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Configuring OSPFv3

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*Author*:

Gabriel Rosas



Purpose

The purpose of this lab was to set up multi area OSPFv3 across five Cisco catalyst 4321 routers. Three of the routers are in area 0, and two are in area 1. We had to figure out how to configure OSPFv3 with our general knowledge on OSPFv2, allowing IPv6 connectivity across all the networks.

Background Information

Routing is a significant process in networking, as it allows hosts on different IP networks to connect to each other. **OSPF** is a protocol simplifying the process of creating routes by using algorithms to figure out the routes automatically. In networking, **routes** are ultimately just **directions** for packets.

OSPF (Open Shortest Path First) is a routing protocol used in large enterprise networks due to its redundancy and efficiency. What makes OSPF so redundant is its ability to calculate backup routes if routers go down- in other words, there will always be a path allowing traffic to flow through a network. What makes OSPF so efficient is the time it takes to set up compared to manually configuring static routes.

In networking, there are two options when dealing with traffic on a network; you can configure static routes, or you can set up a routing protocol. I like to think of static routes as absolute directions drawn onto a map, perhaps going through a forest. The directions are set in stone; the directions can’t be altered unless they are manually redrawn. Let’s suppose you are following those directions by carriage through a forest but get stuck because there is a fallen tree or a broken bridge across a river. You are now lost and there is nowhere else to go. In this case, you, the packet, would get dropped. But now you’re in the same situation except this time a magical wizard constantly redraws the map to show new directions when older ones become unusable. Thus, is the magic of routing protocols- basically just google maps for packets. Ironically, both google maps and OSPF use the same algorithm for finding the best path, Dijkstra’s Algorithm.

Since we’ve defined what routing protocols are, I can go into more detail on how OSPF functions. Each router is like a junction for packets; packets usually have multiple roads they can turn down to reach further junctions, ultimately ending at their destination. Each router communicates with their neighboring routers to relay statuses and updates about themselves. If each router passes information about themselves and their neighbors to every other router, eventually all the routers will have complete knowledge of every direction to and from each other. In networking, having a table of directions to each destination is known as a routing table. All routers gain these directions by broadcasting their information to their neighbors. Via this process of broadcasting information, routers can get updates on what routes may or may not be viable to determine the best path from source to destination. These packets OSPF broadcasts to relay such information are known as **link-state advertisements** (LSAs). For more information regarding LSAs, check out “*LSA Background Information*”.

OSPF configured routers rely on **cost** to commute the shortest path through a network. While you can set the cost manually, OSPF will automatically determine the cost value per interface based on **reference bandwidth**, usually the bandwidth of the fastest interface in your network, and **interface bandwidth,** the bandwidth of the particular interface being assessed.

There are two OSPF protocols that can be configured on a router: OSPFv2 and OSPFv3, the main difference being **OSPFv2** incorporates **IPv4** and **OSPFv3** incorporates **IPv6**. OSPFv3 has nine link-state advertisements. LSAs are used to communicate different states and information of an OSPF router, such as a neighbor’s local topology, in order to build the **routing table**. Although there are other routing protocols such as RIP or EIGRP, OSPF is massively adopted in large enterprise networks as there are many benefits it brings, like route redundancy, at the cost of more advanced networking knowledge.

Lab Summary

In this lab, I set up multi area OSPFv2 and OSPFv3 across five Cisco catalyst 4321 routers. Three of the five routers were in area 0, and the other two were in area 1; connected by serial ports and each with their own gigabit ethernet subnetwork. I began by constructing a topology and then building an IP scheme. After allocating all my IPv4 and IPv6 addresses to their corresponding PC’s and routers, I tested connectivity. The pings from each PC could reach their corresponding routers in both IPv4 and IPv6 but could not extend outside the serial links. This is where OSPF comes into play. I configured each active interface on every router, enabling OSPFv2 and OSPFv3 in the correct areas. OSPFv3 is similar in configuration to OSPFv2, except you activate OSPFv3 whilst in interface configuration mode instead of using network statements in router configuration mode. Now my packets could traverse the network to their heart’s content.

