Configuring Layer 3 Virtualization

This chapter describes how to configure Layer 3 virtualization on the Cisco NX-OS device.

This chapter includes the following sections:

About Layer 3 Virtualization

Cisco NX-OS supports multiple virtual routing and forwarding instances (VRFs). Each VRF contains a separate address space with unicast and multicast route tables for IPv4 and IPv6 and makes routing decisions independent of any other VRF.

Each router has a default VRF and a management VRF.

Management VRF

- The management VRF is for management purposes only.
- Only the mgmt 0 interface can be in the management VRF.
- The mgmt 0 interface cannot be assigned to another VRF.
- No routing protocols can run in the management VRF (static only).

Default VRF

- All Layer 3 interfaces exist in the default VRF until they are assigned to another VRF.
- Routing protocols run in the default VRF context unless another VRF context is specified.
- The default VRF uses the default routing context for all show commands.

- The default VRF is similar to the global routing table concept in Cisco IOS.

Note When you upgrade to Cisco NX-OS Release 10.4(3)F, the default configuration for limit-resource will be changed to 4096.

When you upgrade to Cisco NX-OS Release 10.3(5), the default configuration for limit-resource will be changed to 4096.

Egress Loadbalance Resolution VRF

Egress Loadbalance Resolution (egress-loadbalance-resolution-) is an internal VRF which is created automatically. This VRF is similar to default VRF.

The purpose of this VRF is to assist in additional computation and resolution of routes for a VXLAN EVPN feature.

Note

- This VRF is not configurable by the user and cannot be deleted, as this is a benign empty VRF.
- The VRF limit is increased from 4096 to 4097 to accommodate this new implicit VRF.

  For example:

  - Existing default configuration

    ```
    vdc switch id 1
    limit-resource vrf minimum 2 maximum 4096
    ```

  - New default configuration

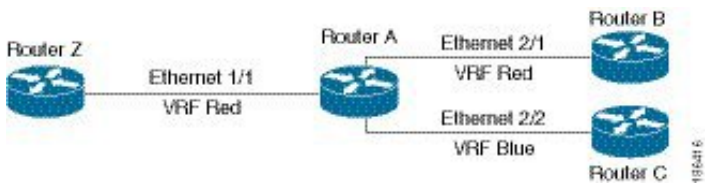
    ```
    vdc switch id 1
    limit-resource vrf minimum 2 maximum 4097
    ```

VRF and Routing

All unicast and multicast routing protocols support VRFs. When you configure a routing protocol in a VRF, you set routing parameters for the VRF that are independent of routing parameters in another VRF for the same routing protocol instance.

You can assign interfaces and route protocols to a VRF to create virtual Layer 3 networks. An interface exists in only one VRF. The following figure shows one physical network split into two virtual networks with two VRFs. Routers Z, A, and B exist in VRF Red and form one address domain. These routers share route updates that do not include Router C because Router C is configured in a different VRF.

Figure 1: VRFs in a Network



By default, Cisco NX-OS uses the VRF of the incoming interface to select which routing table to use for a route lookup. You can configure a route policy to modify this behavior and set the VRF that Cisco NX-OS uses for incoming packets.

Cisco NX-OS supports route leaking (import or export) between VRFs.

Route Leaking and Importing Routes from the Default VRF

Cisco NX-OS supports route leaking (import or export) between VRFs.

You can import IP prefixes from the global routing table (the default VRF) into any other VRF by using an import policy. The VRF import policy uses a route map to specify the prefixes to be imported into a VRF. The policy can import IPv4 and IPv6 unicast prefixes.

Note Routes in the BGP default VRF can be imported directly. Any other routes in the default VRF should be redistributed into BGP first.

IP prefixes are defined as match criteria for the import route map through standard route policy filtering mechanisms. For example, you can create an IP prefix list or an as-path filter to define an IP prefix or IP prefix range and use that prefix list or as-path filter in a match clause for the route map. Prefixes that pass through the route map are imported into the specified VRF using the import policy. IP prefixes that are imported into a VRF through this import policy cannot be reimported into another VRF.

For more information, see the Guidelines and Limitations for VRF Route Leaking section.

BGP VRF Router-ID for IPv6 Only Environments

The following are the sources to obtain router-id in order of priority:

1. VRF level router-id command
2. IPv4 address configured VRF interface
3. Inherit non-default VRF router-id from default VRF router-id config

Note The third source for router-id has the least priority and applies only if the first and second sources are unavailable.

Note In the absence of router-id, BGP OPEN messages cannot be sent.

VRF-Aware Services

A fundamental feature of the Cisco NX-OS architecture is that every IP-based feature is VRF aware.

