

Multi Area OSPFv3

REPORT SUBTITLE

Mikey Carroll | Advanced Cisco | 11/17/2021

# Purpose

The purpose of this lab was to learn how IPv6 OSPF works and what adding multiple areas does.

# Background Information

OSPFv3 is the Open Shortest Path First routing protocol for IPv6. It works the same way as OSPFv2 by only exchanging topology information with neighbors. Multi area OSPF adds different areas to reduce the load on each individual router. When you have multiple areas in OSPF you need to keep the backbone, or area 0 contiguous meaning that every router must have a physical or virtual connection to it.

# Lab Summary

For this lab we setup 6 Cisco integrated services routers in a dual IPv4 and IPv6 multi area OSPF network.

# Lab Commands

In this lab we needed to use some new commands along with some commands we learned about in our last lab.

* Router (config)# ipv6 unicast-routing

This command enables IPv6 routing on our router

* Router (config)# router ospf x

This command starts OSPF on our router with the process id x and drops us into router config mode

* Router (config-router)# network a.b.c.d 0.0.0.255 area x

This command would add the network a.b.c.d with the subnet mask of 255.255.255.0 to OSPF in area x

* Router (config-router)# router-id x.x.x.x

This command adds a unique identification number to our router that is used for neighbor discovery

* Router (config-router)# area x virtual-link a.b.c.d

This command creates a virtual link where x is the area that the link is crossing and a.b.c.d is the router id of our target router. This command is used to add fault tolerance and can help with keeping area 0 contiguous

* Router (config)# ipv6 router ospf x

This command starts IPv6 OSPF on our router with a process id of x

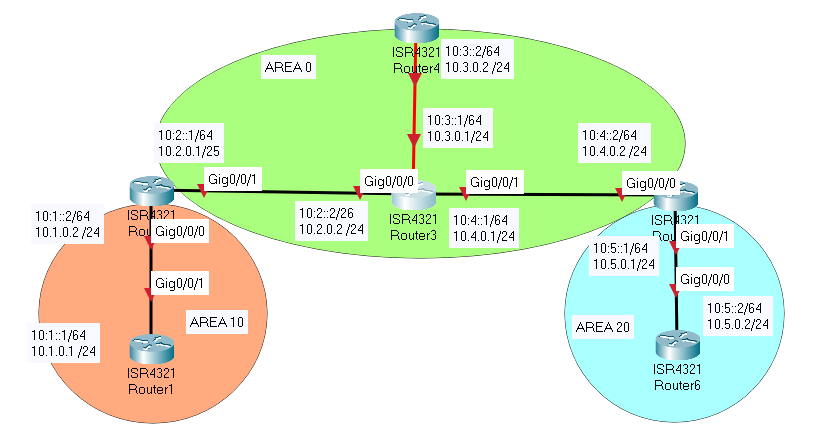
* Router (config-rtr)# router-id x.x.x.x

This command sets the router id for IPv6 OSPF

* Router (config-if)# ipv6 ospf 1 area x

This command adds this interface and any associated networks to IPv6 OSPF process id 1

# Network diagram



(loopback interfaces omitted in this diagram)

# Router Configurations

R1

Current configuration : 1767 bytes

!

! Last configuration change at 16:26:28 UTC Wed Sep 22 2021

!

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

!

ipv6 unicast-routing

!

license udi pid ISR4321/K9 sn FDO214811ZM

!

interface Loopback0

ip address 192.168.1.1 255.255.255.0

ipv6 address 10::1:1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/0

ip address 10.1.0.1 255.255.255.0

negotiation auto

ipv6 address 10:1::1/64

ipv6 ospf 1 area 10

!

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

ip address dhcp

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1

router-id 1.1.1.1

area 10 virtual-link 2.2.2.2

network 10.1.0.0 0.0.0.255 area 10

network 192.168.1.0 0.0.0.255 area 0

!

ipv6 router ospf 1

router-id 1.1.1.1

!

