|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | |
|  | | VRF-Lite | | | | |  | |
|  |  | | | | | | |  |
|  | | | |  |  | | | |
|  | | | | Weizhen Chen |  | | | |
|  | | | | —CCNP—Jeffery Mason &Michael Hansen |  | | | |
|  | | |  | | |  | | |

Purpose

The objective of the lab was to use 4 routers to configure a VRF system with two routing instances simultaneously co-existing within the same router. The routers also require these two do not meet each other.

Background information

Virtual routing and forwarding (VRF) IP technology allows users to configure multiple routing table instances to simultaneously co-exist within the same router. Overlapping IP addresses can be used without conflict because the multiple routing instances are independent and can select different outgoing interfaces. VRFs are used for network isolation/virtualization at Layer 3 of the OSI model as VLANs serve similarly at Layer 2. Typically, users implement VRFs primarily to separate network traffic and more efficiently use network routers. Virtual routing and forwarding can also create VPN tunnels to be solely dedicated to a single network or client.

Lab summary

Before we started to configure the lab equipment, we first opened a notepad to create a topology with the VRF configuration for the routers. Also, during the process, we created the 4 correct IP address and subnet masks for the router interfaces and networks. Next, we connected the 4 routers with a copper cross-over cable through the gigabit ethernet and connected the routers to the computer with the console cable. In the configuration we would first enter user exec mode through the enable command and then enter global configuration mode through the config terminal command. In the global configuration mode, we would use the ip vrf command to enter VRF configuration mode then enter the gigabyte interface to associate the correct Ipv4 address according to the topology for the gigabit ethernet interfaces. After that We then applied a different Ip address on each of the two VRFs on 4 routers. Finally, we would then enter OSPF router config mode with the router OSPF process-id command to configure to apply the multi-VRF capability to OSPF process. To show that VRF was working we used the show run command to show the configuration we did, used the show ip router VRF to display the IP routing table associated with a VRF, use the show ip route vrf command in EXEC mode. Then use the ping command to show the routers are connected.

Lab commands

**ip vrf [*ip vrf vrf-name*]**: Names the VRF and enters VRF configuration mode.

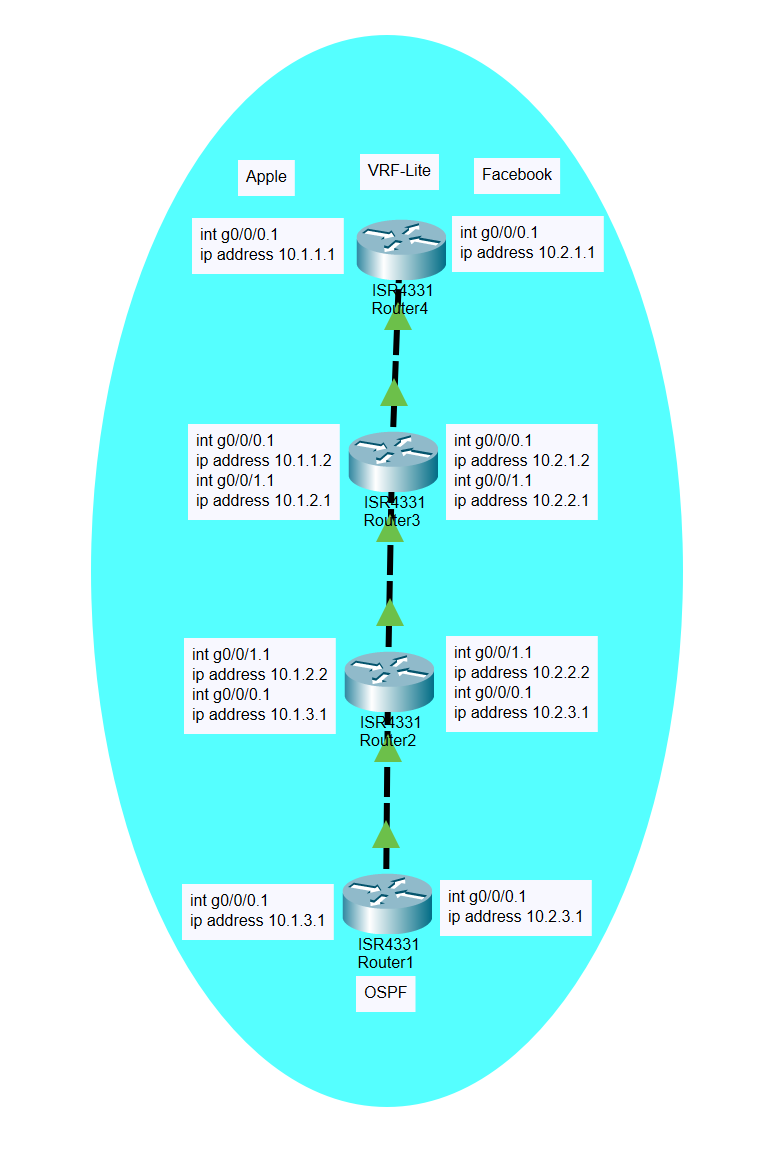
**ip vrf forwarding [*vrf-name*]**: Associates the VRF with the Layer 3 interface.