The following VRF-aware services can select a particular VRF to reach a remote server or to filter information based on the selected VRF:

- AAA—See the Cisco Nexus 9000 Series NX-OS Security Configuration Guide for more information.
- Call Home—See the Cisco Nexus 9000 Series NX-OS System Management Configuration Guide for more information.
- DNS—See Configuring DNS for more information.
- HSRP—See Configuring HSRP for more information.
- HTTP—See the Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide for more information.
- NTP—See the Cisco Nexus 9000 Series NX-OS System Management Configuration Guide for more information.
- Ping and Traceroute—See the Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide for more information.
- RADIUS—See the Cisco Nexus 9000 Series NX-OS Security Configuration Guide for more information.
- SNMP—See the Cisco Nexus 9000 Series NX-OS System Management Configuration Guide for more information.
- SSH—See the Cisco Nexus 9000 Series NX-OS Security Configuration Guidefor more information.
- Syslog—See the Cisco Nexus 9000 Series NX-OS System Management Configuration Guide for more information.
- TACACS+—See the Cisco Nexus 9000 Series NX-OS Security Configuration Guide for more information.
- TFTP—See the Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide for more information.
- VRRP—See Configuring VRRP for more information.
- XML—See the Cisco NX-OS XML Management Interface User Guide for more information.

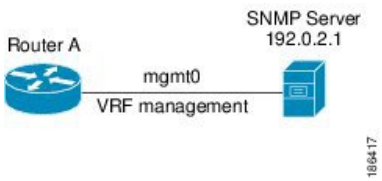
See the appropriate configuration guide for each service for more information on configuring VRF support in that service.

Reachability

Reachability indicates which VRF contains the routing information necessary to get to the server providing the service. For example, you can configure an SNMP server that is reachable on the management VRF. When you configure that server address on the router, you also configure which VRF Cisco NX-OS must use to reach the server.

The following figure shows an SNMP server that is reachable over the management VRF. You configure Router A to use the management VRF for SNMP server host 192.0.2.1.

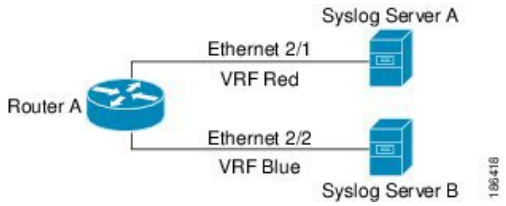
Figure 2: Service VRF Reachability



Filtering

Filtering allows you to limit the type of information that goes to a VRF-aware service based on the VRF. For example, you can configure a syslog server to support a particular VRF. The following figure shows two syslog servers with each server supporting one VRF. Syslog server A is configured in VRF Red, so Cisco NX-OS sends only system messages generated in VRF Red to syslog server A.

Figure 3: Service VRF Filtering

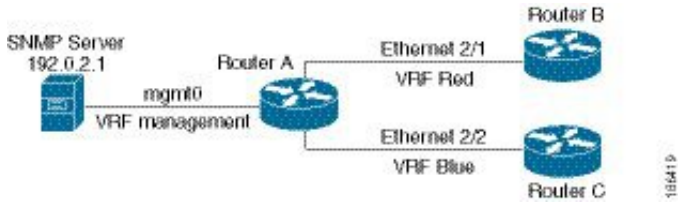


Combining Reachability and Filtering

You can combine reachability and filtering for VRF-aware services. You can configure the VRF that Cisco NX-OS uses to connect to that service as well as the VRF that the service supports. If you configure a service in the default VRF, you can optionally configure the service to support all VRFs.

The following figure shows an SNMP server that is reachable on the management VRF. You can configure the SNMP server to support only the SNMP notifications from VRF Red, for example.

Figure 4: Service VRF Reachability Filtering



Prerequisites for VRF

You must install the Advanced Services license to use virtual device contexts (VDCs) besides the default VDC. The license requirement for VRF is same as VDC.

Guidelines and Limitations for VRFs

VRFs have the following configuration guidelines and limitations:

- Names in the prefix-list are case-insensitive. We recommend using unique names. Do not use the same name by modifying upper-case and lower-case characters. For example, CTCPrimaryNetworks and CtcPrimaryNetworks are not two different entries.
- When you make an interface a member of an existing VRF, Cisco NX-OS removes all Layer 3 configurations. You should configure all Layer 3 parameters after adding an interface to a VRF.