End

R1>show ip route

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, 6 subnets, 2 masks

C 10.1.0.0/24 is directly connected, GigabitEthernet0/0/0

L 10.1.0.1/32 is directly connected, GigabitEthernet0/0/0

O 10.2.0.0/24 [110/2] via 10.1.0.2, 02:02:50, GigabitEthernet0/0/0

O 10.3.0.0/24 [110/3] via 10.1.0.2, 02:02:50, GigabitEthernet0/0/0

O 10.4.0.0/24 [110/3] via 10.1.0.2, 02:02:40, GigabitEthernet0/0/0

O IA 10.5.0.0/24 [110/4] via 10.1.0.2, 00:07:13, GigabitEthernet0/0/0

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

C 192.168.1.0/24 is directly connected, Loopback0

L 192.168.1.1/32 is directly connected, Loopback0

192.168.2.0/32 is subnetted, 1 subnets

O 192.168.2.1 [110/2] via 10.1.0.2, 02:02:50, GigabitEthernet0/0/0

192.168.3.0/32 is subnetted, 1 subnets

O 192.168.3.1 [110/3] via 10.1.0.2, 02:02:50, GigabitEthernet0/0/0

192.168.4.0/32 is subnetted, 1 subnets

O 192.168.4.1 [110/4] via 10.1.0.2, 02:02:50, GigabitEthernet0/0/0

192.168.5.0/32 is subnetted, 1 subnets

O 192.168.5.1 [110/4] via 10.1.0.2, 02:02:30, GigabitEthernet0/0/0

R1>show ipv6 route

IPv6 Routing Table - default - 14 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2

IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external

ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, a - Application

C 10::/64 [0/0]

via Loopback0, directly connected

L 10::1:1/128 [0/0]

via Loopback0, receive

OI 10::2:1/128 [110/1]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10::3:1/128 [110/2]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10::4:1/128 [110/3]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10::5:1/128 [110/3]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10::6:1/128 [110/4]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

C 10:1::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 10:1::1/128 [0/0]

via GigabitEthernet0/0/0, receive

OI 10:2::/64 [110/2]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10:3::/64 [110/3]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10:4::/64 [110/3]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

OI 10:5::/64 [110/4]

via FE80::B6A8:B9FF:FE47:9470, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

R2

Current configuration : 1857 bytes

!

! Last configuration change at 16:30:56 UTC Wed Sep 22 2021

!

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

!

ipv6 unicast-routing

!

license udi pid ISR4321/K9 sn FDO214414TX

!

interface Loopback0

ip address 192.168.2.1 255.255.255.0

ipv6 address 10::2:1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/0

ip address 10.1.0.2 255.255.255.0

negotiation auto

ipv6 address 10:1::2/64

ipv6 ospf 1 area 10

!

interface GigabitEthernet0/0/1

ip address 10.2.0.1 255.255.255.0

negotiation auto

ipv6 address 10:2::1/64

ipv6 ospf 1 area 0

!

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

ip address dhcp

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1

router-id 2.2.2.2

area 10 virtual-link 1.1.1.1

network 10.1.0.0 0.0.0.255 area 10

network 10.2.0.0 0.0.0.255 area 0

network 192.168.2.0 0.0.0.255 area 0

!

ipv6 router ospf 1

router-id 2.2.2.2

!

End

R2>show ip route

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, 7 subnets, 2 masks

C 10.1.0.0/24 is directly connected, GigabitEthernet0/0/0

L 10.1.0.2/32 is directly connected, GigabitEthernet0/0/0

C 10.2.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.2.0.1/32 is directly connected, GigabitEthernet0/0/1

