Configuring VRF-lite

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Information About VRF-lite

VRF-lite is a feature that enables a service provider to support two or more VPNs, where IP addresses can be overlapped among the VPNs. VRF-lite uses input interfaces to distinguish routes for different VPNs and forms virtual packet-forwarding tables by associating one or more Layer 3 interfaces with each VRF. Interfaces in a VRF can be either physical, such as Ethernet ports, or logical, such as VLAN SVIs, but a Layer 3 interface cannot belong to more than one VRF at any time.

Note VRF-lite interfaces must be Layer 3 interfaces.

VRF-lite includes these devices:

- Customer edge (CE) devices provide customer access to the service provider network over a data link to one or more provider edge routers. The CE device advertises the site's local routes to the provider edge router and learns the remote VPN routes from it. A Cisco Catalyst Switch can be a CE.
- Provider edge (PE) routers exchange routing information with CE devices by using static routing or a routing protocol such as BGP, RIPv1, or RIPv2.

  The PE is only required to maintain VPN routes for those VPNs to which it is directly attached, eliminating the need for the PE to maintain all of the service provider VPN routes. Each PE router maintains a VRF for each of its directly connected sites. Multiple interfaces on a PE router can be associated with a single VRF if all of these sites participate in the same VPN. Each VPN is mapped to a specified VRF. After learning local VPN routes from CEs, a PE router exchanges VPN routing information with other PE routers by using internal BGP (iBGP).

- Provider routers (or core routers) are any routers in the service provider network that do not attach to CE devices.

With VRF-lite, multiple customers can share one CE. The shared CE maintains separate VRF tables for each customer and switches or routes packets for each customer based on its own routing table. VRF-lite allows a CE device to maintain separate VRF tables to extend the privacy and security of a VPN to the branch office.

The following figure displays a configuration where each Cisco Catalyst switch acts as multiple virtual CEs. Because VRF-lite is a Layer 3 feature, each interface in a VRF must be a Layer 3 interface.

To configure VRF, create a VRF table and specify the Layer 3 interface associated with the VRF.

Guidelines for Configuring VRF-lite

IPv4 and IPv6

- A switch with VRF-lite is shared by multiple customers, and all customers have their own routing tables.
- Because customers use different VRF tables, you can reuse the same IP addresses.
- VRF-lite lets multiple customers share the same physical link between the PE and the CE.
- The Cisco Catalyst switch supports configuring VRF by using physical ports, VLAN SVIs, or a combination of both. You can connect SVIs through an access port or a trunk port.
- A customer can use multiple VLANs as long because they do not overlap with those of other customers. A customer's VLANs are mapped to a specific routing table ID that is used to identify the appropriate routing tables stored on the switch.
- The Layer 3 TCAM resource is shared between all VRFs. To ensure that any one VRF has sufficient CAM space, use the **maximum routes** command.
- A Cisco Catalyst switch using VRF can support one global network and multiple VRFs. The total number of routes supported is limited by the size of the TCAM.
- A single VRF can be configured for both IPv4 and IPv6.
- If an incoming packet's destination address is not found in the vrf table, the packet is dropped. Also, if insufficient TCAM space exists for a VRF route, hardware switching for that VRF is disabled and the corresponding data packets are sent to software for processing.

IPv4 Specific

- The Cisco Catalyst switch supports PIM-SM and PIM-SSM protocols.

IPv6 specific

- VRF-aware OSPFv3, EIGRPv6, and IPv6 static routing are supported.
- VRF-aware IPv6 route applications include: ping, telnet, ssh, tftp, ftp and traceroute. (This list does not include the management interface, which is handled differently even though you can configure both IPv4 or IPv6 VRF under it.)

How to Configure VRF-lite

This section provides information about configuring VRF-lite.

Configuring VRF-lite for IPv4

This section provides information about configuring VRF-lite for IPv4.

Configuring VRF-Aware Services

IP services can be configured on global interfaces and within the global routing instance. IP services are enhanced to run on multiple routing instances; they are VRF-aware. Any configured VRF in the system can be specified for a VRF-aware service.

