VRF Lite

CCNP Lab 8

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*Lab 8: VRF Lite*

**Purpose**

The objective of the lab was to understand and configure Virtual Routing and Forwarding (VRF), a networking tool that virtualizes routers, serving and partitioning completely isolate networks on the same physical routers.

**Background Information**

Virtual Routing and Forwarding (VRF) is a router feature that enables a provider router to support multiple virtual networks, each with separate virtual routing tables. This means that a network may use the same physical router but is using a different routing table because the router virtualized it. This partitioning is the effect of VRF. Multiple VRF partitions can be held on a physical router, as well as hold different Internet Gateway Protocol (IGP) configurations. VRF is often referred to as a “Layer 3 VLAN,” due to the fact that VRF’s have completely separate addressing tables. Thus, the same duplicate IP address schemes can be overlapped across VRFs without conflict. This trait is synonymous with VLAN.

VRF Lite isn’t dependent on a common component, MPLS, an encapsulation and labelling technique for traffic. All router sub-interfaces that can transport logical traffic require 802.1Q encapsulation, a networking standard for tagging frames as VLAN logical networks. Without switches, VLANs are unnecessary, but encapsulation is still used for virtualized routes for best practice.

A property of VRF is that each layer 3 interface can only be assigned to one VRF, either through physical ports or logical sub-interfaces and VLAN SVI’s. Nonetheless, a Layer 3 interface cannot belong to more than one VRF at any time, thus, multiple sub-interfaces were created to accommodate the 2 different VRFs set up in the lab (see *Network Diagram*).

VRF is not a routing protocol, nor does it interact with OSPF. So, OSPF practices were configured on each VRF respectively, and functions completely within the VRF partition. The main difference in the configuration is directing the OSPF interface to be VRF specific, with the edited OSPF commands (see *Lab Commands*). Thus, we configured 2 OSPFs, one for each VRF. Note, each VRF can hold any IGP, but as IGPs were not the main focus of the lab, we defaulted to simple OSPFv2.

As a brief summary of OSPF, this simple dynamic link-state routing protocol for IP networks calculates the shortest path it takes to send a packet through the network to its destination. It does so by identifying the total cost of that path, as each hop between routers will have a different assigned cost. However, the OSPF is limited to its VRF. The OSPF database consists of the routers known in each respective area per VRF. Routers are identified by their unique Router-ID, in the form of an IPv4 address. Router-IDs are uniquely assigned per router in each VRF.

**Lab Summary**

Four Cisco 4321 routers were set up in a bus-like topology, each sequentially following the next. The 4 routers were assigned two distinct VRFs, named Apple and Facebook, respectively. Naming has no influence on the functionality of the protocol. It is simply used to simulate the routers servicing two different companies, as would the purpose of the protocol in real-life applications. In terms of addressing, the unique property of overlapping addresses across different VRFs is demonstrated through the sharing of Loopback Addresses at each end of the topology, simulating possible host connections with the same addresses, connected via a switch, for example. Simple OSPFv2 is used as the dynamic routing protocol on both sides to connect through the routers and to have the hosts contact the other.

Pings from one VRF cannot reach addresses from the other VRF, and vice versa. Ping and traceroute tests, along with VRF routing tables, is checked to ensure proper functionality of VRF, and that no information is incorrectly overlapped (see *Configurations* and *Ping Tests*). For the Loopback ping tests, note that there is only one operating address on the loopback per VRF. That means pinging the counterpart address on the other VRF will not be successful, and vice versa. This is proved in the ping tests (see *Verification Commands*).