O 10.3.0.0/24 [110/2] via 10.2.0.2, 02:01:27, GigabitEthernet0/0/1

O 10.4.0.0/24 [110/2] via 10.2.0.2, 02:01:13, GigabitEthernet0/0/1

O IA 10.5.0.0/24 [110/3] via 10.2.0.2, 00:05:47, GigabitEthernet0/0/1

192.168.1.0/32 is subnetted, 1 subnets

O 192.168.1.1 [110/2] via 10.1.0.1, 02:01:27, GigabitEthernet0/0/0

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

C 192.168.2.0/24 is directly connected, Loopback0

L 192.168.2.1/32 is directly connected, Loopback0

192.168.3.0/32 is subnetted, 1 subnets

O 192.168.3.1 [110/2] via 10.2.0.2, 02:01:37, GigabitEthernet0/0/1

192.168.4.0/32 is subnetted, 1 subnets

O 192.168.4.1 [110/3] via 10.2.0.2, 02:01:27, GigabitEthernet0/0/1

192.168.5.0/32 is subnetted, 1 subnets

O 192.168.5.1 [110/3] via 10.2.0.2, 02:01:03, GigabitEthernet0/0/1

R2>show ipv6 route

IPv6 Routing Table - default - 15 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2

IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external

ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, a - Application

C 10::/64 [0/0]

via Loopback0, directly connected

O 10::1:1/128 [110/1]

via FE80::267E:12FF:FE55:5720, GigabitEthernet0/0/0

L 10::2:1/128 [0/0]

via Loopback0, receive

O 10::3:1/128 [110/1]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

O 10::4:1/128 [110/2]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

O 10::5:1/128 [110/2]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

OI 10::6:1/128 [110/3]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

C 10:1::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 10:1::2/128 [0/0]

via GigabitEthernet0/0/0, receive

C 10:2::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 10:2::1/128 [0/0]

via GigabitEthernet0/0/1, receive

O 10:3::/64 [110/2]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

O 10:4::/64 [110/2]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

OI 10:5::/64 [110/3]

via FE80::227:90FF:FED4:F31, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

R3

Current configuration : 1915 bytes

!

! Last configuration change at 16:31:42 UTC Wed Sep 22 2021

!

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

!

ipv6 unicast-routing

!

license udi pid ISR4321/K9 sn FDO214328EH

!

interface Loopback0

ip address 192.168.3.1 255.255.255.0

ipv6 address 10::3:1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/0

ip address 10.3.0.1 255.255.255.0

negotiation auto

ipv6 address 10:3::1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/1

ip address 10.2.0.2 255.255.255.0

negotiation auto

ipv6 address 10:2::2/64

ipv6 ospf 1 area 0

!

interface Serial0/1/0

no ip address

shutdown

!

interface Serial0/1/1

no ip address

shutdown

!

interface GigabitEthernet0/2/0

ip address 10.4.0.1 255.255.255.0

negotiation auto

ipv6 address 10:4::1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0

vrf forwarding Mgmt-intf

ip address dhcp

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1

router-id 3.3.3.3

network 10.2.0.0 0.0.0.255 area 0

network 10.3.0.0 0.0.0.255 area 0

network 10.4.0.0 0.0.0.255 area 0

network 192.168.3.0 0.0.0.255 area 0

!

ipv6 router ospf 1

router-id 3.3.3.3

!

End

R3>show ip route

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, 8 subnets, 2 masks

O IA 10.1.0.0/24 [110/2] via 10.2.0.1, 02:00:51, GigabitEthernet0/0/1

C 10.2.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.2.0.2/32 is directly connected, GigabitEthernet0/0/1