- You should add the mgmt0 interface to the management VRF and configure the mgmt0 IP address and other parameters after you add it to the management VRF.
- If you configure an interface for a VRF before the VRF exists, the interface is operationally down until you create the VRF.
- Cisco NX-OS creates the default and management VRFs by default. You should make the mgmt0 interface a member of the management VRF.
- The **write erase boot** command does not remove the management VRF configurations. You must use the **write erase** command and then the **write erase boot** command.
- The following guidelines and limitations are for route targets:
  - It is a best practice to assign different route targets for Layer-2 and Layer-3.
  - For automatic route-target generation, route targets are generated from their EVIs. It is a best practice to have different EVI ranges for Layer 2 and Layer 3, which ensures that Layer-2 and Layer-3 EVIs do not use the same identifier.
- Beginning with Cisco NX-OS Release 10.3(1)F, multi VRF is supported on the Cisco Nexus 9808 platform switches.
- Beginning with Cisco NX-OS Release 10.4(1)F, multi VRF is supported on the Cisco Nexus 9804 platform switches.
- Beginning with Cisco NX-OS Release 10.4(1)F, multi VRF is supported on the Cisco Nexus X98900CD-A and N9KX9836DM-A line cards with Cisco Nexus 9808 and 9804 switches.

Guidelines and Limitations for VRF Route Leaking

VRF route leaking has the following configuration guidelines and limitations:

- Route leaking is supported between any two non-default VRFs and from the default VRF to a non-default VRF.

Note Route leaking between VRFs is not supported for MPLS Segment Routing (SR-MPLS).

Route leaking between VRFs is not supported for BGP. A BGP speaker cannot connect to a peer IP that is routed through a different VRF.

- You can restrict route leaking to specific routes using route map filters to match designated IP addresses.
- By default, the maximum number of IP prefixes that can be imported from the default VRF into a non-default VRF and vice versa is 1000 routes.
- There is no limit on the number of routes that can be leaked between two non-default VRFs.
- Beginning with Cisco NX-OS Release 10.3(1)F, route leak between VRFs is supported on the Cisco Nexus 9808 switches.

- Beginning with Cisco NX-OS Release 10.4(1)F, route leak between VRFs is supported on the Cisco Nexus 9804 switches.
- Beginning with Cisco NX-OS Release 10.4(1)F, route leak between VRFs is supported on Cisco Nexus X98900CD-A and X9836DM-A line cards with 9808 and 9804 switches.

Default Settings

The table lists the default settings for VRF parameters.

Table 1: Default VRF Parameters

Parameters	Default
Configured VRFs	Default, management
Routing context	Default VRF

Configuring VRFs

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Creating a VRF

You can create a VRF.

Note Any commands available in global configuration mode are also available in VRF configuration mode.

SUMMARY STEPS

1. **configure terminal**
2. [**no**] **vrf context** *name*
3. (Optional) **ip route** {*ip-prefix* | *ip-addr ip-mask*} {[*next-hop* | *nh-prefix*] | [*interface next-hop* | *nh-prefix*]} [**tag** *tag-value* [*preference*]
4. (Optional) **show vrf** [*vrf-name*]
5. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	[**no**] **vrf context** *name*
	Example:
	`switch(config)# vrf context Enterprise`
	`switch(config-vrf)#`
		Creates a new VRF and enters VRF configuration mode. The *name* can be any case-sensitive, alphanumeric string up to 32 characters.
		Using the **no** option with this command deletes the VRF and all associated configurations.

Step 3	(Optional) **ip route** {*ip-prefix* | *ip-addr ip-mask*} {[*next-hop* | *nh-prefix*] | [*interface next-hop* | *nh-prefix*]} [**tag** *tag-value* [*preference*] **Example:** `switch(config-vrf)# ip route 192.0.2.0/8 ethernet 1/2 192.0.2.4`	Configures a static route and the interface for this static route. You can optionally configure the next-hop address. The *preference* value sets the administrative distance. The range is from 1 to 255. The default is 1.
Step 4	(Optional) **show vrf** [*vrf-name*] **Example:** `switch(config-vrf)# show vrf Enterprise`	Displays VRF information.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config-vrf)# copy running-config startup-config`	Saves this configuration change.

Example

This example show how to create a VRF and add a static route to the VRF:

```
switch# configure terminal
switch(config)# vrf context Enterprise
switch(config-vrf)# ip route 192.0.2.0/8 ethernet 1/2
switch(config-vrf)# exit
switch(config)# copy running-config startup-config
```

Assigning VRF Membership to an Interface

You can make an interface a member of a VRF.

Before you begin

Assign the IP address for an interface after you have configured the interface for a VRF.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-type slot/port*
3. **vrf member** *vrf-name*
4. **ip address** *ip-prefix/length*
5. (Optional) **show vrf** *vrf-name* **interface** *interface-type number*
6. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**interface** *interface-type slot/port*
	Example:
	`switch(config)# interface ethernet 1/2`
	`switch(config-if)#`
		Enters interface configuration mode.