VRF-aware services are implemented in platform-independent modules. VRF provides multiple routing instances in Cisco IOS. Each platform has its own limit on the number of VRFs it supports.

VRF-aware services have the following characteristics:

- The user can ping a host in a user-specified VRF.
- ARP entries are learned in separate VRFs. The user can display Address Resolution Protocol (ARP) entries for specific VRFs.

Configuring the User Interface for ARP

Procedure

	Command or Action	Purpose
Step 1	**show ip arp vrf** *vrf-name* **Example:** `Device# show ip arp vrf vrf-name`	Displays the ARP table (static and dynamic entries) in the specified VRF.
Step 2	**arp vrf** *vrf-name ip-address mac-address ARPA* **Example:** `Device(config)# arp vrf vrf-name ip-address mac-address ARPA`	Creates a static ARP entry in the specified VRF.

Configuring Per-VRF for TACACS+ Servers

The per-VRF for TACACS+ servers feature enables you to configure per-virtual route forwarding (per-VRF) authentication, authorization, and accounting (AAA) on TACACS+ servers.

You can create the VRF routing table (shown in Steps 3 and 4) and configure the interface (Steps 6, 7, and 8). The actual configuration of per-VRF on a TACACS+ server is done in Steps 10 through 13.

Before you begin

Before configuring per-VRF on a TACACS+ server, you must have configured AAA and a server group.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vrf-name`	Configures a VRF table and enters VRF configuration mode.
Step 4	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd route-distinguisher`	Creates routing and forwarding tables for a VRF instance.
Step 5	**exit** **Example:** `Device(config-vrf)# exit`	Exits VRF configuration mode.
Step 6	**interface** *interface-name* **Example:** `Device(config)# interface interface-name`	Configures an interface and enters interface configuration mode.
Step 7	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding vrf-name`	Configures a VRF for the interface.
Step 8	**ip address** *ip-address mask* [**secondary**] **Example:** `Device(config-if)# ip address ip-address mask [secondary]`	Sets a primary or secondary IP address for an interface.
Step 9	**exit** **Example:** `Device(config-vrf)# exit`	Exits interface configuration mode.
Step 10	**aaa group server tacacs+** *group-name* **Example:** `Device(config)# aaa group server tacacs+ tacacs1`	Groups different TACACS+ server hosts into distinct lists and distinct methods and enters server-group configuration mode.

	Command or Action	Purpose
Step 11	**server-private** {*ip-address* | *name*} [**nat**] [**single-connection**] [**port** *port-number*] [**timeout** *seconds*] [**key** [**0** | **7**] *string*] **Example:** `Device(config-sg-tacacs+)# server-private 10.1.1.1 port 19 key cisco`	Configures the IP address of the private TACACS+ server for the group server.
Step 12	**vrf forwarding** *vrf-name* **Example:** `Device(config-sg-tacacs+)# vrf forwarding vrf-name`	Configures the VRF reference of a AAA TACACS+ server group.
Step 13	**ip tacacs source-interface** *subinterface-name* **Example:** `Device(config-sg-tacacs+)# ip tacacs source-interface subinterface-name`	Uses the IP address of a specified interface for all outgoing TACACS+ packets.
Step 14	**exit** **Example:** `Device(config-sg-tacacs)# exit`	Exits server-group configuration mode.

Example

The following example lists all the steps to configure per-VRF TACACS+:

```
Device> enable
Device# configure terminal
Device(config)# vrf definition cisco
Device(config-vrf)# rd 100:1
Device(config-vrf)# exit
Device(config)# interface Loopback0
Device(config-if)# vrf forwarding cisco
Device(config-if)# ip address 10.0.0.2 255.0.0.0
Device(config-if)# exit
Device(config-sg-tacacs+)# vrf forwarding cisco
Device(config-sg-tacacs+)# ip tacacs source-interface Loopback0
Device(config-sg-tacacs)# exit
```