**router ospf process-id** **[*vrf vpn-name*]**: Enables OSPF routing and enters router configuration mode.

**capability vrf-lite**: Applies the multi-VRF capability to the OSPF process.

**Show ip route vrf [*ip vrf vrf-name*]**: To display the IP routing table associated with a VRF, use the show ip route vrf command in EXEC mode.

Network diagram



Configurations

**Router 1:**

R1#show run

Building configuration...

Current configuration : 4069 bytes

! Last configuration change at 18:09:48 UTC Tue Mar 22 2022

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 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

login on-success log

subscriber templating

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-859896477

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-859896477

revocation-check none

rsakeypair TP-self-signed-859896477

crypto pki certificate chain TP-self-signed-859896477

certificate self-signed 01

3082032E 30820216 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 38353938 39363437 37301E17 0D323230 33323231 38303633

385A170D 33303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F

532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3835 39383936

34373730 82012230 0D06092A 864886F7 0D010101 05000382 010F0030 82010A02

82010100 AE2A72B5 30C4CF19 47721058 AC5C362D C623FC21 E16E16A9 4E5F0485

926A185E 3980B53D 1C3E7EED 1FDEF729 7B93F1E5 2781C405 0C6D2B41 6F45D8D8

56BD07D0 13D853B8 04C37C3A 1063D36E 156BF963 F99BB04B 57CDA951 A3C2D063

8597C69D 1A1BF575 21E95999 1FD1B503 4607761A 10EE3B6E 5F5B0248 5E938508

57C23B2C F7205184 26903A3D 1AD90595 3091901E BAAACDA9 FD87EA5B 3EC0AC40

0BC01F6D 8E0F9330 0ED0D944 2E35C436 69D03D85 FA4596BF 1DDE023A 2A0B2535

C2739CFB A52CE45A 99F333DA 7AF13032 D584101B F89CE837 0A4B64F3 56F40AE6

AA88E572 0E64C9F2 4945DDA7 9EF699BB 73E18375 D5C40B9A DDA0B074 10085CF6

EC7C55AF 02030100 01A35330 51300F06 03551D13 0101FF04 05300301 01FF301F

0603551D 23041830 168014E7 A3FED99C B85FD0CD 306624A5 3A727E0D 8FCD2330

1D060355 1D0E0416 0414E7A3 FED99CB8 5FD0CD30 6624A53A 727E0D8F CD23300D

06092A86 4886F70D 01010505 00038201 010000FC C444C3FB B51FA02A 64526948

244FD23A 022E0589 C3141EFF B40E2694 D4057D24 344DF5F8 8C24C050 E1781F4D

687420CB F820EF61 54806056 524A9959 1C24C00C 563DB63A 0446CF26 860EEEF4

CC77F774 E23A7B90 AA9B8CF2 7C81D8BB C4B6DA9B 5978F0AA A31E23D9 E9EB76EF

CD6DCF49 A352A842 1E8A5AB2 441C7ACD 6C60C351 98AEF5B8 F73B3DB6 A0CF1C8D

5CC8F7E7 06F6A14B 93E933B3 87659885 25115A5A 1B138B33 103825BB B6BF194A

13DCA176 49E7A9AE E264AAE7 DE437376 C8ED8190 FE6D6748 7C4FC7EE 9BCCBB7E

22900AB3 FD09DE6E 630FEA45 171C8CDE F3F02487 930485FF 68CA7FEC 32335160

7CB71CFF 0F76CDCD F38EB398 7E19D48A BDFD

quit

license udi pid ISR4321/K9 sn FLM240608PJ

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

description R1

no ip address

negotiation auto

interface GigabitEthernet0/0/0.1

encapsulation dot1Q 1 native

ip vrf forwarding Apple

ip address 10.1.1.1 255.255.255.0

interface GigabitEthernet0/0/0.2

encapsulation dot1Q 2

ip vrf forwarding Facebook

ip address 10.2.1.1 255.255.255.0