C 10.3.0.0/24 is directly connected, GigabitEthernet0/0/0

L 10.3.0.1/32 is directly connected, GigabitEthernet0/0/0

C 10.4.0.0/24 is directly connected, GigabitEthernet0/2/0

L 10.4.0.1/32 is directly connected, GigabitEthernet0/2/0

O IA 10.5.0.0/24 [110/2] via 10.4.0.2, 00:05:01, GigabitEthernet0/2/0

192.168.1.0/32 is subnetted, 1 subnets

O 192.168.1.1 [110/3] via 10.2.0.1, 02:00:41, GigabitEthernet0/0/1

192.168.2.0/32 is subnetted, 1 subnets

O 192.168.2.1 [110/2] via 10.2.0.1, 02:00:51, GigabitEthernet0/0/1

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

C 192.168.3.0/24 is directly connected, Loopback0

L 192.168.3.1/32 is directly connected, Loopback0

192.168.4.0/32 is subnetted, 1 subnets

O 192.168.4.1 [110/2] via 10.3.0.2, 02:00:41, GigabitEthernet0/0/0

192.168.5.0/32 is subnetted, 1 subnets

O 192.168.5.1 [110/2] via 10.4.0.2, 02:00:27, GigabitEthernet0/2/0

R3>show ipv6 route

IPv6 Routing Table - default - 16 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2

IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external

ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, a - Application

C 10::/64 [0/0]

via Loopback0, directly connected

OI 10::1:1/128 [110/2]

via FE80::B6A8:B9FF:FE47:9471, GigabitEthernet0/0/1

O 10::2:1/128 [110/1]

via FE80::B6A8:B9FF:FE47:9471, GigabitEthernet0/0/1

L 10::3:1/128 [0/0]

via Loopback0, receive

O 10::4:1/128 [110/1]

via FE80::2C1:B1FF:FED5:5331, GigabitEthernet0/0/0

O 10::5:1/128 [110/1]

via FE80::B6A8:B9FF:FE01:B5A0, GigabitEthernet0/2/0

OI 10::6:1/128 [110/2]

via FE80::B6A8:B9FF:FE01:B5A0, GigabitEthernet0/2/0

OI 10:1::/64 [110/2]

via FE80::B6A8:B9FF:FE47:9471, GigabitEthernet0/0/1

C 10:2::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 10:2::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 10:3::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 10:3::1/128 [0/0]

via GigabitEthernet0/0/0, receive

C 10:4::/64 [0/0]

via GigabitEthernet0/2/0, directly connected

L 10:4::1/128 [0/0]

via GigabitEthernet0/2/0, receive

OI 10:5::/64 [110/2]

via FE80::B6A8:B9FF:FE01:B5A0, GigabitEthernet0/2/0

L FF00::/8 [0/0]

via Null0, receive

R4

Building configuration...

Current configuration : 1640 bytes

!

! Last configuration change at 16:16:24 UTC Wed Sep 22 2021

!

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

!

ipv6 unicast-routing

!

license udi pid ISR4321/K9 sn FDO210907U3

!

interface Loopback0

ip address 192.168.4.1 255.255.255.0

ipv6 address 10::4:1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0/0/1

ip address 10.3.0.2 255.255.255.0

negotiation auto

ipv6 address 10:3::2/64

ipv6 ospf 1 area 0

!

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

ip address dhcp

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1

router-id 4.4.4.4

network 10.3.0.0 0.0.0.255 area 0

network 192.168.4.0 0.0.0.255 area 0

!

ipv6 router ospf 1

router-id 4.4.4.4

!

End

R4>show ip route

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, 6 subnets, 2 masks

O IA 10.1.0.0/24 [110/3] via 10.3.0.1, 02:00:20, GigabitEthernet0/0/1

O 10.2.0.0/24 [110/2] via 10.3.0.1, 02:00:20, GigabitEthernet0/0/1

C 10.3.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.3.0.2/32 is directly connected, GigabitEthernet0/0/1

O 10.4.0.0/24 [110/2] via 10.3.0.1, 01:59:58, GigabitEthernet0/0/1

O IA 10.5.0.0/24 [110/3] via 10.3.0.1, 00:04:32, GigabitEthernet0/0/1

192.168.1.0/32 is subnetted, 1 subnets

O 192.168.1.1 [110/4] via 10.3.0.1, 02:00:10, GigabitEthernet0/0/1

192.168.2.0/32 is subnetted, 1 subnets

O 192.168.2.1 [110/3] via 10.3.0.1, 02:00:20, GigabitEthernet0/0/1

192.168.3.0/32 is subnetted, 1 subnets

O 192.168.3.1 [110/2] via 10.3.0.1, 02:00:20, GigabitEthernet0/0/1

192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.4.0/24 is directly connected, Loopback0

