Diagram

Description automatically generated

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Stubby, Totally Stubby, and NSSA

**Purpose:**

This lab requires students to take nine routers and divide them into five different areas: Stubby, Totally Stubby, Not So Stubby, EIGRP, and backbone so that routers can successfully communicate within and across areas.

**Background Info:**

Each OSPF area has a specific purpose in the network topology to improve efficiency and reduce cost.

In **stub areas**, outgoing information packets move in a single direction, and setting a default route for those external packets prevents the routing table from becoming overwhelmed. Because stub areas are not concerned with external routes, LSAs containing information about them will be blocked (type 5).

**Totally Stubby areas** are even more efficient, as they also set default routes for incoming packets, not only outgoing ones like in stub areas. The only time individual routes are ever used is for packets that are travelling within the Totally Stubby Area.

**Not so stubby areas (NSSA)** also set default routes for outgoing packets, and usually work as an extension of a stub area. They also block type 5 LSAs.

The **backbone area** plays a crucial role as all OSPF areas are directly connected to it. This not only reduces redundant paths, since all traffic between OSPF areas must traverse it, but backbone areas are also capable of connecting the internal network to outside networks/systems like the internet.

Lastly, the **EIGRP area** calculates routes for information packets around the network, much like OSPF. It does this by creating three different information tables: neighbor, topology, and routing. A benefit of EIGRP compared to OSPF are that it has a higher convergence time, since it takes less time to calculate alternative paths. This allows packets to travel faster than they would in an OSPF area. EIGRP also sends only incremental updates, which puts less work and strain on the router and makes routing schemes less complex. However, OSPF is much more compatible with the ring networking topology than EIGRP is.

**Lab Summary:**

For this lab, I started by creating nine different routers and separating them into five different areas: stubby, totally stubby, NSSA, EIGRP, and backbone. After dividing the topology into separate areas, I configured each serial interface with an IP address. Each connection was also assigned a separate 192.168.0.0 subnet to avoid any overlap. Once the IP addressing scheme was set in place, each router was configured with network commands specific to their area type. Border routers were configured differently for the areas each interface was on.

Text

Description automatically generatedGraphical user interface, text

Description automatically generated**Network Diagram:**

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Diagram

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Description automatically generatedText

Description automatically generatedGraphical user interface, text, application

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**Router 0:**

***Show run***

Router#show run

Building configuration...

Current configuration : 821 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.1.1 255.255.255.0

clock rate 2000000

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

area 1 stub

network 192.168.1.0 0.0.0.255 area 1

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is 192.168.1.2 to network 0.0.0.0

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

C 192.168.1.0/24 is directly connected, Serial0/1/0

L 192.168.1.1/32 is directly connected, Serial0/1/0

O IA 192.168.2.0/24 [110/128] via 192.168.1.2, 00:02:20, Serial0/1/0

O IA 192.168.3.0/24 [110/192] via 192.168.1.2, 00:02:20, Serial0/1/0

O IA 192.168.4.0/24 [110/256] via 192.168.1.2, 00:02:20, Serial0/1/0

O IA 192.168.7.0/24 [110/192] via 192.168.1.2, 00:02:20, Serial0/1/0

O IA 192.168.8.0/24 [110/256] via 192.168.1.2, 00:02:20, Serial0/1/0

O\*IA 0.0.0.0/0 [110/65] via 192.168.1.2, 00:02:30, Serial0/1/0

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.2.1 0 FULL/ - 00:00:32 192.168.1.2 Serial0/1/0

***Show IP OSPF interface***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.2.1 0 FULL/ - 00:00:32 192.168.1.2 Serial0/1/0

Router#

Router#show ip ospf interface

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

Internet address is 192.168.1.1/24, Area 1

Process ID 10, Router ID 192.168.1.1, 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 00:00:04

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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.2.1

Suppress hello for 0 neighbor(s)

**Router 1:**

***Show run***

Router#show run

Building configuration...