Lab commands

|  |  |
| --- | --- |
| **CLI statement** | A statement necessary for a configuration to work, denoted in bold |
| **[*Argument*]** | An argument necessary for a command to function, denoted in bold italics. |
| *<Optional Argument>* | An optional argument, not necessary for a command to function, denoted in italics |

Router(config)# **interface [*interface*] [*id*]**

* Enables configuration on a specific interface.

Router(config)# **ipv6 router ospf [*process id*]**

* Enables configuration for OSPFv3.

It is good practice for the process ID to be the same, however isn’t necessary for OSPF to form adjacencies; process ID is only locally significant. Each OSPF process retains a different routing table, so depending on the configuration, process ID could determine what routes are redistributed. A router can have multiple OSPF processes but will contain a separate OSPF database per process.

Router(config-if)# **ipv6 ospf [*process id*] area [*number*]**

* Activates OSPFv3 under a specific interface.

This command is typed when in interface configuration mode. It is good practice for the process ID to be the same, however isn’t necessary for OSPF to form adjacencies; process ID is only locally significant. Each OSPF process retains a different routing table, so depending on the configuration, process ID could determine what routes are redistributed. A router can have multiple OSPF processes but will contain a separate OSPF database per process. Routers in a particular area share a complete topological database and have route summaries of external areas.

Router# **show ipv6 ospf database**

* Displays the routing database.

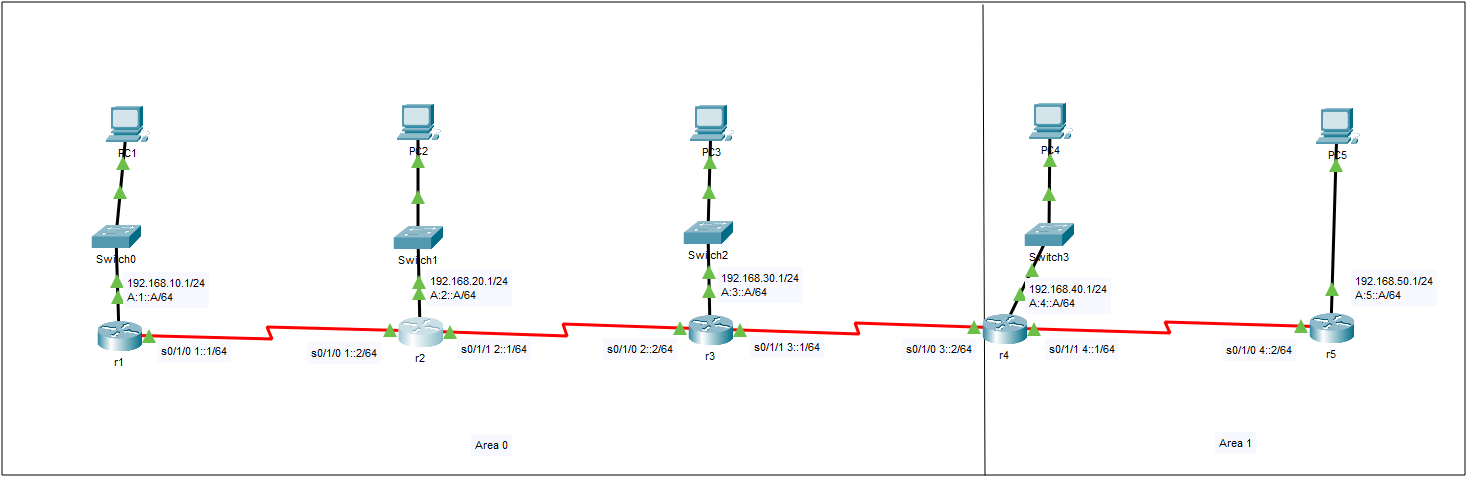
Router# **show ipv6 ospf neighbor**

* Displays information about adjacent routers configured with OSPF.

Router# **show ipv6 ospf interface**

* Displays information about each interface configured with OSPF.