Configuring Multicast VRFs

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**ip routing** **Example:** `Device(config)# ip routing`	Enables IP routing.
Step 3	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vrf-name`	Configures a VRF table and enters VRF configuration mode.
Step 4	**ip multicast-routing vrf** *vrf-name* **Example:** `Device(config-vrf)# ip multicast-routing vrf vrf-name`	(Optional) Enables global multicast routing for VRF table.
Step 5	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd route-distinguisher`	Creates a VRF table by specifying a route distinguisher. Enter either an AS number and an arbitrary number (xxx:y) or an IP address and arbitrary number (A.B.C.D:y).
Step 6	**route-target** {**export** | **import** | **both**} *route-target-ext-community* **Example:** `Device(config-vrf)# route-target {export | import | both} route-target-ext-community`	Creates a list of import, export, or import and export route target communities for the specified VRF. Enter either an AS system number and an arbitrary number (xxx:y) or an IP address and an arbitrary number (A.B.C.D:y). The route-target-ext-community value should be the same as the route-distinguisher value entered in Step 4.
Step 7	**import map** *route-map* **Example:** `Device(config-vrf)# import map route-map`	(Optional) Associates a route map with the VRF.
Step 8	**interface** *interface-id* **Example:** `Device(config)# interface interface-id`	Enters interface configuration mode and specifies the Layer 3 interface to be associated with the VRF. The interface can be a routed port or a SVI.
Step 9	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding vrf-name`	Associates the VRF with the Layer 3 interface.
Step 10	**ip address** *ip-address* **mask** **Example:** `Device(config-if)# ip address ip-address mask`	Configures IP address for the Layer 3 interface.

	Command or Action	Purpose
Step 11	**ip pim sparse-mode** **Example:** `Device(config-if)# ip pim sparse-mode`	Enables PIM on the VRF-associated Layer 3 interface.
Step 12	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 13	**show vrf definition** [**brief** | **detail** | **interfaces**] [*vrf-name*] **Example:** `Device# show vrf definition brief`	Verifies the configuration. Display information about the configured VRFs.
Step 14	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Example

The following example shows how to configure multicast within a VRF table:

```
Device(config)# ip routing
Device(config)# vrf definition multiVrfA
Device(config-vrf)# ip multicast-routing vrf multiVrfA
Device(config-vrf)# interface GigabitEthernet3/1/0
Device(config-if)# vrf forwarding multiVrfA
Device(config-if)# ip address 172.21.200.203 255.255.255.0
Device(config-if)# ip pim sparse-mode
```

Configuring IPv4 VRFs

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ip routing** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vrf-name`	Names the VRF and enters VRF configuration mode.
Step 4	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd route-distinguisher`	Creates a VRF table by specifying a route distinguisher. Enter either an Autonomous System number number and an arbitrary number (xxx:y) or an IP address and arbitrary number (A.B.C.D:y).
Step 5	**route-target** {**export** | **import** | **both**} *route-target-ext-community* **Example:** `Device(config-vrf)# route-target {export | import | both} route-target-ext-community`	Creates a list of import, export, or import and export route target communities for the specified VRF. Enter either an AS system number and an arbitrary number (xxx:y) or an IP address and an arbitrary number (A.B.C.D:y).
Step 6	**import map** *route-map* **Example:** `Device(config-vrf)# import map route-map`	(Optional) Associates a route map with the VRF.
Step 7	**interface** *interface-id* **Example:** `Device(config-vrf)# interface interface-id`	Enters interface configuration mode and specify the Layer 3 interface to be associated with the VRF. The interface can be a routed port or SVI.
Step 8	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding vrf-name`	Associates the VRF with the Layer 3 interface.
Step 9	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 10	**show vrf definition** [**brief** | **detail** | **interfaces**] [*vrf-name*] **Example:** `Device# show vfr definition [brief | detail | interfaces] [vrf-name]`	Verifies the configuration. Displays information about the configured VRFs.
Step 11	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file. Use the **no vrf definition***vrf-name* global configuration command to delete a VRF and to remove all interfaces from it. Use the **no vrf**

	Command or Action	Purpose
		forwarding interface configuration command to remove an interface from the VRF.

Configuring VRF-lite for IPv6

This section provides information about configuring VRF-lite for IPv6.

