

VRF Lite Lab

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**Purpose**

The purpose of this lab is to configure VRF Lite to virtually separate two different networks from each other.

**Background Information on lab concepts**

Virtual routing and Forwarding, also known as VRF is a technology on routers that allow multiple instances of an routing table to be on the same router. One or multiple interfaces can have a VRF, but none of them send routes to other VRFs (packets are forward between interfaces in the same VRF). It is similar to VLANs but instead of working on layer 2, it works on layer 3.

VRF allows the creation of multiple routes on one physical device, lets users manage multiple routing tables simultaneously, and allows users to divide network paths without using multiple routers.

VRF-Lite which is an extension of this, is the simplest form of VRF. VRF-Lite can be used to virtually separate two different networks from each other, such as companies that don’t want to share traffic. In VRF-Lite, a core backbone network transmits data between VRF instances. Typically, customer edge (CE) routers do the local routing and spread routing information to the provider edge (PE) where routing tables are made virtual. The PE router then encapsulates the traffic it gets sent, tags it to identify a certain VRF instance, and transmits it through the provider backbone network to the desired PE router. The desired PE router then decapsulates the traffic and sends it to the CE router. The backbone can be used by multiple customers while keeping end-to-end traffic separation. To route traffic across a backbone, you can use different protocols, such as iBGP, OSPF, ISIS, etc.

**Lab Summary**

In this lab, I used four 4321 Cisco Routers and three copper-straight through cables. Each router, except for the two border routers, had two copper-straight throughs connected to them. One cable went in the GigabitEthernet 0/0/0 interface and the other went in the GigabitEthernet 0/0/1 interface. After that, I created two sub interfaces on each router, with an IPv4 address assigned to each one. Then, I configured two different VRFs on each router, an APPLE VRF on sub interface 0/0/0.1, and a FACEBOOK VRF on sub interface 0/0/0.2. The APPLE VRF used the routing protocol ospf, and the FACEBOOK VRF used the routing protocol isis. Finally, I pinged my routers with each other to verify connectivity and did other commands like show **ip protocols vrf** vrf-name and **show ip vrf detail** to ensure VRF was working.

**Lab Commands**

Router(config)**#ip vrf** vrf-name

This command names the VRF and enters VRF configuration mode.

Router(config-if)**#ip vrf forwarding** vrf-name

This command associates the vrf with the Layer 3 interface.

Router(config) **#router ospf** process-id **vrf** vrf-name

This command enables OSPF and specifics the VPN forwarding table.

Router**#show ip vrf** vrf-name

This command shows the VRF and table-id of the name specified.

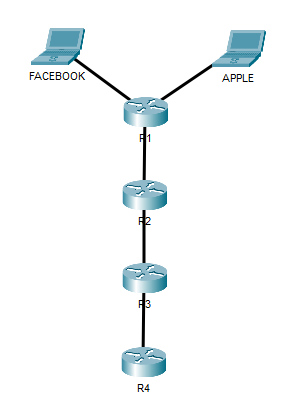
Router**#show ip vrf brief**

This command shows you the VRFs on that router and what interface they’re connected to.

Router**#show ip vrf detail**

This command shows you the status of the interfaces, their ip addresses, and what vrf they’re connected to.

**Network Diagram with IP's**



|  |  |  |
| --- | --- | --- |
| **Device** | **Interface** | **IP Address** |
| R1 | G0/0/0.1 | 192.168.0.1 /24 | |
| G0/0/0.2 | 172.16.0.1 /24 |
| R2 | G0/0/0 | 192.168.1.1 /24 |
| G0/0/0.2 | 172.16.1.1 /24 |
| R3 | G0/0/0.1 | 192.168.2.1 /24 |
| G0/0/0.2 | 172.16.2.1 /24 |
| R4 | G0/0/1.1 | 192.168.2.2 /24 |
| G0/0/1.2 | 172.16.2.2 /24 |

**Configurations**

**Router 1**

**show run**

r1#show run

Building configuration...

Current configuration : 1847 bytes

!

! Last configuration change at 15:47:25 UTC Mon Mar 21 2022

!