Network Diagram



|  |  |  |
| --- | --- | --- |
| **PC** | **IPv4 address** | **IPv6 address** |
| 1 | 192.168.10.10/24 | A:1::1/64 |
| 2 | 192.168.20.20/24 | A:2::1/64 |
| 3 | 192.168.30.30/24 | A:3::1/64 |
| 4 | 192.168.40.40/24 | A:4::1/64 |
| 5 | 192.168.50.50/24 | A:5::1/64 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Router** | **Interface** | **IPv4 Address** | **IPv6 Global Address** | **IPv6 Link-Local Address** |
| 1 | |  | | --- | | G0/0/0 | | S0/1/0 | | |  | | --- | | 192.168.10.1/24 | | 10.10.10.1/30 | | |  | | --- | | A:1::A/64 | | 1::1 | | |  | | --- | | FE80::1 | | FE80::1 | |
| 2 | |  | | --- | | G0/0/0 | | S0/1/0 | | S0/1/1 | | |  | | --- | | 192.168.20.1/24 | | 10.10.10.2/30 | | 10.10.10.5/30 | | |  | | --- | | A:2::A/64 | | 1::2 | | 2::1 | | |  | | --- | | FE80::1 | | FE80::2 | | FE80::1 | |
| 3 | |  | | --- | | G0/0/0 | | S0/1/0 | | S0/1/1 | | |  | | --- | | 192.168.30.1/24 | | 10.10.10.6/30 | | 10.10.10.9/30 | | |  | | --- | | A:3::A/64 | | 2::2 | | 3::1 | | |  | | --- | | FE80::1 | | FE80::2 | | FE80::1 | |
| 4 | |  | | --- | | G0/0/0 | | S0/1/0 | | S0/1/1 | | |  | | --- | | 192.168.40.1/24 | | 10.10.10.10/30 | | 10.10.10.13/30 | | |  | | --- | | A:4::A/64 | | 3::2 | | 4::1 | | |  | | --- | | FE80::1 | | FE80::2 | | FE80::1 | |
| 5 | |  | | --- | | G0/0/0 | | S0/1/0 | | |  | | --- | | 192.168.50.1/24 | | 10.10.10.14/30 | | |  | | --- | | A:5::A/64 | | 4::2 | | |  | | --- | | FE80::1 | | FE80::2 | |

Configurations

Router 1

**r1#show run**

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname r1

no ip cef

ipv6 unicast-routing

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 192.168.10.1 255.255.255.0

duplex auto

speed auto

ipv6 address FE80::1 link-local

ipv6 address A:1::A/64

ipv6 ospf 10 area 0

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 10.10.10.1 255.255.255.252

ipv6 address FE80::1 link-local

ipv6 address 1::1/64

ipv6 ospf 10 area 0

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router ospf 10

router-id 1.1.1.1

log-adjacency-changes

network 192.168.10.0 0.0.0.255 area 0

network 10.10.10.0 0.0.0.3 area 0

ipv6 router ospf 10

log-adjacency-changes

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

**r1#show ipv6 route**

IPv6 Routing Table - 12 entries

Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP

U - Per-user Static route, M - MIPv6

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

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

D - EIGRP, EX - EIGRP external

C 1::/64 [0/0]

via Serial0/1/0, directly connected

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

via Serial0/1/0, receive

O 2::/64 [110/128]

via FE80::2, Serial0/1/0

O 3::/64 [110/192]

via FE80::2, Serial0/1/0

OI 4::/64 [110/256]

via FE80::2, Serial0/1/0

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

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

O A:2::/64 [110/65]

via FE80::2, Serial0/1/0

O A:3::/64 [110/129]

via FE80::2, Serial0/1/0

OI A:4::/64 [110/193]

via FE80::2, Serial0/1/0

OI A:5::/64 [110/257]

via FE80::2, Serial0/1/0

L FF00::/8 [0/0]

via Null0, receive

**r1#show ipv6 ospf int**

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

Link Local Address FE80::1, Interface ID 1

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.10.1

Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 192.168.10.1, local address FE80::1

No backup designated router on this network

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

Hello due in 00:00:08

Index 1/1, flood queue length 0

Next 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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Link Local Address FE80::1, Interface ID 3

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.10.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:08

Index 2/2, flood queue length 0

Next 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 192.168.20.1

Suppress hello for 0 neighbor(s)

**r1#show ipv6 ospf neighbor**

Neighbor ID Pri State Dead Time Interface ID Interface

192.168.20.1 0 FULL/ - 00:00:31 3 Serial0/1/0

**r1#show ipv6 ospf database**

OSPF Router with ID (192.168.10.1) (Process ID 10)

Router Link States (Area 0)