Step 3	**vrf member** *vrf-name* **Example:** `switch(config-if)# vrf member RemoteOfficeVRF`	Adds this interface to a VRF.
Step 4	**ip address** *ip-prefix/length* **Example:** `switch(config-if)# ip address 192.0.2.1/16`	Configures an IP address for this interface. You must do this step after you assign this interface to a VRF.
Step 5	(Optional) **show vrf** *vrf-name* **interface** *interface-type number* **Example:** `switch(config-vrf)# show vrf Enterprise interface ethernet 1/2`	Displays VRF information.
Step 6	(Optional) **copy running-config startup-config** **Example:** `switch(config-vrf)# copy running-config startup-config`	Saves this configuration change.

Example

This example shows how to add an interface to the VRF:

```
switch# configure terminal
switch(config)# interface ethernet 1/2
```

```
switch(config-if)# vrf member RemoteOfficeVRF
switch(config-if)# ip address 192.0.2.1/16
switch(config-if)# copy running-config startup-config
```

Configuring VRF Parameters for a Routing Protocol

You can associate a routing protocol with one or more VRFs. See the appropriate chapter for information on how to configure VRFs for the routing protocol. This section uses OSPFv2 as an example protocol for the detailed configuration steps.

SUMMARY STEPS

1. **configure terminal**
2. **router ospf** *instance-tag*
3. **vrf** *vrf-name*
4. (Optional) **maximum-paths** *paths*
5. **exit**
6. **exit**
7. **interface** *interface-type slot/port*
8. **vrf member** *vrf-name*
9. **ip address** *ip-prefix/length*
10. **ip router ospf** *instance-tag* **area** *area-id*
11. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**router ospf** *instance-tag*
	Example:
	`switch (config-vrf)# router ospf 201`
	`switch(config-router)#`
		Creates a new OSFPv2 instance with the configured instance tag.

Step 3	**vrf** *vrf-name*
	Example:
	`switch(config-router)# vrf RemoteOfficeVRF`
	`switch(config-router-vrf)#`
		Enters VRF configuration mode.

Step 4	(Optional) **maximum-paths** *paths* **Example:** `switch(config-router-vrf)# maximum-paths 4`	Configures the maximum number of equal OSPFv2 paths to a destination in the route table for this VRF. This command is used for load balancing.

	Command or Action	Purpose

Step 5	**exit**
	Example:
	`switch(config-router-vrf)# exit`
	`switch(config-router)#`
		Exits VRF configuration mode.

Step 6	**exit**
	Example:
	`switch(config-router)# exit`
	`switch(config)#`
		Exits router configuration mode.

Step 7	**interface** *interface-type slot/port*
	Example:
	`switch(config)# interface ethernet 1/2`
	`switch(config-if)#`
		Enters interface configuration mode.

Step 8	**vrf member** *vrf-name* **Example:** `switch(config-if)# vrf member RemoteOfficeVRF`	Adds this interface to a VRF.
Step 9	**ip address** *ip-prefix/length* **Example:** `switch(config-if)# ip address 192.0.2.1/16`	Configures an IP address for this interface. You must do this step after you assign this interface to a VRF.
Step 10	**ip router ospf** *instance-tag* **area** *area-id* **Example:** `switch(config-if)# ip router ospf 201 area 0`	Assigns this interface to the OSPFv2 instance and area configured.
Step 11	(Optional) **copy running-config startup-config** **Example:** `switch(config-if)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Example

This example shows how to create a VRF and add an interface to the VRF:

```
switch# configure terminal
switch(config)# vrf context RemoteOfficeVRF
switch(config-vrf)# exit
switch(config)# router ospf 201
switch(config-router)# vrf RemoteOfficeVRF
switch(config-router-vrf)# maximum-paths 4
switch(config-router-vrf)# interface ethernet 1/2
switch(config-if)# vrf member RemoteOfficeVRF
switch(config-if)# ip address 192.0.2.1/16
switch(config-if)# ip router ospf 201 area 0
```

```
switch(config-if)# exit
switch(config)# copy running-config startup-config
```

Configuring a VRF-Aware Service

You can configure a VRF-aware service for reachability and filtering.

This section uses SNMP and IP domain lists as example services for the detailed configuration steps.