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

!

hostname r1

!

boot-start-marker

boot-end-marker

!

vrf definition Mgmt-intf

!

address-family ipv4

exit-address-family

!

address-family ipv6

exit-address-family

!

no aaa new-model

!

ip vrf FACEBOOK

!

ip vrf APPLE

!

subscriber templating

multilink bundle-name authenticated

!

license udi pid ISR4321/K9 sn FDO214811ZM

!

spanning-tree extend system-id

!

redundancy

mode none

!

vlan internal allocation policy ascending

!

interface GigabitEthernet0/0/0

no ip address

negotiation auto

!

interface GigabitEthernet0/0/0.1

encapsulation dot1Q 1 native

ip vrf forwarding APPLE

ip address 192.168.0.1 255.255.255.0

!

interface GigabitEthernet0/0/0.2

encapsulation dot1Q 2

ip vrf forwarding FACEBOOK

ip address 172.16.0.1 255.255.255.0

ip router isis

!

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

!

interface Serial0/1/0

no ip address

shutdown

!

interface Serial0/1/1

no ip address

shutdown

!

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1 vrf APPLE

router-id 1.1.1.1

network 192.168.0.0 0.0.0.255 area 0

!

router isis

vrf FACEBOOK

net 49.0001.0000.0000.000a.00

!

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

!

control-plane

!

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

!

end

**show ip route vrf APPLE/FACEBOOK**

**APPLE**

r1#show ip route vrf APPLE

Routing Table: APPLE

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.0.0/24 is directly connected, GigabitEthernet0/0/0.1

L 192.168.0.1/32 is directly connected, GigabitEthernet0/0/0.1

O 192.168.1.0/24 [110/2] via 192.168.0.2, 3d00h, GigabitEthernet0/0/0.1

O 192.168.2.0/24 [110/3] via 192.168.0.2, 3d00h, GigabitEthernet0/0/0.1

**FACEBOOK**

r1#show ip route vrf FACEBOOK

Routing Table: FACEBOOK

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks

C 172.16.0.0/24 is directly connected, GigabitEthernet0/0/0.2

L 172.16.0.1/32 is directly connected, GigabitEthernet0/0/0.2

i L1 172.16.1.0/24 [115/20] via 172.16.0.2, 3d00h, GigabitEthernet0/0/0.2

i L1 172.16.2.0/24 [115/30] via 172.16.0.2, 3d00h, GigabitEthernet0/0/0.2

**show ip protocols vrf APPLE/FACEBOOK**

**APPLE**

r1#show ip protocols vrf APPLE

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 1.1.1.1

It is an area border router

Number of areas in this router is 1. 1 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.0.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

3.3.3.3 110 3d00h

2.2.2.2 110 3d00h

Distance: (default is 110)

**FACEBOOK**

r1#show ip protocols vrf FACEBOOK

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "isis"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: isis

Address Summarization:

None

Maximum path: 4

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

172.16.2.2 115 00:11:13

172.16.0.2 115 00:11:13

172.16.1.2 115 00:11:13

Distance: (default is 115)

**show ip vrf int**

r1#show ip vrf int

Interface IP-Address VRF Protocol

Gi0 unassigned Mgmt-intf down

Gi0/0/0.2 172.16.0.1 FACEBOOK up

Gi0/0/0.1 192.168.0.1 APPLE up

**show ip vrf brief**

r1#show ip vrf brief

Name Default RD Interfaces

Mgmt-intf <not set> Gi0

FACEBOOK <not set> Gi0/0/0.2

APPLE <not set> Gi0/0/0.1

**show ip vrf detail**

r1#show ip vrf detail

VRF Mgmt-intf (VRF Id = 1); default RD <not set>; default VPNID <not set>

New CLI format, supports multiple address-families

Flags: 0x1808

Interfaces:

Gi0

Address family ipv4 unicast (Table ID = 0x1):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF FACEBOOK (VRF Id = 3); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/0.2

Address family ipv4 unicast (Table ID = 0x3):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF APPLE (VRF Id = 2); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/0.1

Address family ipv4 unicast (Table ID = 0x2):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

**Router 2**

**show run**

r2#show run

Building configuration...

Current configuration : 2143 bytes

!

! Last configuration change at 16:01:30 UTC Mon Mar 21 2022

!