ADV Router Age Seq# Fragment ID Link count Bits

192.168.10.1 765 0x80000003 0 1

192.168.20.1 766 0x80000004 0 2

192.168.40.1 765 0x80000003 0 1 B

192.168.30.1 764 0x80000004 0 2

Inter Area Prefix Link States (Area 0)

ADV Router Age Seq# Metric Prefix

192.168.40.1 761 0x80000004 1 A:4::/64

192.168.40.1 761 0x80000005 64 4::/64

192.168.40.1 752 0x80000006 65 A:5::/64

Link (Type-8) Link States (Area 0)

ADV Router Age Seq# Link ID Interface

192.168.10.1 774 0x80000004 1 Gi0/0/0

192.168.10.1 766 0x80000005 3 Se0/1/0

192.168.20.1 766 0x80000008 3 Se0/1/0

Intra Area Prefix Link States (Area 0)

ADV Router Age Seq# Link ID Ref-lstype Ref-LSID

192.168.10.1 774 0x80000003 2 0x2001 0

192.168.40.1 775 0x80000002 2 0x2001 0

192.168.30.1 767 0x80000004 2 0x2001 0

192.168.20.1 767 0x80000004 2 0x2001 0

Router 2

**r2#show run**

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname r2

no ip cef

ipv6 unicast-routing

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 192.168.20.1 255.255.255.0

duplex auto

speed auto

ipv6 address FE80::1 link-local

ipv6 address A:2::A/64

ipv6 ospf 10 area 0

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 10.10.10.2 255.255.255.252

ipv6 address FE80::2 link-local

ipv6 address 1::2/64

ipv6 ospf 10 area 0

clock rate 2000000

interface Serial0/1/1

ip address 10.10.10.5 255.255.255.252

ipv6 address FE80::1 link-local

ipv6 address 2::1/64

ipv6 ospf 10 area 0

interface Vlan1

no ip address

shutdown

router ospf 10

router-id 2.2.2.2

log-adjacency-changes

network 192.168.20.0 0.0.0.255 area 0

network 10.10.10.0 0.0.0.3 area 0

network 10.10.10.4 0.0.0.3 area 0

ipv6 router ospf 10

log-adjacency-changes

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

**r2#show ipv6 route**

IPv6 Routing Table - 13 entries

Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP

U - Per-user Static route, M - MIPv6

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

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

D - EIGRP, EX - EIGRP external

C 1::/64 [0/0]

via Serial0/1/0, directly connected

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

via Serial0/1/0, receive

C 2::/64 [0/0]

via Serial0/1/1, directly connected

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

via Serial0/1/1, receive

O 3::/64 [110/128]

via FE80::2, Serial0/1/1

OI 4::/64 [110/192]

via FE80::2, Serial0/1/1

O A:1::/64 [110/65]

via FE80::1, Serial0/1/0

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

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

O A:3::/64 [110/65]

via FE80::2, Serial0/1/1

OI A:4::/64 [110/129]

via FE80::2, Serial0/1/1

OI A:5::/64 [110/193]

via FE80::2, Serial0/1/1

L FF00::/8 [0/0]

via Null0, receive

**r2#show ipv6 ospf interface**

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

Link Local Address FE80::1, Interface ID 1

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.20.1

Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 192.168.20.1, local address FE80::1

No backup designated router on this network

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

Hello due in 00:00:02

Index 1/1, flood queue length 0

Next 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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Serial0/1/1 is up, line protocol is up

Link Local Address FE80::1, Interface ID 4

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.20.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:02

Index 2/2, flood queue length 0

Next 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 192.168.30.1

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Link Local Address FE80::2, Interface ID 3

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.20.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:01

Index 3/3, flood queue length 0

Next 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 192.168.10.1

Suppress hello for 0 neighbor(s)

**r2#show ipv6 ospf neighbor**

Neighbor ID Pri State Dead Time Interface ID Interface

192.168.10.1 0 FULL/ - 00:00:35 3 Serial0/1/0

192.168.30.1 0 FULL/ - 00:00:33 3 Serial0/1/1

**r2#show ipv6 ospf database**

OSPF Router with ID (192.168.20.1) (Process ID 10)

Router Link States (Area 0)