SUMMARY STEPS

1. **configure terminal**
2. **snmp-server host** *ip-address* [**filter-vrf** *vrf-name*] [**use-vrf** *vrf-name*]
3. **vrf context** *vrf-name*
4. **ip domain-list** *domain-name* [**all-vrfs**] [**use-vrf** *vrf-name*]
5. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**snmp-server host** *ip-address* [**filter-vrf** *vrf-name*] [**use-vrf** *vrf-name*] **Example:** `switch(config)# snmp-server host 192.0.2.1 use-vrf Red`	Configures a global SNMP server and configures the VRF that Cisco NX-OS uses to reach the service. Use the **filter-vrf** keyword to filter information from the selected VRF to this server.

Step 3	**vrf context** *vrf-name*
	Example:
	`switch(config)# vrf context Blue`
	`switch(config-vrf)#`
		Creates a new VRF.

Step 4	**ip domain-list** *domain-name* [**all-vrfs**] [**use-vrf** *vrf-name*] **Example:** `switch(config-vrf)# ip domain-list List all-vrfs use-vrf Blue`	Configures the domain list in the VRF and optionally configures the VRF that Cisco NX-OS uses to reach the domain name listed.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config-vrf)# copy running-config startup-config`	Saves this configuration change.

Example

This example shows how to send SNMP information for all VRFs to SNMP host 192.0.2.1, reachable on VRF Red:

```
switch# configure terminal
switch(config)# snmp-server host 192.0.2.1 for-all-vrfs use-vrf Red
switch(config)# copy running-config startup-config
```

This example shows how to filter SNMP information for VRF Blue to SNMP host 192.0.2.12, reachable on VRF Red:

```
switch# configure terminal
switch(config)# vrf context Blue
switch(config-vrf)# snmp-server host 192.0.2.12 use-vrf Red
switch(config)# copy running-config startup-config
```

Setting the VRF Scope

You can set the VRF scope for all EXEC commands (for example, **show** commands). Doing so automatically restricts the scope of the output of EXEC commands to the configured VRF. You can override this scope by using the VRF keywords available for some EXEC commands.

SUMMARY STEPS

1. **routing-context vrf** *vrf-name*

DETAILED STEPS

	Command or Action	Purpose

Step 1	**routing-context vrf** *vrf-name*
	Example:
	`switch# routing-context vrf red`
	`switch%red#`
		Sets the routing context for all EXEC commands. The default routing context is the default VRF.
		Note Use the **routing-context vrf default** command to return to the default VRF scope.

Example

To return to the default VRF scope, use the following command in EXEC mode:

Command	Purpose

routing-context vrf default
Example:
`switch%red# routing-context vrf default`
`switch#`
	Sets the default routing context.

Note When you do a shutdown of the VPN VRF with BGP configurations, it will take around 50 seconds for the shutdown process to complete.

Verifying the VRF Configuration

To display VRF configuration information, perform one of the following tasks:

Command	Purpose
show bgp process vrf [*vrf-name*]	Displays the information for all or one VRF.
show vrf [*vrf-name*]	Displays the information for all or one VRF.
show vrf [*vrf-name*] **detail**	Displays detailed information for all or one VRF.
show vrf [*vrf-name*] [**interface** *interface-type slot/port*]	Displays the VRF status for an interface.

Configuration Examples for VRFs

For more information on VRF configuration, see Configuring VRFs, on page 7.

Configuration Example for VRF Red

```
!<<SNMP server configuration under VRF context Red:>>
vrf context Red
  snmp-server host 192.168.0.12 use-vrf Red
!<<OSPF instance configuration to VRF Red>>
router ospf 201
  vrf Red
!<<interface configuration for VRF Red>>
interface ethernet 1/2
  vrf member Red
  ip address 192.168.0.1/16
  ip router ospf 201 area 0
  no shutdown
```

Configuration Example for VRF Red and Blue

```
!<<VRFs (Red, and Blue) creation>>
vrf context Red
vrf context Blue
!<<Configures OSPF per VRF>>
feature ospf
router ospf Lab
  vrf Red

router ospf Production
  vrf Blue
      router-id 192.168.1.0

interface ethernet 1/2
  vrf member Red
```

```
  ip address 192.168.0.1/16
  ip router ospf Lab area 0
  no shutdown

interface ethernet 10/2
  vrf member Blue
  ip address 192.168.0.1/16
  ip router ospf Production area 0
  no shutdown
!<<SNMP server configuration under VRF>>
Use the SNMP context lab to access the OSPF-MIB values for the OSPF instance Lab in VRF Red
 in this example. snmp-server user admin network-admin auth md5 password1
snmp-server community public ro

snmp-server context lab instance Lab vrf Red
snmp-server context production instance Production vrf Blue
```