L 192.168.4.1/32 is directly connected, Loopback0

192.168.5.0/32 is subnetted, 1 subnets

O 192.168.5.1 [110/3] via 10.3.0.1, 01:59:48, GigabitEthernet0/0/1

R4>show ipv6 route

IPv6 Routing Table - default - 14 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2

IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external

ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, a - Application

C 10::/64 [0/0]

via Loopback0, directly connected

OI 10::1:1/128 [110/3]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

O 10::2:1/128 [110/2]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

O 10::3:1/128 [110/1]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

L 10::4:1/128 [0/0]

via Loopback0, receive

O 10::5:1/128 [110/2]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

OI 10::6:1/128 [110/3]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

OI 10:1::/64 [110/3]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

O 10:2::/64 [110/2]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

C 10:3::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 10:3::2/128 [0/0]

via GigabitEthernet0/0/1, receive

O 10:4::/64 [110/2]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

OI 10:5::/64 [110/3]

via FE80::227:90FF:FED4:F30, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

R5

Current configuration : 1782 bytes

!

! Last configuration change at 16:29:01 UTC Wed Sep 22 2021

!

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

!

hostname R5

!

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

!

no ip domain lookup

!

ipv6 unicast-routing

!

license udi pid ISR4321/K9 sn FDO214421CH

!

interface Loopback0

ip address 192.168.5.1 255.255.255.0

ipv6 address 10::5:1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/0

ip address 10.4.0.2 255.255.255.0

negotiation auto

ipv6 address 10:4::2/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/1

ip address 10.5.0.2 255.255.255.0

negotiation auto

ipv6 address 10:5::2/64

ipv6 ospf 1 area 20

!

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

ip address dhcp

negotiation auto

!

interface Vlan1

no ip address

shutdown

!

router ospf 1

router-id 5.5.5.5

area 20 virtual-link 6.6.6.6

network 10.4.0.0 0.0.0.255 area 0

network 10.5.0.0 0.0.0.255 area 20

network 192.168.5.0 0.0.0.255 area 0

!

ipv6 router ospf 1

router-id 5.5.5.5

!

end

R5>show ip route

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, 7 subnets, 2 masks

O IA 10.1.0.0/24 [110/3] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

O 10.2.0.0/24 [110/2] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

O 10.3.0.0/24 [110/2] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

C 10.4.0.0/24 is directly connected, GigabitEthernet0/0/0

L 10.4.0.2/32 is directly connected, GigabitEthernet0/0/0

C 10.5.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.5.0.2/32 is directly connected, GigabitEthernet0/0/1

192.168.1.0/32 is subnetted, 1 subnets

O 192.168.1.1 [110/4] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

192.168.2.0/32 is subnetted, 1 subnets

O 192.168.2.1 [110/3] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

192.168.3.0/32 is subnetted, 1 subnets

O 192.168.3.1 [110/2] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

192.168.4.0/32 is subnetted, 1 subnets

O 192.168.4.1 [110/3] via 10.4.0.1, 00:02:15, GigabitEthernet0/0/0

192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.5.0/24 is directly connected, Loopback0

L 192.168.5.1/32 is directly connected, Loopback0

R5>show ipv6 route

IPv6 Routing Table - default - 15 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2

IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external

ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, a - Application

C 10::/64 [0/0]

via Loopback0, directly connected

OI 10::1:1/128 [110/3]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

O 10::2:1/128 [110/2]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

O 10::3:1/128 [110/1]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

O 10::4:1/128 [110/2]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

L 10::5:1/128 [0/0]

via Loopback0, receive

O 10::6:1/128 [110/1]

via FE80::B6A8:B9FF:FE47:96B1, GigabitEthernet0/0/1

OI 10:1::/64 [110/3]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

O 10:2::/64 [110/2]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

O 10:3::/64 [110/2]

via FE80::227:90FF:FED4:F40, GigabitEthernet0/0/0

C 10:4::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 10:4::2/128 [0/0]

via GigabitEthernet0/0/0, receive

C 10:5::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 10:5::2/128 [0/0]

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

R6

Current configuration : 1589 bytes

!