ADV Router Age Seq# Fragment ID Link count Bits

192.168.20.1 836 0x80000004 0 2

192.168.10.1 836 0x80000003 0 1

192.168.40.1 836 0x80000003 0 1 B

192.168.30.1 835 0x80000004 0 2

Inter Area Prefix Link States (Area 0)

ADV Router Age Seq# Metric Prefix

192.168.40.1 832 0x80000004 1 A:4::/64

192.168.40.1 832 0x80000005 64 4::/64

192.168.40.1 822 0x80000006 65 A:5::/64

Link (Type-8) Link States (Area 0)

ADV Router Age Seq# Link ID Interface

192.168.20.1 845 0x80000006 1 Gi0/0/0

192.168.20.1 838 0x80000007 4 Se0/1/1

192.168.20.1 836 0x80000008 3 Se0/1/0

192.168.10.1 837 0x80000005 3 Se0/1/0

192.168.30.1 836 0x80000007 3 Se0/1/1

Intra Area Prefix Link States (Area 0)

ADV Router Age Seq# Link ID Ref-lstype Ref-LSID

192.168.20.1 837 0x80000004 2 0x2001 0

192.168.40.1 846 0x80000002 2 0x2001 0

192.168.10.1 845 0x80000003 2 0x2001 0

192.168.30.1 838 0x80000004 2 0x2001 0

Router 3

**r3#show run**

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname r3

no ip cef

ipv6 unicast-routing

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 192.168.30.1 255.255.255.0

duplex auto

speed auto

ipv6 address FE80::1 link-local

ipv6 address A:3::A/64

ipv6 ospf 10 area 0

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 10.10.10.6 255.255.255.252

ipv6 address FE80::2 link-local

ipv6 address 2::2/64

ipv6 ospf 10 area 0

clock rate 2000000

interface Serial0/1/1

ip address 10.10.10.9 255.255.255.252

ipv6 address FE80::1 link-local

ipv6 address 3::1/64

ipv6 ospf 10 area 0

interface Vlan1

no ip address

shutdown

router ospf 10

router-id 3.3.3.3

log-adjacency-changes

network 192.168.30.0 0.0.0.255 area 0

network 10.10.10.4 0.0.0.3 area 0

network 10.10.10.8 0.0.0.3 area 0

ipv6 router ospf 10

log-adjacency-changes

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

**r3#show ipv6 route**

IPv6 Routing Table - 13 entries

Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP

U - Per-user Static route, M - MIPv6

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

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

D - EIGRP, EX - EIGRP external

O 1::/64 [110/128]

via FE80::1, Serial0/1/0

C 2::/64 [0/0]

via Serial0/1/0, directly connected

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

via Serial0/1/0, receive

C 3::/64 [0/0]

via Serial0/1/1, directly connected

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

via Serial0/1/1, receive

OI 4::/64 [110/128]

via FE80::2, Serial0/1/1

O A:1::/64 [110/129]

via FE80::1, Serial0/1/0

O A:2::/64 [110/65]

via FE80::1, Serial0/1/0

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

via GigabitEthernet0/0/0, directly connected

L A:3::A/128 [0/0]

via GigabitEthernet0/0/0, receive

OI A:4::/64 [110/65]

via FE80::2, Serial0/1/1

OI A:5::/64 [110/129]

via FE80::2, Serial0/1/1

L FF00::/8 [0/0]

via Null0, receive

**r3#show ipv6 ospf interface**

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

Link Local Address FE80::1, Interface ID 1

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.30.1

Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 192.168.30.1, local address FE80::1

No backup designated router on this network

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

Hello due in 00:00:04

Index 1/1, flood queue length 0

Next 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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Serial0/1/1 is up, line protocol is up

Link Local Address FE80::1, Interface ID 4

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.30.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:00

Index 2/2, flood queue length 0

Next 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 192.168.40.1

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Link Local Address FE80::2, Interface ID 3

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.30.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:02

Index 3/3, flood queue length 0

Next 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 192.168.20.1

Suppress hello for 0 neighbor(s)

**r3#show ipv6 ospf neighbor**

Neighbor ID Pri State Dead Time Interface ID Interface

192.168.20.1 0 FULL/ - 00:00:38 4 Serial0/1/0

192.168.40.1 0 FULL/ - 00:00:38 3 Serial0/1/1

**r3#show ipv6 ospf database**

OSPF Router with ID (192.168.30.1) (Process ID 10)