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/1/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/1/1

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

capability vrf-lite

network 10.1.1.0 0.0.0.255 area 0

router ospf 2 vrf Facebook

router-id 1.1.1.2

capability vrf-lite

network 10.2.1.0 0.0.0.255 area 0

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

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

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

C 10.1.1.0/24 is directly connected, GigabitEthernet0/0/0.1

L 10.1.1.1/32 is directly connected, GigabitEthernet0/0/0.1

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

10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks

C 10.2.1.0/24 is directly connected, GigabitEthernet0/0/0.2

L 10.2.1.1/32 is directly connected, GigabitEthernet0/0/0.2

O 10.2.2.0/24 [110/2] via 10.2.1.2, 00:03:59, GigabitEthernet0/0/0.2

R1#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

1.1.2.2 1 FULL/DR 00:00:34 10.2.1.2 GigabitEthernet0/0/0.2

1.1.2.1 1 FULL/DR 00:00:37 10.1.1.2 GigabitEthernet0/0/0.1

R1#show ip ospf 1

Routing Process "ospf 1" with ID 1.1.1.1

Start time: 00:07:21.027, Time elapsed: 00:08:33.139

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 1

Area has no authentication

SPF algorithm last executed 00:05:00.565 ago

SPF algorithm executed 7 times

Area ranges are

Number of LSA 3. Checksum Sum 0x0157DA

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R1#show ip ospf 2

Routing Process "ospf 2" with ID 1.1.1.2

Start time: 00:07:21.284, Time elapsed: 00:08:44.803

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 1

Area has no authentication

SPF algorithm last executed 00:04:16.381 ago

SPF algorithm executed 12 times

Area ranges are

Number of LSA 5. Checksum Sum 0x022DD7

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R1#show ip ospf interface

GigabitEthernet0/0/0.2 is up, line protocol is up

Internet Address 10.2.1.1/24, Interface ID 12, Area 0

Attached via Network Statement

Process ID 2, Router ID 1.1.1.2, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State BDR, Priority 1

Designated Router (ID) 1.1.2.2, Interface address 10.2.1.2

Backup Designated router (ID) 1.1.1.2, Interface address 10.2.1.1

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:07

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 1

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 1.1.2.2 (Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0.1 is up, line protocol is up

Internet Address 10.1.1.1/24, Interface ID 11, Area 0

Attached via Network Statement

Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State BDR, Priority 1

Designated Router (ID) 1.1.2.1, Interface address 10.1.1.2

Backup Designated router (ID) 1.1.1.1, Interface address 10.1.1.1

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:06

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 1

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 1.1.2.1 (Designated Router)

Suppress hello for 0 neighbor(s)

**Router 2:**

R2#show run

Building configuration...