Configuring VRF-Aware Services

IPv6 services can be configured on global interfaces and within the global routing instance. IPv6 services are enhanced to run on multiple routing instances; they are VRF-aware. Any configured VRF in the system can be specified for a VRF-aware service.

VRF-aware services are implemented in platform-independent modules. VRF provides multiple routing instances in Cisco IOS. Each platform has its own limit on the number of VRFs it supports.

VRF-aware services have the following characteristics:

- The user can ping a host in a user-specified VRF.
- Neighbor Discovery entries are learned in separate VRFs. The user can display Neighbor Discovery (ND) entries for specific VRFs.

The following services are VRF-aware:

- Ping
- Unicast Reverse Path Forwarding (uRPF)
- Traceroute
- FTP and TFTP
- Telnet and SSH
- NTP

Configuring the User Interface for PING

Perform the following task to configure a VRF-aware ping:

Procedure

	Command or Action	Purpose
Step 1	**ping vrf** *vrf-name* **ipv6-host** **Example:** `Device# ping vrf vrf-name ipv6-host`	Pings an IPv6 host or address in the specified VRF.

Configuring the User Interface for uRPF

You can configure uRPF on an interface assigned to a VRF. Source lookup is performed in the VRF table

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Device(config)# interface interface-id`	Enters interface configuration mode and specifies the Layer 3 interface to configure.
Step 3	**no switchport** **Example:** `Device(config-if)# no switchport`	Removes the interface from Layer 2 configuration mode if it is a physical interface.
Step 4	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding vrf-name`	Configures VRF on the interface.
Step 5	**ipv6 address** *ip-address* **subnet-mask** **Example:** `Device(config-if)# ip address ip-address mask`	Enters the IPv6 address for the interface.
Step 6	**ipv6 verify unicast source reachable-via rx allow-default** **Example:** `Device(config-if)# ipv6 verify unicast source reachable-via rx allow-default`	Enables uRPF on the interface.
Step 7	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Configuring the User Interface for Traceroute

Procedure

	Command or Action	Purpose
Step 1	**traceroute vrf** *vrf-name ipv6address* **Example:** `Device# traceroute vrf vrf-name ipv6address`	Specifies the name of a VPN VRF in which to find the destination address.

Configuring the User Interface for Telnet and SSH

Procedure

	Command or Action	Purpose
Step 1	**telnet** *ipv6-address*/**vrf** *vrf-name* **Example:** `Device# telnet ipv6-address/vrf vrf-name`	Connects through Telnet to an IPv6 host or address in the specified VRF.
Step 2	**ssh -l** *username* **-vrf** *vrf-name* **ipv6-host** **Example:** `Device# ssh -l username -vrf  vrf-name ipv6-host`	Connects through SSH to an IPv6 host or address in the specified VRF.

Configuring the User Interface for NTP

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ntp server vrf** *vrf-name* **ipv6-host** **Example:** `Device(config)# ntp server vrf vrf-name ipv6-host`	Configure the NTP server in the specified VRF.
Step 3	**ntp peer vrf** *vrf-name* **ipv6-host** **Example:** `Device(config)# ntp peer vrf vrf-name ipv6-host`	Configure the NTP peer in the specified VRF.

Configuring IPv6 VRFs

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vrf-name`	Names the VRF and enters VRF configuration mode.
Step 3	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd route-distinguisher`	(Optional) Creates a VRF table by specifying a route distinguisher. Enter either an Autonomous System number and an arbitrary number (xxx:y) or an IP address and arbitrary number (A.B.C.D:y).
Step 4	**address-family** *ipv4* | *ipv6* **Example:** `Device(config-vrf)# address-family ipv4 | ipv6`	(Optional) IPv4 by default. Configuration MUST for IPv6.
Step 5	**route-target** {**export** | **import** | **both**} *route-target-ext-community* **Example:** `Device(config-vrf)# route-target {export | import | both} route-target-ext-community`	Creates a list of import, export, or import and export route target communities for the specified VRF. Enter either an AS system number and an arbitrary number (xxx:y) or an IP address and an arbitrary number (A.B.C.D:y). **Note** This command is effective only if BGP is running.
Step 6	**exit-address-family** **Example:** `Device(config-vrf)# exit-address-family`	Exits VRF address-family configuration mode and return to VRF configuration mode.
Step 7	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vrf-name`	Enters VRF configuration mode.
Step 8	**ipv6 multicast multitopology** **Example:** `Device(config-vrf-af)# ipv6 multicast multitopology`	Enables multicast specific RPF topology.
Step 9	**address-family ipv6 multicast** **Example:** `Device(config-vrf)# address-family ipv6 multicast`	Enter multicast IPv6 address-family.
Step 10	**end** **Example:** `Device(config-vrf-af)# end`	Returns to privileged EXEC mode.