Current configuration : 852 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.1.2 255.255.255.0

interface Serial0/1/1

ip address 192.168.2.1 255.255.255.0

clock rate 2000000

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

area 1 stub

network 192.168.1.0 0.0.0.255 area 1

network 192.168.2.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

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

C 192.168.1.0/24 is directly connected, Serial0/1/0

L 192.168.1.2/32 is directly connected, Serial0/1/0

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

C 192.168.2.0/24 is directly connected, Serial0/1/1

L 192.168.2.1/32 is directly connected, Serial0/1/1

O 192.168.3.0/24 [110/128] via 192.168.2.2, 00:02:25, Serial0/1/1

O IA 192.168.4.0/24 [110/192] via 192.168.2.2, 00:02:25, Serial0/1/1

O 192.168.7.0/24 [110/128] via 192.168.2.2, 00:02:25, Serial0/1/1

O IA 192.168.8.0/24 [110/192] via 192.168.2.2, 00:02:25, Serial0/1/1

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.1.1 0 FULL/ - 00:00:34 192.168.1.1 Serial0/1/0

192.168.7.1 0 FULL/ - 00:00:34 192.168.2.2 Serial0/1/1

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.1.2/24, Area 1

Process ID 10, Router ID 192.168.2.1, 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 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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.1.1

Suppress hello for 0 neighbor(s)

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

Internet address is 192.168.2.1/24, Area 0

Process ID 10, Router ID 192.168.2.1, 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 00:00:04

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 192.168.7.1

Suppress hello for 0 neighbor(s)

**Router 2:**

***Show run***

Router#show run

Building configuration...

Current configuration : 1028 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.2.2 255.255.255.0

interface Serial0/1/1

ip address 192.168.3.1 255.255.255.0

clock rate 2000000

interface Serial0/2/0

ip address 192.168.7.1 255.255.255.0

clock rate 2000000

interface Serial0/2/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

network 192.168.2.0 0.0.0.255 area 0

network 192.168.3.0 0.0.0.255 area 0

network 192.168.7.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

O IA 192.168.1.0/24 [110/128] via 192.168.2.1, 00:02:25, Serial0/1/0

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

C 192.168.2.0/24 is directly connected, Serial0/1/0

L 192.168.2.2/32 is directly connected, Serial0/1/0

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

C 192.168.3.0/24 is directly connected, Serial0/1/1

L 192.168.3.1/32 is directly connected, Serial0/1/1

O IA 192.168.4.0/24 [110/128] via 192.168.3.2, 00:02:25, Serial0/1/1

192.168.7.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.7.0/24 is directly connected, Serial0/2/0

L 192.168.7.1/32 is directly connected, Serial0/2/0

O IA 192.168.8.0/24 [110/128] via 192.168.7.2, 00:02:25, Serial0/2/0

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.2.1 0 FULL/ - 00:00:34 192.168.2.1 Serial0/1/0

192.168.8.1 0 FULL/ - 00:00:30 192.168.7.2 Serial0/2/0

192.168.4.1 0 FULL/ - 00:00:31 192.168.3.2 Serial0/1/1

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.3.1/24, Area 0

Process ID 10, Router ID 192.168.7.1, 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 00:00:04

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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.4.1

Suppress hello for 0 neighbor(s)

Serial0/2/0 is up, line protocol is up

Internet address is 192.168.7.1/24, Area 0

Process ID 10, Router ID 192.168.7.1, 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 00:00:04

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 192.168.8.1

Suppress hello for 0 neighbor(s)

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

Internet address is 192.168.2.2/24, Area 0

Process ID 10, Router ID 192.168.7.1, 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 00:00:04

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 192.168.2.1

Suppress hello for 0 neighbor(s)

**Router 3:**

***Show run***

Router#show run

Building configuration...

Current configuration : 866 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.3.2 255.255.255.0

interface Serial0/1/1

ip address 192.168.4.1 255.255.255.0

clock rate 2000000

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

area 3 nssa

redistribute rip subnets

network 192.168.4.0 0.0.0.255 area 3

network 192.168.3.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

O IA 192.168.1.0/24 [110/192] via 192.168.3.1, 00:02:15, Serial0/1/0

O 192.168.2.0/24 [110/128] via 192.168.3.1, 00:02:25, Serial0/1/0

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

C 192.168.3.0/24 is directly connected, Serial0/1/0

L 192.168.3.2/32 is directly connected, Serial0/1/0

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

C 192.168.4.0/24 is directly connected, Serial0/1/1

L 192.168.4.1/32 is directly connected, Serial0/1/1

O 192.168.7.0/24 [110/128] via 192.168.3.1, 00:02:25, Serial0/1/0

O IA 192.168.8.0/24 [110/192] via 192.168.3.1, 00:02:15, Serial0/1/0

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.7.1 0 FULL/ - 00:00:34 192.168.3.1 Serial0/1/0

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.4.1/24, Area 3

Process ID 10, Router ID 192.168.4.1, 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 00:00:04

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

Suppress hello for 0 neighbor(s)

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

Internet address is 192.168.3.2/24, Area 0

Process ID 10, Router ID 192.168.4.1, 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 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 192.168.7.1

Suppress hello for 0 neighbor(s)

**Router 4:**

***Show run***

Router#show run

Building configuration...