**Table of IP’s**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Router 1** | **Router 2** | **Router 3** | **Router 4** |
| **Gig Sub-Interfaces (Ipv4)**  *All subnets are of /24*  *.1 Sub-Interfaces are of Apple’s VRF*  *.2 Sub-Interfaces are of Facebook’s VRF* | **G0/0/0.1: 192.168.1.1**  **--**  **G0/0/0.2:**  **1.0.0.1**  **--** | **G0/0/0.1: 192.168.2.1**  **G0/0/1.1: 192.168.1.2**  **G0/0/0.2:**  **2.0.0.1**  **G0/0/1.2:**  **1.0.0.2** | **G0/0/0.1: 192.168.3.1**  **G0/0/1.1: 192.168.2.2**  **G0/0/0.2:**  **3.0.0.1**  **G0/0/1.2:**  **2.0.0.2** | **--**  **G0/0/1.1: 192.168.3.2**  **--**  **G0/0/1.2:**  **3.0.0.2** |
| **Loopback Interfaces** | **Apple:**  **10.10.10.1**  **Facebook: 10.10.10.2** | -- | -- | **Apple:**  **40.40.40.1**  **Facebook: 40.40.40.2** |
| **Router-IDs Apple’s VRF** | **1.1.1.1** | **2.2.2.2** | **3.3.3.3** | **4.4.4.4** |
| **Router-IDs Facebook’s VRF** | **5.5.5.5** | **6.6.6.6** | **7.7.7.7** | **8.8.8.8** |

**Lab Commands**

Most commands were common network fundamentals. Others were unique to configuring VRF. Key commands to this lab include:

**IP vrf [*vrf name*] –** Creates, enables, and enters VRF interface with the given name.

**IP vrf forwarding [*vrf name*] –** Assigns the layer 3 interface to the VRF. There can only be one VRF assigned per interface, logical or physical.

**Encapsulation dot1q [*vlan-id*] –** Encapsulated in the IEEE 802.1Q (dot1q) format, and specifies the VLAN identifier.

**Interface [sub-interface] –** Creates and enables a sub-interface, a virtual, logical layer 3 interface.

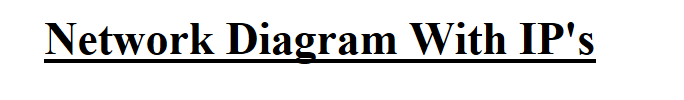
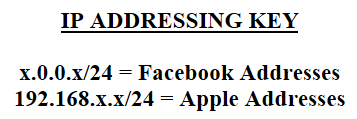
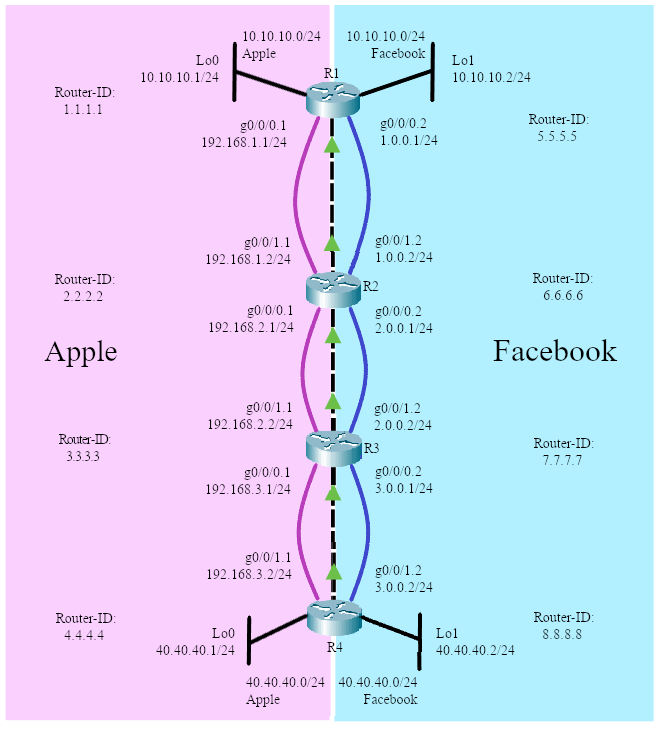
**Router ospf [*process-id*] vrf [*vrf name*] –** Enables and enters OSPF configuration interface, specific to the stated VRF.