Current configuration : 4399 bytes

! Last configuration change at 18:12:24 UTC Tue Mar 22 2022

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

crypto pki trustpoint TP-self-signed-4288135047

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-4288135047

revocation-check none

rsakeypair TP-self-signed-4288135047

crypto pki certificate chain TP-self-signed-4288135047

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 34323838 31333530 3437301E 170D3232 30333232 31383130

34365A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D34 32383831

33353034 37308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 010093B6 19253A68 C64383EC 1D750A5E BC580B8F 0419DCA6 FC737BE0

00716E93 4834AD7B 29638879 3BD6A881 C8D1C479 3441986F DA50FC27 55693BDF

1354581F 3239D426 4F2CF9FC E1E0C452 796CD2E1 FF9A7052 FB8FACA7 BC1DA93A

7B749A24 FA8D59FF E8BED0C8 36292443 DC1A81EA 7F6B461E 64A886BD FF013CE6

88E9CA6B EC41D598 A8F70F47 E8850A8A 2794F938 9BB98AA3 A97FB202 161130D0

7BE60A30 1ECFB444 75C76C05 C968205E 3A60FA55 89FFA724 5F009BC9 D6162344

8A63490E 7DD00779 90A1F567 A31C6168 F8D714B3 FFBB365F F31AB4B4 AF1AB5F2

A6A7B3A9 7519C8B3 02418948 CB64A7F4 19638E3B 41FD1C98 BBDD0521 A2BD28A4

9791C67C E1150203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 1464253B FB3DB6D8 60E49FF4 2760B2D6 8175344A

B3301D06 03551D0E 04160414 64253BFB 3DB6D860 E49FF427 60B2D681 75344AB3

300D0609 2A864886 F70D0101 05050003 82010100 2216CB24 370FCA50 2F907EFF

E63B6BD6 DAB3F192 D9277F66 914BFA18 34C2F9DA D7E9ECEE EF01961E B96D94CB

75015E72 A604F113 1474D38A 609E2714 9D5C3201 FB6D2EBB 4BFED4AF 087E773B

E3CE51BF DC37738F 9CD3E3AF D4047B81 334DA7E6 EF090523 FD528A92 E1A1758E

5C94A612 2C4BF5E5 667A0832 3A522087 3BFCE9A7 258DE055 3B2B3145 5BBB50E4

3B20FDF9 5C89405D 99F99804 64D8B36D 288EDE3F A56F8285 6A40ED51 D872F8C8

FA6328F9 ECAF21D9 93D3216A 3DEBD58F 8D5EB543 239B0912 8474410A 7075E611

ABE898CB C8B2ED74 A01028F8 A6B01EF9 752F97DF B6971A74 6D3FDAF1 B5C5491D

602C5774 28EEA723 F169596F B25CEF9B 3738952B

quit

license udi pid ISR4321/K9 sn FLM2406090M

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

description R2

no ip address

negotiation auto

interface GigabitEthernet0/0/0.1

encapsulation dot1Q 1 native

ip vrf forwarding Apple

ip address 10.1.1.2 255.255.255.0

interface GigabitEthernet0/0/0.2

encapsulation dot1Q 2

ip vrf forwarding Facebook

ip address 10.2.1.2 255.255.255.0

interface GigabitEthernet0/0/1

description R2

no ip address

negotiation auto

interface GigabitEthernet0/0/1.1

encapsulation dot1Q 1 native

ip vrf forwarding Apple

ip address 10.1.2.1 255.255.255.0

interface GigabitEthernet0/0/1.2

encapsulation dot1Q 2

ip vrf forwarding Facebook

ip address 10.2.2.1 255.255.255.0

interface GigabitEthernet0/1/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/1/1

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 1.1.2.1

capability vrf-lite

network 10.1.1.0 0.0.0.255 area 0

network 10.2.2.0 0.0.0.255 area 0

router ospf 2 vrf Facebook

router-id 1.1.2.2

capability vrf-lite

network 10.2.1.0 0.0.0.255 area 0

network 10.2.2.0 0.0.0.255 area 0

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 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

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.1.1.0/24 is directly connected, GigabitEthernet0/0/0.1