Example

This example shows how to configure VRFs:

```
Device(config)#  vrf definition red
Device(config-vrf)# rd 100:1
Device(config-vrf)# address family ipv6
Device(config-vrf-af)# route-target both 200:1
Device(config-vrf)# exit-address-family
Device(config-vrf)# vrf definition red
Device(config-vrf)# ipv6 multicast multitopology
Device(config-vrf)# address-family ipv6 multicast
Device(config-vrf-af)# end
```

Associating Interfaces to the Defined VRFs

Procedure

	Command or Action	Purpose
Step 1	**interface** *interface-id* **Example:** `Device(config-vrf)# interface interface-id`	Enters interface configuration mode and specify the Layer 3 interface to be associated with the VRF. The interface can be a routed port or SVI.
Step 2	**no switchport** **Example:** `Device(config-if)# no switchport`	Removes the interface from configuration mode if it is a physical interface.
Step 3	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwarding vrf-name`	Associates the VRF with the Layer 3 interface.
Step 4	**ipv6 enable** **Example:** `Device(config-if)# ipv6 enable`	Enable IPv6 on the interface.
Step 5	**ipv6 address** *ip-address subnet-mask* **Example:** `Device(config-if)# ipv6 address ip-address subnet-mask`	Enters the IPv6 address for the interface.
Step 6	**show ipv6 vrf** [**brief** | **detail** | **interfaces**] [*vrf-name*] **Example:** `Device# show ipv6 vrf [brief | detail | interfaces] [vrf-name]`	Verifies the configuration. Displays information about the configured VRFs.

	Command or Action	Purpose
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Example

This example shows how to associate an interface to VRFs:

```
Switch(config-vrf)# interface ethernet0/1
Switch(config-if)# vrf forwarding red
Switch(config-if)# ipv6 enable
Switch(config-if)# ipv6 address 5000::72B/64
```

Populate VRF with Routes via Routing Protocols

This section provides information about populating VRF with routes via routing protocols.

Configuring VRF Static Routes

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 route** [**vrf** *vrf-name*] *ipv6-prefix*/*prefix-length* {*ipv6-address* | **interface-type** *interface-number* [*ipv6-address*]} **Example:** `Device(config)# ipv6 route [vrf vrf-name] ipv6-prefix/prefix-length {ipv6-address | interface-type interface-number [ipv6-address]}`	To configure static routes specific to VRF.

Example

```
Device(config)# ipv6 route vrf v6a 7000::/64 TenGigabitEthernet32 4000::2
```

Configuring OSPFv3 Router Process

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**router ospfv3** *process-id* **Example:** `Device(config)# router ospfv3 process-id`	Enables OSPFv3 router configuration mode for the IPv6 address family.
Step 3	**area** *area-ID* [**default-cot** | **nssa** | **stub**] **Example:** `Device(config-router)# area area-ID [default-cot | nssa | stub]`	Configures the OSPFv3 area.
Step 4	**router-id** *router-id* **Example:** `Device(config-router)# router-id router-id`	Use a fixed router ID.
Step 5	**address-family ipv6 unicast vrf** *vrf-name* **Example:** `Device(config-router)# address-family ipv6 unicast vrf vrf-name`	Enters IPv6 address family configuration mode for OSPFv3 in VRF vrf-name
Step 6	**redistribute source-protocol** [*process-id*] **options** **Example:** `Device(config-router)# redistribute source-protocol [process-id] options`	Redistributes IPv6 routes from one routing domain into another routing domain.
Step 7	**end** **Example:** `Device(config-router)# end`	Returns to privileged EXEC mode.