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

!

hostname r2

!

boot-start-marker

boot-end-marker

!

vrf definition Mgmt-intf

!

address-family ipv4

exit-address-family

!

address-family ipv6

exit-address-family

!

no aaa new-model

!

ip vrf FACEBOOK

!

ip vrf APPLE

!

subscriber templating

multilink bundle-name authenticated

!

license udi pid ISR4321/K9 sn FDO214414TX

!

spanning-tree extend system-id

!

redundancy

mode none

!

vlan internal allocation policy ascending

!

interface GigabitEthernet0/0/0

no ip address

negotiation auto

!

interface GigabitEthernet0/0/0.1

encapsulation dot1Q 1 native

ip vrf forwarding APPLE

ip address 192.168.1.1 255.255.255.0

!

interface GigabitEthernet0/0/0.2

encapsulation dot1Q 2

ip vrf forwarding FACEBOOK

ip address 172.16.1.1 255.255.255.0

ip router isis

!

interface GigabitEthernet0/0/1

no ip address

negotiation auto

!

interface GigabitEthernet0/0/1.1

encapsulation dot1Q 1 native

ip vrf forwarding APPLE

ip address 192.168.0.2 255.255.255.0

!

interface GigabitEthernet0/0/1.2

encapsulation dot1Q 2

ip vrf forwarding FACEBOOK

ip address 172.16.0.2 255.255.255.0

ip router isis

!

interface Serial0/1/0

no ip address

shutdown

!

interface Serial0/1/1

no ip address

shutdown

!

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1 vrf APPLE

router-id 2.2.2.2

network 192.168.0.0 0.0.0.255 area 0

network 192.168.1.0 0.0.0.255 area 0

!

router isis

vrf FACEBOOK

net 49.0001.0000.0000.000b.00

!

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

!

control-plane

!

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

!

end

**show ip route vrf APPLE/FACEBOOK**

**APPLE**

r2#show ip route vrf APPLE

Routing Table: APPLE

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.0.0/24 is directly connected, GigabitEthernet0/0/1.1

L 192.168.0.2/32 is directly connected, GigabitEthernet0/0/1.1

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.1.0/24 is directly connected, GigabitEthernet0/0/0.1

L 192.168.1.1/32 is directly connected, GigabitEthernet0/0/0.1

O 192.168.2.0/24 [110/2] via 192.168.1.2, 3d00h, GigabitEthernet0/0/0.1

**FACEBOOK**

r2#show ip route vrf FACEBOOK

Routing Table: FACEBOOK

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks

C 172.16.0.0/24 is directly connected, GigabitEthernet0/0/1.2

L 172.16.0.2/32 is directly connected, GigabitEthernet0/0/1.2

C 172.16.1.0/24 is directly connected, GigabitEthernet0/0/0.2

L 172.16.1.1/32 is directly connected, GigabitEthernet0/0/0.2

i L1 172.16.2.0/24 [115/20] via 172.16.1.2, 3d00h, GigabitEthernet0/0/0.2

**show ip protocols vrf**

**APPLE**

r2#show ip protocols vrf APPLE

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 2.2.2.2

It is an area border router

Number of areas in this router is 1. 1 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.0.0 0.0.0.255 area 0

192.168.1.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

3.3.3.3 110 3d00h

Distance: (default is 110)

**FACEBOOK**

r2#show ip protocols vrf FACEBOOK

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "isis"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: isis

Address Summarization:

None

Maximum path: 4

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

172.16.2.2 115 00:02:38

172.16.0.1 115 00:02:38

172.16.1.2 115 00:02:38

Distance: (default is 115)

**show ip vrf int**

r2#show ip vrf int

Interface IP-Address VRF Protocol

Gi0 unassigned Mgmt-intf down

Gi0/0/1.2 172.16.0.2 FACEBOOK up

Gi0/0/0.2 172.16.1.1 FACEBOOK up

Gi0/0/1.1 192.168.0.2 APPLE up

Gi0/0/0.1 192.168.1.1 APPLE up

**show ip vrf brief**

r2#show ip vrf brief

Name Default RD Interfaces

Mgmt-intf <not set> Gi0

FACEBOOK <not set> Gi0/0/1.2

Gi0/0/0.2

APPLE <not set> Gi0/0/1.1

Gi0/0/0.1

**show ip vrf detail**

r2#show ip vrf detail

VRF Mgmt-intf (VRF Id = 1); default RD <not set>; default VPNID <not set>

New CLI format, supports multiple address-families

Flags: 0x1808

Interfaces:

Gi0

Address family ipv4 unicast (Table ID = 0x1):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF FACEBOOK (VRF Id = 2); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/1.2 Gi0/0/0.2

Address family ipv4 unicast (Table ID = 0x2):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF APPLE (VRF Id = 3); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/1.1 Gi0/0/0.1

Address family ipv4 unicast (Table ID = 0x3):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

**Router 3**

**show run**

r3#show run

Building configuration...

Current configuration : 2048 bytes

!

! Last configuration change at 16:03:27 UTC Tue Mar 22 2022

!

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

!

hostname r3

!

boot-start-marker

boot-end-marker

!

vrf definition Mgmt-intf

!

address-family ipv4

exit-address-family

!

address-family ipv6

exit-address-family

!

no aaa new-model

!

ip vrf FACEBOOK

!

ip vrf APPLE

!

subscriber templating

multilink bundle-name authenticated

!

license udi pid ISR4321/K9 sn FDO214328EH

!

spanning-tree extend system-id

!

redundancy

mode none

!

vlan internal allocation policy ascending

!

interface GigabitEthernet0/0/0

no ip address

negotiation auto

!

interface GigabitEthernet0/0/0.1

encapsulation dot1Q 1 native

ip vrf forwarding APPLE

ip address 192.168.2.1 255.255.255.0

!

interface GigabitEthernet0/0/0.2

encapsulation dot1Q 2

ip vrf forwarding FACEBOOK

ip address 172.16.2.1 255.255.255.0

ip router isis

!

interface GigabitEthernet0/0/1

no ip address

negotiation auto

!

interface GigabitEthernet0/0/1.1

encapsulation dot1Q 1 native

ip vrf forwarding APPLE

ip address 192.168.1.2 255.255.255.0

!

interface GigabitEthernet0/0/1.2

encapsulation dot1Q 2

ip vrf forwarding FACEBOOK

ip address 172.16.1.2 255.255.255.0

ip router isis

!

interface Serial0/1/0

no ip address

shutdown

!

interface Serial0/1/1

no ip address

shutdown

!

interface Service-Engine0/2/0

no ip address

shutdown

!

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1 vrf APPLE

router-id 3.3.3.3

network 192.168.1.0 0.0.0.255 area 0

network 192.168.2.0 0.0.0.255 area 0

!

router isis

vrf FACEBOOK

net 49.0001.0000.0000.000c.00

!

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

!

control-plane

!

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

!

end

**show ip route vrf APPLE/FACEBOOK**

**APPLE**

r3#show ip route vrf APPLE

Routing Table: APPLE

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

O 192.168.0.0/24 [110/2] via 192.168.1.1, 3d00h, GigabitEthernet0/0/1.1

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.1.0/24 is directly connected, GigabitEthernet0/0/1.1

L 192.168.1.2/32 is directly connected, GigabitEthernet0/0/1.1

192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.2.0/24 is directly connected, GigabitEthernet0/0/0.1

L 192.168.2.1/32 is directly connected, GigabitEthernet0/0/0.1

**FACEBOOK**

r3#show ip route vrf FACEBOOK

Routing Table: FACEBOOK

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks

i L1 172.16.0.0/24 [115/20] via 172.16.1.1, 3d00h, GigabitEthernet0/0/1.2

C 172.16.1.0/24 is directly connected, GigabitEthernet0/0/1.2

L 172.16.1.2/32 is directly connected, GigabitEthernet0/0/1.2

C 172.16.2.0/24 is directly connected, GigabitEthernet0/0/0.2

L 172.16.2.1/32 is directly connected, GigabitEthernet0/0/0.2

**show ip protocols vrf APPLE/FACEBOOK**

**APPLE**

r3#show ip protocols vrf APPLE

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 3.3.3.3

It is an area border router

Number of areas in this router is 1. 1 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.1.0 0.0.0.255 area 0

192.168.2.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

1.1.1.1 110 3d00h

Distance: (default is 110)