VRFs Configuration Example for Route Leaking

```
!<<VRF configuration>>
feature bgp
vrf context red
  ip route 192.168.33.0/32 192.168.3.1
  address-family ipv4 unicast
    route-target import 3:3
    route-target export 2:2
    export map test
    import map test
    import vrf default map test

interface Ethernet1/7
  vrf member red
  ip address 192.168.3.2/24
  no shutdown

vrf context blue
  ip route 192.168.44.0/32 192.168.4.1
  address-family ipv4 unicast
    route-target import 1:1
    route-target import 2:2
    route-target export 3:3
    export map test
    import map test
    import vrf default map test

interface Ethernet1/11
  vrf member blue
  ip address 192.168.4.2/24
  no shutdown
!<<IP prefix list configuration>>
ip prefix-list test seq 5 permit 0.0.0.0/0 le 32
  route-map test permit 10
  match ip address prefix-list test

ip route 192.168.101.101/32 192.168.55.1
!<<BGP per VRF assignment>>
router bgp 100
  address-family ipv4 unicast
    redistribute static route-map test

  vrf red
    address-family ipv4 unicast
      redistribute static route-map test

 vrf blue
```

```
    address-family ipv4 unicast
      redistribute static route-map test
```

Verification Example for route leaking between global and non-default VRFs

```
switch# show ip route vrf all
IP Route Table for VRF "default"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

192.168.55.0/24, ubest/mbest: 1/0, attached
    *via 192.168.55.5, Lo0, [0/0], 00:07:59, direct
192.168.55.5/32, ubest/mbest: 1/0, attached
    *via 192.168.55.5, Lo0, [0/0], 00:07:59, local
192.168.101.101/32, ubest/mbest: 1/0
    *via 192.168.55.1, [1/0], 00:07:42, static
!
IP Route Table for VRF "management"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

0.0.0.0/0, ubest/mbest: 1/0
    *via 10.29.176.1, [1/0], 12:53:54, static
10.29.176.0/24, ubest/mbest: 1/0, attached
    *via 10.29.176.233, mgmt0, [0/0], 13:11:57, direct
10.29.176.233/32, ubest/mbest: 1/0, attached
    *via 10.29.176.233, mgmt0, [0/0], 13:11:57, local
!
IP Route Table for VRF "red"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

192.168.33.0/32, ubest/mbest: 1/0
    *via 192.168.3.1, [1/0], 00:23:44, static
35.35.1.0/24, ubest/mbest: 1/0, attached
    *via 35.35.1.2, Eth1/7, [0/0], 00:26:46, direct
35.35.1.2/32, ubest/mbest: 1/0, attached
    *via 35.35.1.2, Eth1/7, [0/0], 00:26:46, local
192.168.44.0/32, ubest/mbest: 1/0
    *via 192.168.4.1%blue, [20/0], 00:12:08, bgp-100, external, tag 100
192.168.101.101/32, ubest/mbest: 1/0
    *via 192.168.55.1%default, [20/0], 00:07:41, bgp-100, external, tag 100
!
IP Route Table for VRF "blue"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>
192.168.33.0/32, ubest/mbest: 1/0
    *via 192.168.3.1%red, [20/0], 00:12:34, bgp-100, external, tag 100
192.168.44.0/32, ubest/mbest: 1/0
    *via 192.168.4.1, [1/0], 00:23:16, static
45.45.1.0/24, ubest/mbest: 1/0, attached
    *via 192.168.4.2, Eth1/11, [0/0], 00:25:53, direct
192.168.4.2/32, ubest/mbest: 1/0, attached
    *via 192.168.4.2, Eth1/11, [0/0], 00:25:53, local
192.168.101.101/32, ubest/mbest: 1/0
    *via 192.168.55.1%default, [20/0], 00:07:41, bgp-100, external, tag 100
```

```
switch(config)#
```

Configuration Example of Export VRF Default

The following example shows how to allow re-importation of already imported routes that is introduced in the “export vrf default” command to allow VPN imported routes to be re-imported into the default-VRF.

```
vrf context vpn1
  address-family ipv4 unicast
    export vrf default [<prefix-limit>] map <route-map> [allow-vpn]
  address-family ipv6 unicast
    export vrf default [<prefix-limit>] map <route-map> [allow-vpn]
```