Router Link States (Area 0)

ADV Router Age Seq# Fragment ID Link count Bits

192.168.30.1 889 0x80000004 0 2

192.168.20.1 891 0x80000004 0 2

192.168.10.1 891 0x80000003 0 1

192.168.40.1 891 0x80000003 0 1 B

Inter Area Prefix Link States (Area 0)

ADV Router Age Seq# Metric Prefix

192.168.40.1 887 0x80000004 1 A:4::/64

192.168.40.1 886 0x80000005 64 4::/64

192.168.40.1 876 0x80000006 65 A:5::/64

Link (Type-8) Link States (Area 0)

ADV Router Age Seq# Link ID Interface

192.168.30.1 899 0x80000006 1 Gi0/0/0

192.168.30.1 890 0x80000007 3 Se0/1/0

192.168.30.1 890 0x80000008 4 Se0/1/1

192.168.40.1 896 0x80000003 3 Se0/1/1

192.168.20.1 893 0x80000007 4 Se0/1/0

Intra Area Prefix Link States (Area 0)

ADV Router Age Seq# Link ID Ref-lstype Ref-LSID

192.168.30.1 892 0x80000004 2 0x2001 0

192.168.40.1 900 0x80000002 2 0x2001 0

192.168.10.1 900 0x80000003 2 0x2001 0

192.168.20.1 892 0x80000004 2 0x2001 0

Router 4

**r4#show run**

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname r4

no ip cef

ipv6 unicast-routing

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 192.168.40.1 255.255.255.0

ip ospf 10 area 1

duplex auto

speed auto

ipv6 address FE80::1 link-local

ipv6 address A:4::A/64

ipv6 ospf 10 area 1

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 10.10.10.10 255.255.255.252

ip ospf 10 area 0

ipv6 address FE80::2 link-local

ipv6 address 3::2/64

ipv6 ospf 10 area 0

clock rate 2000000

interface Serial0/1/1

ip address 10.10.10.13 255.255.255.252

ip ospf 10 area 1

ipv6 address FE80::1 link-local

ipv6 address 4::1/64

ipv6 ospf 10 area 1

interface Vlan1

no ip address

shutdown

router ospf 10

router-id 4.4.4.4

log-adjacency-changes

ipv6 router ospf 10

log-adjacency-changes

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

**r4#show ipv6 route**

IPv6 Routing Table - 13 entries

Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP

U - Per-user Static route, M - MIPv6

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

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

D - EIGRP, EX - EIGRP external

O 1::/64 [110/192]

via FE80::1, Serial0/1/0

O 2::/64 [110/128]

via FE80::1, Serial0/1/0

C 3::/64 [0/0]

via Serial0/1/0, directly connected

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

via Serial0/1/0, receive

C 4::/64 [0/0]

via Serial0/1/1, directly connected

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

via Serial0/1/1, receive

O A:1::/64 [110/193]

via FE80::1, Serial0/1/0

O A:2::/64 [110/129]

via FE80::1, Serial0/1/0

O A:3::/64 [110/65]

via FE80::1, Serial0/1/0

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

via GigabitEthernet0/0/0, directly connected

L A:4::A/128 [0/0]

via GigabitEthernet0/0/0, receive

O A:5::/64 [110/65]

via FE80::2, Serial0/1/1

L FF00::/8 [0/0]

via Null0, receive

**r4#show ipv6 ospf interface**

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

Link Local Address FE80::1, Interface ID 1

Area 1, Process ID 10, Instance ID 0, Router ID 192.168.40.1

Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 192.168.40.1, local address FE80::1

No backup designated router on this network

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

Hello due in 00:00:06

Index 1/1, flood queue length 0

Next 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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Serial0/1/1 is up, line protocol is up

Link Local Address FE80::1, Interface ID 4

Area 1, Process ID 10, Instance ID 0, Router ID 192.168.40.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:06

Index 2/2, flood queue length 0

Next 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 192.168.50.1

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Link Local Address FE80::2, Interface ID 3

Area 0, Process ID 10, Instance ID 0, Router ID 192.168.40.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:06

Index 3/3, flood queue length 0

Next 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 192.168.30.1

Suppress hello for 0 neighbor(s)