Example

This example shows how configure the OSPFv3 router process:

```
Device(config-router)# router ospfv3 1
Device(config-router)# router-id 1.1.1.1
Device(config-router)# address-family ipv6 unicast
Device(config-router-af)# exit-address-family
```

Enabling OSPFv3 on an Interface

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface** *type-number* **Example:** `Device(config-vrf)# interface type-number`	Specifies an interface type and number, and places the switch in interface configuration mode.
Step 3	**ospfv3** *process-id* **area** *area-ID* **ipv6** [**instance** *instance-id*] **Example:** `Device(config-if)# ospfv3 process-id area area-ID ipv6 [instance instance-id]`	Enables OSPFv3 on an interface with IPv6 AF.
Step 4	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Example

This example show how to enable OSPFv3 on an interface:

```
Device(config)# interface GigabitEthernet2/1
Device(config-if)# no switchport
Device(config-if)# ipv6 address 4000::2/64
Device(config-if)# ipv6 enable
Device(config-if)# ipv6 ospf 1 area 0
Device(config-if)# end
```

Configuring EIGRPv6 Routing Process

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**router eigrp** *virtual-instance-name* **Example:** `Device(config)# router eigrp virtual-instance-name`	Configures the EIGRP routing process and enters router configuration mode.

	Command or Action	Purpose
Step 3	**address-family ipv6 vrf** *vrf-name* **autonomous-system** *autonomous-system-number* **Example:** `Device(config-router)# address-family ipv6 vrf vrf-name autonomous-system autonomous-system-number`	Enables EIGRP IPv6 VRF-Lite and enters address family configuration mode.
Step 4	**topology** {**base** | **topology-name tid number** **Example:** `Device(config-router-af)# topology {base | topology-name tid number`	Configures an EIGRP process to route IP traffic under the specified topology instance and enters address family topology configuration mode.
Step 5	**exit-aftopology** **Example:** `Device(config-router-af-topology)# exit-aftopology`	Exits address family topology configuration mode.
Step 6	**eigrp router-id** *ip-address* **Example:** `Device(config-router)# eigrp router-id ip-address`	Enables the use of a fixed router-id.
Step 7	end **Example:** `Device(config-router)# end`	Exits router configuration mode.

Example

This example shows how to configure an EIGRP routing process:

```
Device(config)# router eigrp test
Device(config-router)# address-family ipv6 unicast vrf b1 autonomous-system 10
Device(config-router-af)# topology base
Device(config-router-af-topology)# exit-af-topology
Device(config-router)# eigrp router-id 2.3.4.5
Device(config-router)# exit-address-family
```

Additional Information for VRF-lite

This section provides additional information about VRF-lite.

VPN Co-existence Between IPv4 and IPv6

Backward compatibility between the “older” CLI for configuring IPv4 and the “new” CLI for IPv6 exists. This means that a configuration might contain both CLI. The IPv4 CLI retains the ability to have on the same interface, an IP address defined within a VRF as well as an IPv6 address defined in the global routing table.

For example:

```
vrf definition red
 rd 100:1
 address family ipv6
 route-target both 200:1
 exit-address-family
!
vrf definition blue
 rd 200:1
 route-target both 200:1
!
interface Ethernet0/0
 vrf forwarding red
 ip address 50.1.1.2 255.255.255.0
 ipv6 address 4000::72B/64
!
interface Ethernet0/1
 vrf forwarding blue
 ip address 60.1.1.2 255.255.255.0
 ipv6 address 5000::72B/64
```

In this example, all addresses (v4 and v6) defined for Ethernet0/0 refer to VRF red whereas for Ethernet0/1, the IP address refers to VRF blue but the ipv6 address refers to the global IPv6 routing table.

Verifying VRF-lite Configuration

This section provides steps for verifying VRF-lite configuration.