Configuration Example of Border-leaf Configuration

- To configure IP prefix list, use the following commands:

```
!<<IP prefix list configuration>>
ip prefix-list DEFAULT_ROUTE seq 5 permit 0.0.0.0/0
route-map NO_DEFAULT_ROUTE deny 5
  match ip address prefix-list DEFAULT_ROUTE
route-map NO_DEFAULT_ROUTE permit 10
route-map allow permit 10
!<<Creation of VRFs, and importing the route maps>>
vrf context vni100
  vni 100
  ip route 0.0.0.0/0 Null0
  rd auto
  address-family ipv4 unicast
    route-target import 100:200
    route-target import 100:200 evpn
    route-target both auto
    route-target both auto evpn
    import vrf default map allow
    export vrf default map NO_DEFAULT_ROUTE allow-vpn

vrf context vni200
  vni 200
  ip route 0.0.0.0/0 Null0
  rd auto
  address-family ipv4 unicast
    route-target import 100:100
    route-target import 100:100 evpn
    route-target both auto
    route-target both auto evpn
    import vrf default map allow
    export vrf default map NO_DEFAULT_ROUTE
!<<BGP configuration>>
router bgp 100
  address-family ipv4 unicast
    redistribute direct route-map allow
  address-family ipv6 unicast
    redistribute direct route-map allow

  neighbor 192.168.101.101
    remote-as 100
    update-source loopback0
    address-family l2vpn evpn
      send-community extended

  neighbor 192.168.30.2
    remote-as 300
    address-family ipv4 unicast
```

```
    vrf vni100
      address-family ipv4 unicast
        network 0.0.0.0/0
        advertise l2vpn evpn
        redistribute direct route-map allow

    vrf vni200
      address-family ipv4 unicast
        network 0.0.0.0/0
        advertise l2vpn evpn
        redistribute direct route-map allow
```

Verification Example of BGP IPv4 Unicast configuration

```
switch(config-vrf)# show bgp ipv4 unicast 192.168.11.11/32
BGP routing table information for VRF default, address family IPv4 Unicast
BGP routing table entry for 192.168.11.11/32, version 14
Paths: (1 available, best #1)
Flags: (0x08041a) on xmit-list, is in urib, is best urib route, is in HW

  Advertised path-id 1
  Path type: internal, path is valid, is best path, in rib
             Imported from 192.168.3.3:3:192.168.11.11/32 (VRF vni100)
  AS-Path: 150 , path sourced external to AS
    192.168.1.0 (metric 81) from 192.168.101.101 (192.168.101.101)
      Origin incomplete, MED 0, localpref 100, weight 0
      Received label 100
      Extcommunity:
          RT:100:100
          ENCAP:8
          Router MAC:5254.004e.a437
      Originator: 192.168.1.0 Cluster list: 192.168.101.101

  Path-id 1 advertised to peers:
    192.168.30.2
```

Verification Example of BGP IPv4 Unicast configuration per VRF

```
switch(config-vrf)# show bgp vrf vni100 ipv4 unicast 192.168.11.11/32
BGP routing table information for VRF vni100, address family IPv4 Unicast
BGP routing table entry for 192.168.11.11/32, version 8
Paths: (1 available, best #1)
Flags: (0x08041e) on xmit-list, is in urib, is best urib route, is in HW
  vpn: version 19, (0x100002) on xmit-list

  Advertised path-id 1, VPN AF advertised path-id 1
  Path type: internal, path is valid, is best path, in rib
             Imported from 192.168.1.0:3:[5]:[0]:[0]:[32]:[192.168.11.11]:[0.0.0.0]/224
  AS-Path: 150 , path sourced external to AS
    192.168.1.0 (metric 81) from 192.168.101.101 (192.168.101.101)
      Origin incomplete, MED 0, localpref 100, weight 0
      Received label 100
      Extcommunity:
          RT:100:100
          ENCAP:8
          Router MAC:5254.004e.a437
      Originator: 192.168.1.0 Cluster list: 192.168.101.101

  VRF advertise information:
  Path-id 1 not advertised to any peer

  VPN AF advertise information:
  Path-id 1 not advertised to any peer
```

Verification Examples of BGP IPv6 Unicast configuration

```
switch(config-vrf)# show bgp ipv6 unicast 11::11/128
BGP routing table information for VRF default, address family IPv6 Unicast
BGP routing table entry for 11::11/128, version 13
Paths: (1 available, best #1)
Flags: (0x08041a) on xmit-list, is in u6rib, is best u6rib route, is in HW

  Advertised path-id 1
  Path type: internal, path is valid, is best path
             Imported from 192.168.3.3:3:11::11/128 (VRF vni100)
  AS-Path: 150 , path sourced external to AS
    ::ffff:192.168.1.0 (metric 81) from 192.168.101.101 (192.168.101.101)
      Origin incomplete, MED 0, localpref 100, weight 0
      Received label 100
      Extcommunity:
          RT:100:100
          ENCAP:8
          Router MAC:5254.004e.a437
      Originator: 192.168.1.0 Cluster list: 192.168.101.101

  Path-id 1 advertised to peers:
    30::2
```