**Show ip route vrf [*vrf name*] –** View the VRF-specific routing table. Without specifying the VRF, there should have no routes, as it displays the “global” routing table.

**Ping vrf [*vrf name*] [*IP address*] –** Ping address within VRF. Without specifying the VRF, the ping will look for addresses in the global routing table, which should have no routes.

**Show ip interface brief –** A useful show command for viewing sub-interfaces and its addresses.

**Show ip vrf [vrf name | interfaces] –** See general details and to check the VRF’s existence, or, to display all VRFs in the virtual router and their associated interfaces.



**Configurations**

Show Running-Configurations:

**R1**

R1#**show run**

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

**router ospf 1 vrf apple**

**router-id 1.1.1.1**

**network 10.10.10.0 0.0.0.255 area 1**

**network 192.168.1.0 0.0.0.255 area 1**

**router ospf 2 vrf facebook**

**router-id 5.5.5.5**

**network 1.0.0.0 0.0.0.255 area 2**

**network 10.10.10.0 0.0.0.255 area 2**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 2290 bytes

version 16.7

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

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 apple**

**ip vrf facebook**

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO220523GF

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

**interface Loopback0**

**ip vrf forwarding apple**

**ip address 10.10.10.1 255.255.255.0**

**interface Loopback1**

**ip vrf forwarding facebook**

**ip address 10.10.10.2 255.255.255.0**

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 1.0.0.1 255.255.255.0**

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

interface Serial0/1/0

no ip address

shutdown

**R2**

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

**router ospf 1 vrf apple**

**router-id 2.2.2.2**

**network 192.168.1.0 0.0.0.255 area 1**

**network 192.168.2.0 0.0.0.255 area 1**

**router ospf 2 vrf facebook**

**router-id 6.6.6.6**

**network 1.0.0.0 0.0.0.255 area 2**

**network 2.0.0.0 0.0.0.255 area 2**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

R2#show run

Building configuration...

Current configuration : 4381 bytes

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

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 apple**

**ip vrf facebook**

login on-success log

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21482DXE

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

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 2.0.0.1 255.255.255.0**

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 1.0.0.2 255.255.255.0**

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

**R3**

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

**router ospf 1 vrf apple**

**router-id 3.3.3.3**

**network 192.168.2.0 0.0.0.255 area 1**

**network 192.168.3.0 0.0.0.255 area 1**

**router ospf 2 vrf facebook**

**router-id 7.7.7.7**

**network 2.0.0.0 0.0.0.255 area 2**

**network 3.0.0.0 0.0.0.255 area 2**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R3#show run**

Building configuration...

Current configuration : 4419 bytes

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

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 apple**

**ip vrf facebook**

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21500G1N

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

no ip address

negotiation auto

**interface GigabitEthernet0/0/0.1**

**encapsulation dot1Q 1 native**

**ip vrf forwarding apple**

**ip address 192.168.3.1 255.255.255.0**

**interface GigabitEthernet0/0/0.2**

**encapsulation dot1Q 2**

**ip vrf forwarding facebook**

**ip address 3.0.0.1 255.255.255.0**

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 2.0.0.2 255.255.255.0**

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

**R4**

R4#**show run**

interface Vlan1

no ip address

shutdown

**router ospf 2 vrf facebook**

**router-id 8.8.8.8**

**network 3.0.0.0 0.0.0.255 area 2**

**network 40.40.40.0 0.0.0.255 area 2**

**router ospf 1 vrf apple**

**router-id 4.4.4.4**

**network 40.40.40.0 0.0.0.255 area 1**

**network 192.168.3.0 0.0.0.255 area 1**

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

Building configuration...