**r4#show ipv6 ospf neighbor**

Neighbor ID Pri State Dead Time Interface ID Interface

192.168.50.1 0 FULL/ - 00:00:37 3 Serial0/1/1

192.168.30.1 0 FULL/ - 00:00:36 4 Serial0/1/0

**r4#show ipv6 ospf database**

OSPF Router with ID (192.168.40.1) (Process ID 10)

Router Link States (Area 1)

ADV Router Age Seq# Fragment ID Link count Bits

192.168.40.1 961 0x80000003 0 1 B

192.168.50.1 960 0x80000003 0 1

Inter Area Prefix Link States (Area 1)

ADV Router Age Seq# Metric Prefix

192.168.40.1 966 0x80000007 64 3::/64

192.168.40.1 946 0x80000008 129 A:2::/64

192.168.40.1 946 0x80000009 192 1::/64

192.168.40.1 946 0x8000000a 65 A:3::/64

192.168.40.1 946 0x8000000b 128 2::/64

192.168.40.1 946 0x8000000c 193 A:1::/64

Link (Type-8) Link States (Area 1)

ADV Router Age Seq# Link ID Interface

192.168.40.1 970 0x80000004 1 Gi0/0/0

192.168.40.1 964 0x80000005 4 Se0/1/1

192.168.50.1 961 0x80000005 3 Se0/1/1

Intra Area Prefix Link States (Area 1)

ADV Router Age Seq# Link ID Ref-lstype Ref-LSID

192.168.40.1 970 0x80000003 2 0x2001 0

192.168.50.1 964 0x80000003 2 0x2001 0

OSPF Router with ID (192.168.40.1) (Process ID 10)

Router Link States (Area 0)

ADV Router Age Seq# Fragment ID Link count Bits

192.168.40.1 960 0x80000003 0 1 B

192.168.20.1 961 0x80000004 0 2

192.168.10.1 960 0x80000003 0 1

192.168.30.1 959 0x80000004 0 2

Inter Area Prefix Link States (Area 0)

ADV Router Age Seq# Metric Prefix

192.168.40.1 956 0x80000004 1 A:4::/64

192.168.40.1 956 0x80000005 64 4::/64

192.168.40.1 946 0x80000006 65 A:5::/64

Link (Type-8) Link States (Area 0)

ADV Router Age Seq# Link ID Interface

192.168.40.1 965 0x80000003 3 Se0/1/0

192.168.30.1 960 0x80000008 4 Se0/1/0

Intra Area Prefix Link States (Area 0)

ADV Router Age Seq# Link ID Ref-lstype Ref-LSID

192.168.40.1 970 0x80000002 2 0x2001 0

192.168.10.1 969 0x80000003 2 0x2001 0

192.168.30.1 962 0x80000004 2 0x2001 0

192.168.20.1 962 0x80000004 2 0x2001 0

Router 5

**r5#show run**

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname r5

no ip cef

ipv6 unicast-routing

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

ip address 192.168.50.1 255.255.255.0

ip ospf 10 area 1

duplex auto

speed auto

ipv6 address FE80::1 link-local

ipv6 address A:5::A/64

ipv6 ospf 10 area 1

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 10.10.10.14 255.255.255.252

ip ospf 10 area 1

ipv6 address FE80::2 link-local

ipv6 address 4::2/64

ipv6 ospf 10 area 1

clock rate 2000000

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router ospf 10

router-id 5.5.5.5

log-adjacency-changes

ipv6 router ospf 10

log-adjacency-changes

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

**r5#show ipv6 route**

IPv6 Routing Table - 12 entries

Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP

U - Per-user Static route, M - MIPv6

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

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

D - EIGRP, EX - EIGRP external

OI 1::/64 [110/256]

via FE80::1, Serial0/1/0

OI 2::/64 [110/192]

via FE80::1, Serial0/1/0

OI 3::/64 [110/128]

via FE80::1, Serial0/1/0

C 4::/64 [0/0]

via Serial0/1/0, directly connected

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

via Serial0/1/0, receive

OI A:1::/64 [110/257]

via FE80::1, Serial0/1/0

OI A:2::/64 [110/193]

via FE80::1, Serial0/1/0

OI A:3::/64 [110/129]

via FE80::1, Serial0/1/0

O A:4::/64 [110/65]

via FE80::1, Serial0/1/0

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

via GigabitEthernet0/0/0, directly connected

L A:5::A/128 [0/0]

via GigabitEthernet0/0/0, receive

L FF00::/8 [0/0]

via Null0, receive

**r5#show ipv6 ospf interface**

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

Link Local Address FE80::1, Interface ID 1

Area 1, Process ID 10, Instance ID 0, Router ID 192.168.50.1

Network Type BROADCAST, Cost: 1

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 192.168.50.1, local address FE80::1