! Last configuration change at 14:46:05 UTC Thu Sep 23 2021

!

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

!

hostname R6

!

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

!

no ip domain lookup

!

ipv6 unicast-routing

!

license udi pid ISR4321/K9 sn FDO214414VU

!

interface Loopback0

ip address 192.168.1.6 255.255.255.0

ipv6 address 10::6:1/64

ipv6 ospf 1 area 0

!

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

!

interface GigabitEthernet0/0/1

ip address 10.5.0.1 255.255.255.0

negotiation auto

ipv6 address 10:5::1/64

ipv6 ospf 1 area 20

!

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

!

interface Vlan1

no ip address

!

router ospf 1

router-id 6.6.6.6

area 20 virtual-link 5.5.5.5

network 10.5.0.0 0.0.0.255 area 20

network 192.168.10.0 0.0.0.255 area 0

!

ipv6 router ospf 1

router-id 6.6.6.6

!

end

R6>show ip route

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, 6 subnets, 2 masks

O IA 10.1.0.0/24 [110/4] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

O IA 10.2.0.0/24 [110/3] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

O IA 10.3.0.0/24 [110/3] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

O IA 10.4.0.0/24 [110/2] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

C 10.5.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.5.0.1/32 is directly connected, GigabitEthernet0/0/1

192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks

C 192.168.1.0/24 is directly connected, Loopback0

O IA 192.168.1.1/32 [110/5] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

L 192.168.1.6/32 is directly connected, Loopback0

192.168.2.0/32 is subnetted, 1 subnets

O IA 192.168.2.1 [110/4] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

192.168.3.0/32 is subnetted, 1 subnets

O IA 192.168.3.1 [110/3] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

192.168.4.0/32 is subnetted, 1 subnets

O IA 192.168.4.1 [110/4] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

192.168.5.0/32 is subnetted, 1 subnets

O IA 192.168.5.1 [110/2] via 10.5.0.2, 00:00:18, GigabitEthernet0/0/1

R6>show ipv6 route

IPv6 Routing Table - default - 14 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, R - RIP, I1 - ISIS L1, I2 - ISIS L2

IA - ISIS interarea, IS - ISIS summary, D - EIGRP, EX - EIGRP external

ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2, a - Application

C 10::/64 [0/0]

via Loopback0, directly connected

OI 10::1:1/128 [110/4]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10::2:1/128 [110/3]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10::3:1/128 [110/2]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10::4:1/128 [110/3]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10::5:1/128 [110/1]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

L 10::6:1/128 [0/0]

via Loopback0, receive

OI 10:1::/64 [110/4]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10:2::/64 [110/3]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10:3::/64 [110/3]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

OI 10:4::/64 [110/2]

via FE80::B6A8:B9FF:FE01:B5A1, GigabitEthernet0/0/1

C 10:5::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 10:5::1/128 [0/0]

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

# Problems

For this lab the only problem we had was we confused ourselves with /30 networks, we solved this by changing all our IPv4 networks to /24. Another problem we faced was that IPv6 OSPF does not like having area 0 partitioned which caused out loopback interfaces to not respond to pings. We fixed this by taking the loopback interfaces out of area 0 and placing them into areas respective to the rest of the router.

# Conclusion

In summary we developed IPv4 and IPv6 addressing schemes, configured OSPFv2 and OSPFv3, create an IP addressing scheme, and troubleshoot backbone issues. All of this was done to allow the routers to communicate with each other with the ability for easy expansion.