**FACEBOOK**

r3#show ip protocols vrf FACEBOOK

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "isis"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: isis

Address Summarization:

None

Maximum path: 4

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

172.16.2.2 115 00:02:46

172.16.0.1 115 00:02:46

172.16.0.2 115 00:02:46

Distance: (default is 115)

**show ip vrf int**

r3#show ip vrf int

Interface IP-Address VRF Protocol

Gi0 unassigned Mgmt-intf down

Gi0/0/1.2 172.16.1.2 FACEBOOK up

Gi0/0/0.2 172.16.2.1 FACEBOOK up

Gi0/0/1.1 192.168.1.2 APPLE up

Gi0/0/0.1 192.168.2.1 APPLE up

**show ip vrf brief**

r3#show ip vrf brief

Name Default RD Interfaces

Mgmt-intf <not set> Gi0

FACEBOOK <not set> Gi0/0/1.2

Gi0/0/0.2

APPLE <not set> Gi0/0/1.1

Gi0/0/0.1

**show ip vrf detail**

r3#show ip vrf detail

VRF Mgmt-intf (VRF Id = 1); default RD <not set>; default VPNID <not set>

New CLI format, supports multiple address-families

Flags: 0x1808

Interfaces:

Gi0

Address family ipv4 unicast (Table ID = 0x1):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF FACEBOOK (VRF Id = 2); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/1.2 Gi0/0/0.2

Address family ipv4 unicast (Table ID = 0x2):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF APPLE (VRF Id = 3); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/1.1 Gi0/0/0.1

Address family ipv4 unicast (Table ID = 0x3):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

**Router 4**

**show run**

r4#show run

Building configuration...

Current configuration : 1868 bytes

!

! Last configuration change at 15:52:17 UTC Tue Mar 22 2022

!

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

!

hostname r4

!

boot-start-marker

boot-end-marker

!

vrf definition Mgmt-intf

!

address-family ipv4

exit-address-family

!

address-family ipv6

exit-address-family

!

no aaa new-model

!

ip vrf FACEBOOK

!

ip vrf APPLE

!

subscriber templating

vtp mode transparent

multilink bundle-name authenticated

!

license udi pid ISR4321/K9 sn FDO210907U3

!

spanning-tree extend system-id

!

redundancy

mode none

!

vlan internal allocation policy ascending

!

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0/0/1

no ip address

negotiation auto

!

interface GigabitEthernet0/0/1.1

encapsulation dot1Q 1 native

ip vrf forwarding APPLE

ip address 192.168.2.2 255.255.255.0

!

interface GigabitEthernet0/0/1.2

encapsulation dot1Q 2

ip vrf forwarding FACEBOOK

ip address 172.16.2.2 255.255.255.0

ip router isis

!

interface Serial0/1/0

no ip address

shutdown

!

interface Serial0/1/1

no ip address

shutdown

!

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1 vrf APPLE

router-id 4.4.4.4

network 192.168.2.0 0.0.0.255 area 0

!

router isis

vrf FACEBOOK

net 49.0001.0000.0000.000d.00

!

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

!

control-plane

!

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

!

end

**show ip route vrf APPLE/FACEBOOK**

**APPLE**

r4#show ip route vrf APPLE

Routing Table: APPLE

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

O 192.168.0.0/24 [110/3] via 192.168.2.1, 3d00h, GigabitEthernet0/0/1.1

O 192.168.1.0/24 [110/2] via 192.168.2.1, 3d00h, GigabitEthernet0/0/1.1

192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.2.0/24 is directly connected, GigabitEthernet0/0/1.1

L 192.168.2.2/32 is directly connected, GigabitEthernet0/0/1.1

**FACEBOOK**

r4#show ip route vrf FACEBOOK

Routing Table: FACEBOOK

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks

i L1 172.16.0.0/24 [115/30] via 172.16.2.1, 3d00h, GigabitEthernet0/0/1.2

i L1 172.16.1.0/24 [115/20] via 172.16.2.1, 3d00h, GigabitEthernet0/0/1.2

C 172.16.2.0/24 is directly connected, GigabitEthernet0/0/1.2

L 172.16.2.2/32 is directly connected, GigabitEthernet0/0/1.2

**show ip protocols vrf APPLE/FACEBOOK**

**APPLE**

r4#show ip protocols vrf APPLE

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 192.168.2.2

It is an area border router

Number of areas in this router is 1. 1 normal 0 stub 0 nssa

Maximum path: 4

Routing for Networks:

192.168.2.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

3.3.3.3 110 3d00h

1.1.1.1 110 3d00h

Distance: (default is 110)

**FACEBOOK**

r4#show ip protocols vrf FACEBOOK

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "isis"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Redistributing: isis

Address Summarization:

None

Maximum path: 4

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

172.16.0.1 115 00:14:51

172.16.0.2 115 00:14:51

172.16.1.2 115 00:14:51

Distance: (default is 115)

**show ip vrf int**

r4#show ip vrf int

Interface IP-Address VRF Protocol

Gi0 unassigned Mgmt-intf down

Gi0/0/1.2 172.16.2.2 FACEBOOK up

Gi0/0/1.1 192.168.2.2 APPLE up

**show ip vrf brief**

r4#show ip vrf brief

Name Default RD Interfaces

Mgmt-intf <not set> Gi0

FACEBOOK <not set> Gi0/0/1.2

APPLE <not set> Gi0/0/1.1

**show ip vrf detail**

r4#show ip vrf detail

VRF Mgmt-intf (VRF Id = 1); default RD <not set>; default VPNID <not set>

New CLI format, supports multiple address-families

Flags: 0x1808

Interfaces:

Gi0

Address family ipv4 unicast (Table ID = 0x1):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF FACEBOOK (VRF Id = 3); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/1.2

Address family ipv4 unicast (Table ID = 0x3):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

VRF APPLE (VRF Id = 2); default RD <not set>; default VPNID <not set>

Old CLI format, supports IPv4 only

Flags: 0x8

Interfaces:

Gi0/0/1.1

Address family ipv4 unicast (Table ID = 0x2):

Flags: 0x0

No Export VPN route-target communities

No Import VPN route-target communities

No import route-map

No global export route-map

No export route-map

VRF label distribution protocol: not configured

VRF label allocation mode: per-prefix

**Problems**

A problem I faced was that my APPLE VRF on R1 didn’t have OSPF. When I did show ip protocols vrf APPLE, it didn’t show ospf as the routing protocol. I concluded that this was because I had set up OSPF incorrectly on this router. After looking through the **show run** command, I found that instead of doing **router ospf 1 vrf APPLE** I accidentally did **router ospf 1.** After changing this command so it included the APPLE VRF, I did the **show ip protocols vrf APPLE** command, and it showed that the routing protocol was ospf 1.

**Conclusion**

VRF-Lite is an extension of VRF and is used to virtually separate two different networks from each other. To configure VRF you need to use VRF specific commands such as **ip vrf** vrf-name and **ip vrf forwarding** vrf-name. There are also some VRF-Lite specific show commands that are helpful to verify VRF-Lite is working correctly after configuring it. These include **show ip protocols vrf** vrf-name and **show ip vrf detail.** I was able to configure VRF-Lite to separate two different networks (APPLE and FACEBOOK) from each other, on 4 Cisco 4321 routers. Although I had some problems with OSPF, I was able to troubleshoot them to get VRF to work. Through this lab, I learned how to configure VRF-Lite to separate two networks, as well as develop a deeper understanding of how it works, and everything needed to make it work.

EBGP is an extension of the BGP routing protocol and is used to transport information to different autonomous systems with BGP enabled. To configure eBGP you need to use BGP specific commands such as **router bgp <AS Number>** and **redistribute <protocol> <protocol number>.** There are also some BGP specific show commands that are helpful to verify BGP is working correctly after configuring it. These include **show ip bgp** and **show ip bgp summary.** I was able to configure an eBGP network that enabled communications between two separate autonomous systems, on 6 Cisco 4321 routers. Although I had some problems with my IPv6 routes, I was able to troubleshoot them to get BGP to work. Through this lab, I learned how to configure BGP in both ipv6 and ipv6, as well as develop a deeper understanding of how it works, and everything needed to make it work.

**Teacher Signoff Page of Lab Completed**

**Evan Choi has completed this VRF Lite Lab**

**March 22, 2022**