L 10.1.1.2/32 is directly connected, GigabitEthernet0/0/0.1

C 10.1.2.0/24 is directly connected, GigabitEthernet0/0/1.1

L 10.1.2.1/32 is directly connected, GigabitEthernet0/0/1.1

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

10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks

C 10.2.1.0/24 is directly connected, GigabitEthernet0/0/0.2

L 10.2.1.2/32 is directly connected, GigabitEthernet0/0/0.2

C 10.2.2.0/24 is directly connected, GigabitEthernet0/0/1.2

L 10.2.2.1/32 is directly connected, GigabitEthernet0/0/1.2

R2#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

1.1.3.2 1 FULL/DR 00:00:35 10.2.2.2 GigabitEthernet0/0/1.2

1.1.1.2 1 FULL/BDR 00:00:35 10.2.1.1 GigabitEthernet0/0/0.2

1.1.1.1 1 FULL/BDR 00:00:35 10.1.1.1 GigabitEthernet0/0/0.1

R2#show ip ospf 1

Routing Process "ospf 1" with ID 1.1.2.1

Start time: 00:08:52.169, Time elapsed: 00:08:17.209

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 1

Area has no authentication

SPF algorithm last executed 00:07:21.847 ago

SPF algorithm executed 5 times

Area ranges are

Number of LSA 3. Checksum Sum 0x0157DA

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R2#show ip ospf 2

Routing Process "ospf 2" with ID 1.1.2.2

Start time: 00:08:52.565, Time elapsed: 00:08:29.421

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 2

Area has no authentication

SPF algorithm last executed 00:06:39.122 ago

SPF algorithm executed 11 times

Area ranges are

Number of LSA 5. Checksum Sum 0x022DD7

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R2#show ip ospf interface

GigabitEthernet0/0/1.2 is up, line protocol is up

Internet Address 10.2.2.1/24, Interface ID 14, Area 0

Attached via Network Statement

Process ID 2, Router ID 1.1.2.2, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State BDR, Priority 1

Designated Router (ID) 1.1.3.2, Interface address 10.2.2.2

Backup Designated router (ID) 1.1.2.2, Interface address 10.2.2.1

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:00

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/2/2, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 1

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 1.1.3.2 (Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0.2 is up, line protocol is up

Internet Address 10.2.1.2/24, Interface ID 13, Area 0

Attached via Network Statement

Process ID 2, Router ID 1.1.2.2, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 1.1.2.2, Interface address 10.2.1.2

Backup Designated router (ID) 1.1.1.2, Interface address 10.2.1.1

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:05

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 2

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 1.1.1.2 (Backup Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0.1 is up, line protocol is up

Internet Address 10.1.1.2/24, Interface ID 11, Area 0

Attached via Network Statement

Process ID 1, Router ID 1.1.2.1, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 1.1.2.1, Interface address 10.1.1.2

Backup Designated router (ID) 1.1.1.1, Interface address 10.1.1.1

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:07

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 2

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 1.1.1.1 (Backup Designated Router)

Suppress hello for 0 neighbor(s)

**Router 3:**

R3#show run

Building configuration...

Current configuration : 4399 bytes

! Last configuration change at 18:08:51 UTC Tue Mar 22 2022

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

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2667303412

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2667303412

revocation-check none

rsakeypair TP-self-signed-2667303412

crypto pki certificate chain TP-self-signed-2667303412

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 32363637 33303334 3132301E 170D3232 30333232 31373537

31325A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 36363733

30333431 32308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 0100C584 0F9DCCCC 2A2AC5FC F9DA44BF E6F735E4 1ADDD7CA 8501B2AF