Current configuration : 1943 bytes

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 apple**

**ip vrf facebook**

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21441WDF

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

**interface Loopback0**

**ip vrf forwarding apple**

**ip address 40.40.40.1 255.255.255.0**

**interface Loopback1**

**ip vrf forwarding facebook**

**ip address 40.40.40.2 255.255.255.0**

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/0/1

no ip address

negotiation

**interface GigabitEthernet0/0/1.1**

**encapsulation dot1Q 1 native**

**ip vrf forwarding apple**

**ip address 192.168.3.2 255.255.255.0**

**interface GigabitEthernet0/0/1.2**

**encapsulation dot1Q 2**

**ip vrf forwarding facebook**

**ip address 3.0.0.2 255.255.255.0**

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

**Apple VRF Routing Tables**

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

**R1 Apple:**

R1#show ip route vrf apple

Routing Table: apple

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 10.10.10.0/24 is directly connected, Loopback0

L 10.10.10.1/32 is directly connected, Loopback0

40.0.0.0/32 is subnetted, 1 subnets

O 40.40.40.1 [110/4] via 192.168.1.2, 00:42:17, GigabitEthernet0/0/0.1

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, 00:42:17, GigabitEthernet0/0/0.1

**R2 Apple:**

R2#show ip route vrf apple

Routing Table: apple

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 1 subnets

O 10.10.10.1 [110/2] via 192.168.1.1, 00:47:35, GigabitEthernet0/0/1.1

40.0.0.0/32 is subnetted, 1 subnets

O 40.40.40.1 [110/3] via 192.168.2.2, 00:47:37, GigabitEthernet0/0/0.1

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

O 192.168.3.0/24 [110/2] via 192.168.2.2, 00:47:37, GigabitEthernet0/0/0.1

**R3 Apple:**

R3#show ip route vrf apple

Routing Table: apple

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 1 subnets

O 10.10.10.1 [110/3] via 192.168.2.1, 00:51:37, GigabitEthernet0/0/1.1

40.0.0.0/32 is subnetted, 1 subnets

O 40.40.40.1 [110/2] via 192.168.3.2, 00:52:53, GigabitEthernet0/0/0.1

O 192.168.1.0/24 [110/2] via 192.168.2.1, 00:51:42, 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

192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.3.0/24 is directly connected, GigabitEthernet0/0/0.1

L 192.168.3.1/32 is directly connected, GigabitEthernet0/0/0.1

**R4 Apple:**

R4#show ip route vrf apple

Routing Table: apple

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 1 subnets

O 10.10.10.1 [110/4] via 192.168.3.1, 00:47:26, GigabitEthernet0/0/1.1

40.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 40.40.40.0/24 is directly connected, Loopback0

L 40.40.40.1/32 is directly connected, Loopback0

O 192.168.1.0/24 [110/3] via 192.168.3.1, 00:47:36, GigabitEthernet0/0/1.1

O 192.168.2.0/24 [110/2] via 192.168.3.1, 00:48:21, GigabitEthernet0/0/1.1

192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.3.0/24 is directly connected, GigabitEthernet0/0/1.1

L 192.168.3.2/32 is directly connected, GigabitEthernet0/0/1.1

**Facebook VRF Routing Tables**

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

**R1 Facebook:**

R1#shOW ip route vrf facebook

Routing Table: facebook

Gateway of last resort is not set

1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 1.0.0.0/24 is directly connected, GigabitEthernet0/0/0.2

L 1.0.0.1/32 is directly connected, GigabitEthernet0/0/0.2

2.0.0.0/24 is subnetted, 1 subnets

O 2.0.0.0 [110/2] via 1.0.0.2, 00:42:31, GigabitEthernet0/0/0.2

3.0.0.0/24 is subnetted, 1 subnets

O 3.0.0.0 [110/3] via 1.0.0.2, 00:42:31, GigabitEthernet0/0/0.2

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 10.10.10.0/24 is directly connected, Loopback1

L 10.10.10.2/32 is directly connected, Loopback1

40.0.0.0/32 is subnetted, 1 subnets

O 40.40.40.2 [110/4] via 1.0.0.2, 00:42:31, GigabitEthernet0/0/0.2

**R2 Facebook:**

R2#show ip route vrf facebook

Routing Table: facebook

Gateway of last resort is not set

1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 1.0.0.0/24 is directly connected, GigabitEthernet0/0/1.2