No backup designated router on this network

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

Hello due in 00:00:00

Index 1/1, flood queue length 0

Next 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 0, Adjacent neighbor count is 0

Suppress hello for 0 neighbor(s)

Serial0/1/0 is up, line protocol is up

Link Local Address FE80::2, Interface ID 3

Area 1, Process ID 10, Instance ID 0, Router ID 192.168.50.1

Network Type POINT-TO-POINT, Cost: 64

Transmit Delay is 1 sec, State POINT-TO-POINT,

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

Hello due in 00:00:07

Index 2/2, flood queue length 0

Next 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 192.168.40.1

Suppress hello for 0 neighbor(s)

**r5#show ipv6 ospf neighbor**

Neighbor ID Pri State Dead Time Interface ID Interface

192.168.40.1 0 FULL/ - 00:00:35 4 Serial0/1/0

**r5#show ipv6 ospf database**

OSPF Router with ID (192.168.50.1) (Process ID 10)

Router Link States (Area 1)

ADV Router Age Seq# Fragment ID Link count Bits

192.168.50.1 1020 0x80000003 0 1

192.168.40.1 1022 0x80000003 0 1 B

Inter Area Prefix Link States (Area 1)

ADV Router Age Seq# Metric Prefix

192.168.40.1 1027 0x80000007 64 3::/64

192.168.40.1 1006 0x80000008 129 A:2::/64

192.168.40.1 1006 0x80000009 192 1::/64

192.168.40.1 1006 0x8000000a 65 A:3::/64

192.168.40.1 1006 0x8000000b 128 2::/64

192.168.40.1 1006 0x8000000c 193 A:1::/64

Link (Type-8) Link States (Area 1)

ADV Router Age Seq# Link ID Interface

192.168.50.1 1030 0x80000004 1 Gi0/0/0

192.168.50.1 1021 0x80000005 3 Se0/1/0

192.168.40.1 1024 0x80000005 4 Se0/1/0

Intra Area Prefix Link States (Area 1)

ADV Router Age Seq# Link ID Ref-lstype Ref-LSID

192.168.50.1 1024 0x80000003 2 0x2001 0

192.168.40.1 1030 0x80000003 2 0x2001 0

Problems

This lab was very similar to the IPv4 single area OSPF lab which I had completed previously, so I didn’t run into much trouble. However, I ran into an interesting problem where no device could reach router 5 from area 0.

First, I tested whether I could ping router 5 from router 1. I could reach its neighbor, router 4, but couldn’t get beyond that to router 5. Since each of the subnets could reach each other except the one on router 5, I concluded this was probably an issue on router 5’s serial interface. In order to troubleshoot the interface, I went into router 5 to double check the IPs and my OSPFv3 configuration.

After lots of show commands, I noticed router 5’s OSPFv3 process ID didn’t match the other routers. The process ID on router 5 was 1, whereas all the other routers had 10. This was a typo, but I didn’t think it should’ve caused a huge problem either way. Throughout my research, I assumed process ID didn’t have to match for OSPF to function. This isn’t totally wrong; however, with further investigation, I realized each process retains a different routing table. So while connectivity had been established, it was understandable how routes could have messed up. I decided to wipe router 5 clean and start over, matching the processes, which solved the problem.

Conclusion

In this lab, I set up multi area OSPFv2 and OSPFv3 in CISCO packet tracer. Though it was just a simulation, I think I could take this knowledge and configure OSPFv3 on a physical catalyst 4321 router. Being able to configure an IGP is important for networks with multiple subnets and can be used alongside more complicated protocols like iBGP. A takeaway from this lab for me would be to figure out what piece is out of place in your puzzle before you dive into a mad rampage of trial and error.