F9AA92ED 6B025959 DED528DE 03D45AB7 B50F4424 769C5A35 737C7627 F2459329

717D9315 CE39FD34 3BCE63FA BEA93183 1D761ACE 7ABAC5C1 A97A1334 F8617A10

F8DB4EA8 BBBA881C B84D5BBB A9302DC1 54ED3BBB 07B94657 93C97A13 8601C763

789EE682 EBFB8D23 671A1C40 EBDB39B6 5DE868A7 1122F6C6 60386DDA ECEC19C7

FF54B330 3ABA7405 2FFB1794 49B8FB96 5D9F623F DE484E9B 0906DAC9 B49A80EF

1606B33D 6906E980 47DBE256 18322233 1E5BD2D8 02BA1214 B5D07D9D 8BF529B2

B933F073 EF4F496E 44B52F23 2BE060AE 941A7DF6 C61DFBE0 FBE9D009 5FF6C6B1

D4FB0D61 11F30203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 141D807A ADE28B25 298EB0BA D6135E7A 016FC09D

5E301D06 03551D0E 04160414 1D807AAD E28B2529 8EB0BAD6 135E7A01 6FC09D5E

300D0609 2A864886 F70D0101 05050003 82010100 98640608 99EEAFC8 BD95631B

FBF11B07 1C068CF6 E18B61A3 4E6B6A72 5C3F026A 15EEC4F0 54B6D80D 9AB910EC

3DAEAD9E AE1D835C 77C17ED7 B1B9BC0A B8A92430 3A980FBC 9454587C 57D54A6B

A0630A0C 08A6A2BE 706F23DB 1EA2C1EB A208A6A6 4CA2126E C1EE3FA6 E55D9CAB

57F86A5F 8D821B63 25AF2D63 2659ABB9 D7603D8A 0742680D 8FA63650 1AF18606

C49E8716 68524EF7 FB845534 5120A876 5BE80C0A 134A70F7 6D408995 98E075E4

DD4E49C5 39F00CCB 86DD6E96 1C1DC3F0 EE1D46C7 E67BC316 B252FF75 AAE9A7D7

86BF015D 51AC3185 4467D65A C3CDA58E EE03E993 C233AFE5 E957605F 459CCE47

80368395 C3B8888A DB94D751 80078581 2162A30E

quit

license udi pid ISR4321/K9 sn FLM2407011F

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

description R3

no ip address

negotiation auto

interface GigabitEthernet0/0/0.1

encapsulation dot1Q 1 native

ip vrf forwarding Apple

ip address 10.1.3.1 255.255.255.0

interface GigabitEthernet0/0/0.2

encapsulation dot1Q 2

ip vrf forwarding Facebook

ip address 10.2.3.1 255.255.255.0

interface GigabitEthernet0/0/1

description R3

no ip address

negotiation auto

interface GigabitEthernet0/0/1.1

encapsulation dot1Q 1 native

ip vrf forwarding Apple

ip address 10.1.2.2 255.255.255.0

interface GigabitEthernet0/0/1.2

encapsulation dot1Q 2

ip vrf forwarding Facebook

ip address 10.2.2.2 255.255.255.0

interface GigabitEthernet0/1/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/1/1

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 1.1.3.1

capability vrf-lite

network 10.1.2.0 0.0.0.255 area 0

network 10.1.3.0 0.0.0.255 area 0

router ospf 2 vrf Facebook

router-id 1.1.3.2

capability vrf-lite

network 10.2.2.0 0.0.0.255 area 0

network 10.2.3.0 0.0.0.255 area 0

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 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

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

C 10.1.2.0/24 is directly connected, GigabitEthernet0/0/1.1

L 10.1.2.2/32 is directly connected, GigabitEthernet0/0/1.1

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

10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks

O 10.2.1.0/24 [110/2] via 10.2.2.1, 00:08:17, GigabitEthernet0/0/1.2

C 10.2.2.0/24 is directly connected, GigabitEthernet0/0/1.2

L 10.2.2.2/32 is directly connected, GigabitEthernet0/0/1.2

R3#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

1.1.2.2 1 FULL/BDR 00:00:30 10.2.2.1 GigabitEthernet0/0/1.2

R3#show ip ospf 1

Routing Process "ospf 1" with ID 1.1.3.1

Start time: 02:57:12.037, Time elapsed: 00:09:33.379

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0) (Inactive)