Verification Example of BGP IPv6 Unicast configuration per VRF

```
switch(config-vrf)# show bgp vrf vni100 ipv6 unicast 11::11/128
BGP routing table information for VRF vni100, address family IPv6 Unicast
BGP routing table entry for 11::11/128, version 6
Paths: (1 available, best #1)
Flags: (0x08041e) on xmit-list, is in u6rib, is best u6rib route, is in HW
  vpn: version 7, (0x100002) on xmit-list

  Advertised path-id 1, VPN AF advertised path-id 1
  Path type: internal, path is valid, is best path
             Imported from 192.168.1.0:3:[5]:[0]:[0]:[128]:[11::11]:[0::]/416
  AS-Path: 150 , path sourced external to AS
    ::ffff:192.168.1.0 (metric 81) from 192.168.101.101 (192.168.101.101)
      Origin incomplete, MED 0, localpref 100, weight 0
      Received label 100
      Extcommunity:
          RT:100:100
          ENCAP:8
          Router MAC:5254.004e.a437
      Originator: 192.168.1.0 Cluster list: 192.168.101.101

  VRF advertise information:
  Path-id 1 not advertised to any peer

  VPN AF advertise information:
  Path-id 1 not advertised to any peer
```

Verification Example of IPv4 Route configuration

```
switch(config-if)# show ip route
IP Route Table for VRF "default"
'*' denotes best ucast next-hop
'**' denotes best mcast next-hop
'[x/y]' denotes [preference/metric]
'%<string>' in via output denotes VRF <string>

0.0.0.0/0, ubest/mbest: 1/0
    *via vrf vni100, Null0, [20/0], 1d04h, bgp-100, external, tag 100
192.168.1.0/32, ubest/mbest: 1/0
```

```
    *via 192.168.103.1, Eth1/1, [110/81], 1d04h, ospf-100, intra
192.168.2.2/32, ubest/mbest: 1/0
    *via 192.168.103.1, Eth1/1, [110/81], 1d04h, ospf-100, intra
192.168.3.3/32, ubest/mbest: 2/0, attached
    *via 192.168.3.3, Lo0, [0/0], 1d04h, local
    *via 192.168.3.3, Lo0, [0/0], 1d04h, direct
192.168.9.9/32, ubest/mbest: 1/0, attached
    *via 192.168.9.9%vni100, Lo9, [20/0], 1d03h, bgp-100, external, tag 100
192.168.10.0/24, ubest/mbest: 1/0
   *via 192.168.1.0, [200/0], 1d04h, bgp-100, internal, tag 100 (evpn) segid: 100 tunnelid:
 0x1010101 encap: VXLAN
192.168.11.11/32, ubest/mbest: 1/0
   *via 192.168.1.0, [200/0], 1d04h, bgp-100, internal, tag 150 (evpn) segid: 100 tunnelid:
 0x1010101 encap: VXLAN
192.168.20.0/24, ubest/mbest: 1/0
   *via 192.168.2.2, [200/0], 1d04h, bgp-100, internal, tag 100 (evpn) segid: 200 tunnelid:
 0x2020202 encap: VXLAN
192.168.22.22/32, ubest/mbest: 1/0
   *via 192.168.2.2, [200/0], 1d04h, bgp-100, internal, tag 250 (evpn) segid: 200 tunnelid:
 0x2020202 encap: VXLAN
192.168.30.0/24, ubest/mbest: 1/0, attached
    *via 192.168.30.1, Eth1/2, [0/0], 1d04h, direct
192.168.30.1/32, ubest/mbest: 1/0, attached
    *via 192.168.30.1, Eth1/2, [0/0], 1d04h, local
192.168.33.0/32, ubest/mbest: 1/0
    *via 192.168.30.2, [20/0], 1d04h, bgp-100, external, tag 300
192.168.100.0/24, ubest/mbest: 1/0, attached
    *via 192.168.100.3%vni100, Vlan100, [20/0], 1d04h, bgp-100, external, tag 100
192.168.101.0/24, ubest/mbest: 1/0
    *via 192.168.103.1, Eth1/1, [110/80], 1d04h, ospf-100, intra
192.168.101.101/32, ubest/mbest: 1/0
    *via 192.168.103.1, Eth1/1, [110/41], 1d04h, ospf-100, intra
192.168.102.0/24, ubest/mbest: 1/0
    *via 192.168.103.1, Eth1/1, [110/80], 1d04h, ospf-100, intra
192.168.103.0/24, ubest/mbest: 1/0, attached
    *via 192.168.103.2, Eth1/1, [0/0], 1d04h, direct
192.168.103.2/32, ubest/mbest: 1/0, attached
```

Additional References

For additional information related to implementing virtualization, see the following sections:

Related Documents for VRFs

Related Topic	Document Title
VRFs	*Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide* *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—