Displaying IPv4 VRF-lite Status

To display information about VRF-lite configuration and status, perform one of the following tasks:

Command	Purpose
`Device# show ip protocols vrf vrf-name`	Displays routing protocol information associated with a VRF.
`Device# show ip route vrf vrf-name [connected] [protocol [as-number]] [list] [mobile] [odr] [profile] [static] [summary][supernets-only]`	Displays IP routing table information associated with a VRF.
`Device# show vrf definition [brief | detail | interfaces] [vrf-name]`	Displays information about the defined VRF instances.

Command	Purpose
`Device# bidir vrf instance-name a.b.c.d | active | bidriectional| count | interface | proxy | pruned | sparse | ssm | static | summary`	Displays information about the defined VRF instances.

This example shows how to display multicast route table information within a VRF instance:

```
Switch# show ip mroute 226.0.0.2
IP Multicast Routing Table
Flags: S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
       X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
       N - Received BGP Shared-Tree Prune, n - BGP C-Mroute suppressed,
       Q - Received BGP S-A Route, q - Sent BGP S-A Route,
       V - RD & Vector, v - Vector, p - PIM Joins on route,
       x - VxLAN group, c - PFP-SA cache created entry
Outgoing interface flags: H - Hardware switched, A - Assert winner, p - PIM Join
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 226.0.0.2), 00:01:17/stopped, RP 1.11.1.1, flags: SJCF
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Vlan100, Forward/Sparse, 00:01:17/00:02:36

(5.0.0.11, 226.0.0.2), 00:01:17/00:01:42, flags: FT
  Incoming interface: Vlan5, RPF nbr 0.0.0.0
  Outgoing interface list:
    Vlan100, Forward/Sparse, 00:01:17/00:02:36
```

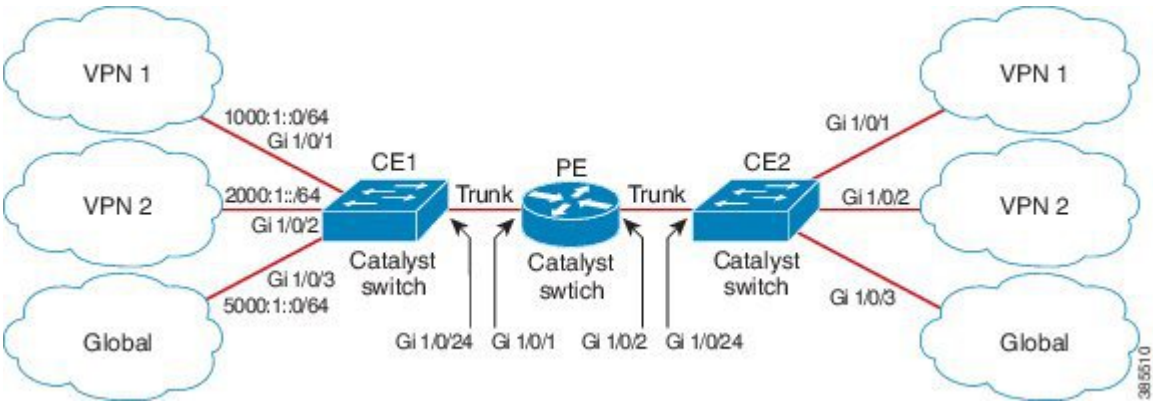
Configuration Examples for VRF-lite

This section provides configuration examples for VRF-lite.

Configuration Example for IPv6 VRF-lite

The following topology illustrates how to use OSPFv3 for CE-PE routing.