Number of interfaces in this area is 2

Area has no authentication

SPF algorithm last executed 00:08:21.497 ago

SPF algorithm executed 5 times

Area ranges are

Number of LSA 1. Checksum Sum 0x00E232

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R3#show ip ospf 2

Routing Process "ospf 2" with ID 1.1.3.2

Start time: 02:57:12.423, Time elapsed: 00:09:47.217

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 2

Area has no authentication

SPF algorithm last executed 00:08:35.719 ago

SPF algorithm executed 9 times

Area ranges are

Number of LSA 5. Checksum Sum 0x022DD7

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R3#show ip ospf interface

GigabitEthernet0/0/0.2 is down, line protocol is down

Internet Address 10.2.3.1/24, Interface ID 14, Area 0

Attached via Network Statement

Process ID 2, Router ID 1.1.3.2, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DOWN, Priority 1

No designated router on this network

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

GigabitEthernet0/0/1.2 is up, line protocol is up

Internet Address 10.2.2.2/24, Interface ID 13, Area 0

Attached via Network Statement

Process ID 2, Router ID 1.1.3.2, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 1.1.3.2, Interface address 10.2.2.2

Backup Designated router (ID) 1.1.2.2, Interface address 10.2.2.1

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:04

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 2

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 1.1.2.2 (Backup Designated Router)

Suppress hello for 0 neighbor(s)

GigabitEthernet0/0/0.1 is down, line protocol is down

Internet Address 10.1.3.1/24, Interface ID 12, Area 0

Attached via Network Statement

Process ID 1, Router ID 1.1.3.1, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DOWN, Priority 1

No designated router on this network

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

GigabitEthernet0/0/1.1 is up, line protocol is up

Internet Address 10.1.2.2/24, Interface ID 11, Area 0

Attached via Network Statement

Process ID 1, Router ID 1.1.3.1, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 1.1.3.1, Interface address 10.1.2.2

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Hello due in 00:00:03

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 1/1/1, flood queue length 0

Next 0x0(0)/0x0(0)/0x0(0)

Last flood scan length is 0, maximum is 0

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

**Router 4:**

R4#show run

Building configuration...

Current configuration : 3932 bytes

! Last configuration change at 18:23:24 UTC Tue Mar 22 2022

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

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

ip dhcp pool webuidhcp

subscriber templating

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2951285168

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2951285168

revocation-check none

rsakeypair TP-self-signed-2951285168

crypto pki certificate chain TP-self-signed-2951285168

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 32393531 32383531 3638301E 170D3232 30333232 31383233

30345A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 39353132

38353136 38308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 01008AB8 13024DD0 FD77B9F6 147B0F3F E5C98185 FAFBCBE5 34AA2B73

EB77494F F2307159 23EA6D79 002A62C4 B73BCE9A ED7DC4B7 F1D5C810 FF1C9541

82CFC6A0 730208A4 6FF82036 51B50C3F A8E9216A BDBCCD48 C154F1E3 F979C67E

BEE29C7A 706DFDB7 871DF0E1 054E68FB 61CBC2F5 1677C1B8 CF4CACC0 A4817BE0

F2870065 979813D1 43343554 B5799141 C95C1047 D2A5DF57 8B2447E1 4335B6AE

12334B9F BF85E5FC 86A621C7 9716E05E AA3EA870 84C5F300 C54A93F8 CAB637B3

7C127964 E3D3EFAC 2593B613 C707D3E7 03A4CF3E 12E75B3A 4D90961A C4D89E2C

D70B3507 981B847D 35A2D8B3 9F472A95 BB25F22A C9E35A2C 516BD3A2 11B071C6

799B8C11 39450203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 14EA8B90 A5C2C053 6BC0E770 E563C198 788E5324