L 1.0.0.2/32 is directly connected, GigabitEthernet0/0/1.2

2.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 2.0.0.0/24 is directly connected, GigabitEthernet0/0/0.2

L 2.0.0.1/32 is directly connected, GigabitEthernet0/0/0.2

3.0.0.0/24 is subnetted, 1 subnets

O 3.0.0.0 [110/2] via 2.0.0.2, 00:47:46, GigabitEthernet0/0/0.2

10.0.0.0/32 is subnetted, 1 subnets

O 10.10.10.2 [110/2] via 1.0.0.1, 00:47:44, GigabitEthernet0/0/1.2

40.0.0.0/32 is subnetted, 1 subnets

O 40.40.40.2 [110/3] via 2.0.0.2, 00:47:46, GigabitEthernet0/0/0.2

**R3 Facebook:**

R3#show ip route vrf facebook

Routing Table: facebook

Gateway of last resort is not set

1.0.0.0/24 is subnetted, 1 subnets

O 1.0.0.0 [110/2] via 2.0.0.1, 00:52:01, GigabitEthernet0/0/1.2

2.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 2.0.0.0/24 is directly connected, GigabitEthernet0/0/1.2

L 2.0.0.2/32 is directly connected, GigabitEthernet0/0/1.2

3.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 3.0.0.0/24 is directly connected, GigabitEthernet0/0/0.2

L 3.0.0.1/32 is directly connected, GigabitEthernet0/0/0.2

10.0.0.0/32 is subnetted, 1 subnets

O 10.10.10.2 [110/3] via 2.0.0.1, 00:51:56, GigabitEthernet0/0/1.2

40.0.0.0/32 is subnetted, 1 subnets

O 40.40.40.2 [110/2] via 3.0.0.2, 00:53:12, GigabitEthernet0/0/0.2

**R4 Facebook:**

R4#show ip route vrf facebook

Routing Table: facebook

Gateway of last resort is not set

1.0.0.0/24 is subnetted, 1 subnets

O 1.0.0.0 [110/3] via 3.0.0.1, 00:47:54, GigabitEthernet0/0/1.2

2.0.0.0/24 is subnetted, 1 subnets

O 2.0.0.0 [110/2] via 3.0.0.1, 00:48:39, GigabitEthernet0/0/1.2

3.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 3.0.0.0/24 is directly connected, GigabitEthernet0/0/1.2

L 3.0.0.2/32 is directly connected, GigabitEthernet0/0/1.2

10.0.0.0/32 is subnetted, 1 subnets

O 10.10.10.2 [110/4] via 3.0.0.1, 00:47:44, GigabitEthernet0/0/1.2

40.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 40.40.40.0/24 is directly connected, Loopback1

L 40.40.40.2/32 is directly connected, Loopback1

Verification Commands:

R1 Interfaces:

R1#**show ip interface brief**

Interface IP-Address OK? Method Status Protocol

GigabitEthernet0/0/0 unassigned YES unset up up

GigabitEthernet0/0/0.1 192.168.1.1 YES manual up up

GigabitEthernet0/0/0.2 1.0.0.1 YES manual up up

GigabitEthernet0/0/1 unassigned YES unset administratively down down

GigabitEthernet0/0/1.1 unassigned YES unset administratively down down

Serial0/1/0 unassigned YES unset administratively down down

Serial0/1/1 unassigned YES unset administratively down down

GigabitEthernet0/2/0 unassigned YES unset administratively down down

GigabitEthernet0/2/1 unassigned YES unset administratively down down

GigabitEthernet0 unassigned YES unset administratively down down

Loopback0 10.10.10.1 YES manual up up

Loopback1 10.10.10.2 YES manual up up

R4 Interfaces:

R4#**show ip interface brief**

Interface IP-Address OK? Method Status Protocol

GigabitEthernet0/0/0 unassigned YES unset administratively down down

GigabitEthernet0/0/1 unassigned YES unset up up

GigabitEthernet0/0/1.1 192.168.3.2 YES manual up up

GigabitEthernet0/0/1.2 3.0.0.2 YES manual up up

Serial0/1/0 unassigned YES unset administratively down down

Serial0/1/1 unassigned YES unset administratively down down

GigabitEthernet0 unassigned YES unset administratively down down

Loopback0 40.40.40.1 YES manual up up

Loopback1 40.40.40.2 YES manual up up

Apple VRF Pings and Traceroutes from edge to edge:

R1#**ping vrf apple 40.40.40.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 40.40.40.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R1#**ping vrf apple 40.40.40.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 40.40.40.2, timeout is 2 seconds:

.....

R1#**traceroute vrf apple 40.40.40.1**

Type escape sequence to abort.

Tracing the route to 40.40.40.1

VRF info: (vrf in name/id, vrf out name/id)

1 192.168.1.2 1 msec 1 msec 1 msec

2 192.168.2.2 1 msec 1 msec 1 msec

3 192.168.3.2 4 msec 1 msec \*

R4#**ping vrf apple 10.10.10.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.10.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R4#**ping vrf apple 10.10.10.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.10.2, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

R4#**traceroute vrf apple 10.10.10.1**

Type escape sequence to abort.

Tracing the route to 10.10.10.1

VRF info: (vrf in name/id, vrf out name/id)

1 192.168.3.1 0 msec 1 msec 0 msec

2 192.168.2.1 0 msec 3 msec 2 msec

3 192.168.1.1 2 msec 2 msec \*

Facebook VRF Ping and Traceroutes, from edge to edge:

R1#**ping vrf facebook 40.40.40.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 40.40.40.1, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

R1#**ping vrf facebook 40.40.40.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 40.40.40.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R1#**traceroute vrf facebook 40.40.40.2**

Type escape sequence to abort.

Tracing the route to 40.40.40.2

VRF info: (vrf in name/id, vrf out name/id)

1 1.0.0.2 1 msec 1 msec 1 msec

2 2.0.0.2 1 msec 1 msec 1 msec

3 3.0.0.2 1 msec 1 msec \*

R4#**ping vrf facebook 10.10.10.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.10.1, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

R4#**ping vrf facebook 10.10.10.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.10.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

R4#**traceroute vrf facebook 10.10.10.2**

Type escape sequence to abort.

Tracing the route to 10.10.10.2

VRF info: (vrf in name/id, vrf out name/id)

1 3.0.0.1 1 msec 1 msec 1 msec

2 2.0.0.1 1 msec 1 msec 1 msec

3 1.0.0.1 1 msec 1 msec \*

**Problems**

There were minimal issues in relation to the configuration of VRF. The nature of the network is similar to any default, directly connected topology. The only issue was learning the new VRF specific commands for the IGP configuration (OSPF) and pings, but did not require much solving. Another issue was the failure of direct connections of hosts onto the router via straight-through ethernet cables. According to lab coworker Manmeet Ranu, he concluded it was Window Firewall restriction. Switches were suggested, albeit ultimately unnecessary for the display and configuration of VRF Lite.

A possible future iteration may contain switches for the hosts. However, due to the physical limitations of only 2 hosts per rack of routers, PC hosts were not appropriate for this lab as there are multiple VRFs and multiple endpoints. So, Loopback Interfaces were used to display host connections, a logical, fast, and efficient way to demonstrate the VRF feature.

**Conclusion**

This quick but informative lab provided a foundation for further VRF research. VRFs are a flexible and useful technique to achieve networking strategies with limited given resources. It can also be expanded on, with further experimentation in conjunction with MPLS and VLANs. In conclusion, VRF Lite is a powerful and essential tool for network engineering, with much potential to be explored.