Figure 1: VRF-lite Configuration Example



Configuring CE1 Switch

```
ipv6 unicast-routing
vrf definition v1
 rd 100:1
 !
address-family ipv6
 exit-address-family
!

vrf definition v2
 rd 200:1
 !
address-family ipv6
 exit-address-family
!

interface Vlan100
 vrf forwarding v1
 ipv6 address 1000:1::1/64
 ospfv3 100 ipv6 area 0
!

interface Vlan200
 vrf forwarding v2
 ipv6 address 2000:1::1/64
 ospfv3 200 ipv6 area 0
!

interface GigabitEthernet 1/0/1
switchport access vlan 100
end

interface GigabitEthernet 1/0/2
switchport access vlan 200
end

interface GigabitEthernet 1/0/24
 switchport trunk encapsulation dot1q

switchport mode trunk
end

router ospfv3 100
 router-id 10.10.10.10
```

```
 !
 address-family ipv6 unicast vrf v1
  redistribute connected
  area 0 normal
 exit-address-family
!

router ospfv3 200
 router-id 20.20.20.20
 !
 address-family ipv6 unicast vrf v2
  redistribute connected
  area 0 normal
 exit-address-family
!
```

Configuring PE Switch

```
ipv6 unicast-routing

vrf definition v1
 rd 100:1
 !
address-family ipv6
 exit-address-family
!

vrf definition v2
 rd 200:1
 !
address-family ipv6
 exit-address-family
!
interface Vlan600
 vrf forwarding v1
 no ipv6 address
 ipv6 address 1000:1::2/64
 ospfv3 100 ipv6 area 0
!

interface Vlan700
 vrf forwarding v2
 no ipv6 address
 ipv6 address 2000:1::2/64
 ospfv3 200 ipv6 area 0
!

interface Vlan800
 vrf forwarding v1
 ipv6 address 3000:1::7/64
 ospfv3 100 ipv6 area 0
!
interface Vlan900
 vrf forwarding v2
 ipv6 address 4000:1::7/64
 ospfv3 200 ipv6 area 0
!

interface GigabitEthernet 1/0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
 exit

interface GigabitEthernet 1/0/2
```

```
 switchport trunk encapsulation dot1q

switchport mode trunk
 exit

router ospfv3 100
 router-id 30.30.30.30
 !
 address-family ipv6 unicast vrf v1
  redistribute connected
  area 0 normal
 exit-address-family
 !
address-family ipv6 unicast vrf v2
  redistribute connected
  area 0 normal
 exit-address-family
 !
```

Configuring CE2 Switch

```
ipv6 unicast-routing

vrf definition v1
 rd 100:1
 !
address-family ipv6
 exit-address-family
!

vrf definition v2
 rd 200:1
 !
address-family ipv6
 exit-address-family
!

interface Vlan100
 vrf forwarding v1

ipv6 address 1000:1::3/64
 ospfv3 100 ipv6 area 0
!

interface Vlan200
 vrf forwarding v2
 ipv6 address 2000:1::3/64
 ospfv3 200 ipv6 area 0
!

interface GigabitEthernet 1/0/1
switchport access vlan 100
end

interface GigabitEthernet 1/0/2
switchport access vlan 200
end

interface GigabitEthernet 1/0/24
 switchport trunk encapsulation dot1q
 switchport mode trunk
 end

router ospfv3 100
```

```
 router-id 40.40.40.40
 !
 address-family ipv6 unicast vrf v1
  redistribute connected
  area 0 normal
 exit-address-family
!

router ospfv3 200
 router-id 50.50.50.50
 !
 address-family ipv6 unicast vrf v2
  redistribute connected

area 0 normal
 exit-address-family
!
```

Additional References for VRF-Lite

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	See the IP Multicast Routing Commands section of the *Command Reference (Catalyst 9200 Series Switches)*

Standards and RFCs

Standard/RFC	Title
RFC 6763	*DNS-Based Service Discovery*
Multicast DNS Internet-Draft	Multicast

Feature History for Multicast VRF-lite

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Fuji 16.9.2	IPv6 Multicast support with VRF-Lite	IPv6 VRF-Lite allows a service provider to support two or more VPNs with overlapping IP addresses using one interface.

Release	Feature	Feature Information
Cisco IOS XE Cupertino 17.9.1	IPv6 Multicast support with VRF-Lite	This feature was implemented on C9200CX-12P-2X2G, C9200CX-8P-2X2G, and C9200CX-12T-2X2G models of the Cisco Catalyst 9200CX Series Switches, which were introduced in this release.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/