <ul style="list-style-type: none"> • <i>n.2</i>—Interface sub-bundle number. You can configure as many as 40 virtual interface bundles on the Cisco CMTS. Numeric identifiers may range from 1 to 255.
Step 14	ip vrf forwarding vrf-name Example: <pre>Router(config-subif)# ip vrf forwarding CM-VRF</pre>	Associates a VRF instance with an interface or subinterface. <ul style="list-style-type: none"> • <i>vrf-name</i>—Name assigned to a VRF.
Step 15	ip address ip-address mask Example: <pre>Router(config-subif)# ip address 192.0.2.1 255.255.255.0</pre>	Sets a primary or secondary IP address for the specified interface. <ul style="list-style-type: none"> • <i>mask</i>—Mask for the associated IP subnet address.
Step 16	ip policy route-map map-tag Example: <pre>Router(config-subif)# ip policy route-map cpe</pre>	Identifies a route map to use for policy routing on an interface. <ul style="list-style-type: none"> • <i>map-tag</i>—Name of the route map to use for policy routing. The name must match a map-tag value specified by a route-map command.
Step 17	cable helper-address IP-address Example: <pre>Router(config-subif)# cable helper-address 192.0.2.200</pre>	Specifies a destination IP address for User Datagram Protocol (UDP) broadcast Dynamic Host Configuration Protocol (DHCP) packets in cable subinterface configuration mode. <ul style="list-style-type: none"> • <i>IP-address</i>—The IP address of a DHCP server to which UDP broadcast packets will be sent.

	Command or Action	Purpose
Step 18	cable source-route Example: Router(config-subif)# cable source-route	Configures the VRF source route in the cable modem's sub- bundle interface configuration mode. Note This command is applicable to Cisco uBR10012 routers only.
Step 19	exit Example: Router(config-subif)# exit	Exits the subinterface configuration mode.

Troubleshooting Tips

Run the debug cable bundle vrf-steering command to display the interfaces selected during the configuration.

Configuration Examples for VRF Steering

This section provides the following configuration examples:

Example: VRF Steering for CMTS Routers

The following example shows how to configure VRF steering on CMTS routers:

```
Router> enable configure terminal
ip vrf CM-VRF
rd 100:100
route-target export 100:100
route-target import 100:100
! These commands apply to all the devices attached on this cable bundle.
!
interface Bundle1
no ip address
no cable arp filter request-send
no cable arp filter reply-accept
cable vrf-steering cable-modem CM-VRF
end
!Subinterface for CPEs.
!
interface Bundle1.1
ip address 112.1.1.1 255.255.0.0 secondary
ip address 111.1.1.1 255.255.0.0 secondary
ip address 101.1.1.1 255.255.0.0
cable dhcp-giaddr policy
cable helper-address 72.10.10.2
! Subinterface for CMs. These CMs go into CM-VRF
!
interface Bundle1.2
ip vrf forwarding CM-VRF
ip address 72.10.10.1 255.255.0.0
ip policy route-map cpe
cable helper-address 72.10.10.2
cable source-route
```

```

end
! Create ACL for CPE
!
ip access-list extended vrfcpe
 permit ip 111.1.0.0 0.0.255.255 any
 permit ip 112.1.0.0 0.0.255.255 any
 permit ip 101.1.0.0 0.0.255.255 any
!
! Create route-map for CPE
!
route-map cpe permit 10
 match ip address vrfcpe
 set global
end.

```

Verifying VRF Steering

To verify or view which VRF contains a specific cable modem in the ARP cache table, use the `show ip arp vrf` command in privileged EXEC mode.

The following is sample output from the `show ip arp vrf` command:

```

Router # show ip arp vrf
CM-VRF
Protocol Address           Age (min)  Hardware Addr  Type   Interface
-----
Internet 203.0.113.1      0          0018.742c.6e00  ARPA   FastEthernet0/0/0
Internet 203.0.113.2      -          0014.f1e4.fb58  ARPA   FastEthernet0/0/0
Internet 198.51.100.1     -          0014.f1e4.fc31  ARPA   Bundle1.2
Internet 198.51.100.2     0          001e.6bfb.34e8  ARPA   Bundle1.2
Internet 198.51.100.3     0          0007.0e07.9f1f  ARPA   Bundle1.2
Internet 198.51.100.5     0          0025.2eaf.6bea  ARPA   Bundle1.2
Internet 198.51.100.6     0          001a.c3ff.d1a4  ARPA   Bundle1.2
Internet 198.51.100.7     0          001e.6bfb.1c7e  ARPA   Bundle1.2

```

Additional References

The following sections provide references related to the VRF Steering feature.

Related Documents

Related Topic	Document Title
Cisco uBR10012 Universal Broadband Router Documentation	<p><i>IPv6 on Cable</i> http://www.cisco.com/en/US/docs/ios/cable/configuration/guide/cmts_ipv6.html</p> <p><i>Virtual Interface Bundling for the Cisco CMTS</i> http://www.cisco.com/en/US/docs/ios/cable/configuration/guide/cmts_cbl_if_bundlg.html</p> <p><i>Cisco uBR10012 Universal Broadband Router Hardware Installation Guide</i> http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/guide/hig.html</p> <p><i>Cisco uBR10012 Universal Broadband Router Software Configuration Guide</i> http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/configuration/guide/scg.html</p> <p>Cisco uBR10012 Universal Broadband Router Release Notes http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_release_notes_list.html</p>
CMTS Command Reference	<p><i>Cisco IOS CMTS Cable Command Reference</i> http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html</p>

Standards

Standard	Title
None	

MIBs

MIB	MIBs Link
None	<p>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:</p> <p>http://tools.cisco.com/ITDIT/MIBS/servlet/index</p>

RFCs

RFC	Title
None	

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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for VRF Steering

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

**Note**

The below 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.

Table 2: Feature Information for VRF Steering

Feature Name	Releases	Feature Information
VRF Steering	12.2(33)SCF	<p>The VRF steering feature allows provisioning of data traffic from cable modems to be contained to a specified VRF instance.</p> <p>In Cisco IOS Release 12.2(33)SCF, this feature was introduced on the Cisco CMTS routers.</p> <p>The following commands were introduced or modified:</p> <ul style="list-style-type: none">• cable source-route• cable vrf-steering cable-modem• ip vrf• show ip arp vrf