D4301D06 03551D0E 04160414 EA8B90A5 C2C0536B C0E770E5 63C19878 8E5324D4

300D0609 2A864886 F70D0101 05050003 82010100 5228770A F276A81A 27B92040

D7929C30 348C120E B3F09C91 570529F8 978443EB EAF53E21 D906C663 A5570A3E

5F3D15DD 72D5C6C9 9C861A90 999AD255 1E8FBF90 66382E2E 98C33FC4 0BACADF6

4F58CF49 06C6E628 5936BE21 5736EE2B 4685DB6E 400C086F 6C5E3FA4 242A2ACF

23C0A7C8 89566757 CA99DBAE 2DAA34FB 49FE38F7 C96C7B86 53E390EC FBB49DC5

346F66AC 2D2E95B4 D34A43F2 04B67103 17D79112 1B841D8F 8713949D 78F9FDBD

7430032C 289F77EF B2E53177 096A0CB5 A14D49CD 0E984148 441B80D1 706EC593

BA013544 BA4116BD B94F6000 A8F8EF9C 24523C1A A0A15037 529E154C DCC8B0DD

FAC51190 648F17F9 16193CD9 03B85615 9102EDF4

quit

license udi pid ISR4321/K9 sn FLM240608H7

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/0/1

description R4

no ip address

negotiation auto

interface GigabitEthernet0/0/1.1

encapsulation dot1Q 1 native

ip vrf forwarding Apple

ip address 10.1.3.2 255.255.255.0

interface GigabitEthernet0/0/1.2

encapsulation dot1Q 2

ip vrf forwarding Facebook

ip address 10.2.3.2 255.255.255.0

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1 vrf Apple

router-id 1.1.4.1

capability vrf-lite

network 10.1.3.0 0.0.0.255 area 0

router ospf 2 vrf Facebook

router-id 1.1.4.2

capability vrf-lite

network 10.2.3.0 0.0.0.255 area 0

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

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

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

R4#show ip ospf 1

Routing Process "ospf 1" with ID 1.1.4.1

Start time: 00:09:19.287, Time elapsed: 00:09:37.619

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0) (Inactive)

Number of interfaces in this area is 1

Area has no authentication

SPF algorithm last executed 00:09:37.564 ago

SPF algorithm executed 0 times

Area ranges are

Number of LSA 0. Checksum Sum 0x000000

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R4#show ip ospf 2

Routing Process "ospf 2" with ID 1.1.4.2

Start time: 00:09:19.525, Time elapsed: 00:10:00.262

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log disabled

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300

Number of external LSA 0. Checksum Sum 0x000000

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0) (Inactive)

Number of interfaces in this area is 1

Area has no authentication

SPF algorithm last executed 00:10:00.217 ago

SPF algorithm executed 0 times

Area ranges are

Number of LSA 0. Checksum Sum 0x000000

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

R4#show ip ospf interface

GigabitEthernet0/0/1.2 is down, line protocol is down

Internet Address 10.2.3.2/24, Interface ID 10, Area 0

Attached via Network Statement

Process ID 2, Router ID 1.1.4.2, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DOWN, Priority 1

No designated router on this network

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

GigabitEthernet0/0/1.1 is down, line protocol is down

Internet Address 10.1.3.2/24, Interface ID 9, Area 0

Attached via Network Statement

Process ID 1, Router ID 1.1.4.1, Network Type BROADCAST, Cost: 1

Topology-MTID Cost Disabled Shutdown Topology Name

0 1 no no Base

Transmit Delay is 1 sec, State DOWN, Priority 1

No designated router on this network

No backup designated router on this network

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

oob-resync timeout 40

Problems

One of the biggest Problem that I faced in the lab was that I did not know how to configure a VRF, so I looked at a VRF videos along with a website on VRF configuration to understand how to properly create a VRF system. During the process of creating VRF, I encountered some minor problems, like typing the wrong commands in the wrong configuration mode

Conclusion

The objective of the lab was to be able to configure a VRF system for all the 4 routers. During this prosses of creating the VRF it allowed us to review this IP routing and allowed us to better understand and familiarize ourselves with how to configure networks physically. During the lab we encountered some small troubles that we learned from, but We were able to config the VRF system correctly by the end. This lab was straight forward, and I was able to gain experience in setting up the routers by the end of the lab.