Current configuration : 890 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.4.2 255.255.255.0

interface Serial0/1/1

ip address 192.168.5.1 255.255.255.0

clock rate 2000000

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

area 3 nssa no-summary

redistribute rip subnets

network 192.168.5.0 0.0.0.255 area 3

network 192.168.4.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

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

C 192.168.4.0/24 is directly connected, Serial0/1/0

L 192.168.4.2/32 is directly connected, Serial0/1/0

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

C 192.168.5.0/24 is directly connected, Serial0/1/1

L 192.168.5.1/32 is directly connected, Serial0/1/1

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.6.1 0 FULL/ - 00:00:34 192.168.5.2 Serial0/1/1

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.5.1/24, Area 3

Process ID 10, Router ID 192.168.5.1, 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 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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.6.1

Suppress hello for 0 neighbor(s)

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

Internet address is 192.168.4.2/24, Area 0

Process ID 10, Router ID 192.168.5.1, 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

Suppress hello for 0 neighbor(s)

**Router 5:**

***Show run***

Router#show run

Building configuration...

Current configuration : 1034 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.5.2 255.255.255.0

interface Serial0/1/1

ip address 192.168.6.1 255.255.255.0

clock rate 2000000

interface Vlan1

no ip address

shutdown

router eigrp 10

redistribute ospf 10 metric 1000 100 255 1 1500

network 192.168.5.0

network 192.168.6.0

router ospf 10

log-adjacency-changes

area 3 nssa no-summary

redistribute rip subnets

redistribute eigrp 10 subnets

network 192.168.5.0 0.0.0.255 area 3

network 192.168.6.0 0.0.0.255 area 4

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is 192.168.5.1 to network 0.0.0.0

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

C 192.168.5.0/24 is directly connected, Serial0/1/0

L 192.168.5.2/32 is directly connected, Serial0/1/0

192.168.6.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.6.0/24 is directly connected, Serial0/1/1

L 192.168.6.1/32 is directly connected, Serial0/1/1

O\*IA 0.0.0.0/0 [110/65] via 192.168.5.1, 00:02:25, Serial0/1/0

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.5.1 0 FULL/ - 00:00:32 192.168.5.1 Serial0/1/0

192.168.6.2 0 FULL/ - 00:00:32 192.168.6.2 Serial0/1/1

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.5.2/24, Area 3

Process ID 10, Router ID 192.168.6.1, 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 00:00:04

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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.5.1

Suppress hello for 0 neighbor(s)

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

Internet address is 192.168.6.1/24, Area 4

Process ID 10, Router ID 192.168.6.1, 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 00:00:04

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 192.168.6.2

Suppress hello for 0 neighbor(s)

**Router 6:**

***Show run***

Router#show run

Building configuration...

Current configuration : 1227 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.6.2 255.255.255.0

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router eigrp 10

redistribute ospf 10 metric 1000 100 255 1 1500

network 192.168.6.0

router eigrp 1

router ospf 10

log-adjacency-changes

redistribute eigrp 1 subnets

redistribute eigrp 10 subnets

network 192.168.6.0 0.0.0.255 area 4

network 192.168.1.0 0.0.0.255 area 1

network 192.168.2.0 0.0.0.255 area 0

network 192.168.3.0 0.0.0.255 area 0

network 192.168.7.0 0.0.0.255 area 0

network 192.168.8.0 0.0.0.255 area 2

network 192.168.4.0 0.0.0.255 area 3

network 192.168.5.0 0.0.0.255 area 3

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is 192.168.6.1 to network 0.0.0.0

D 192.168.5.0/24 [90/2681856] via 192.168.6.1, 00:02:37, Serial0/1/0

192.168.6.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.6.0/24 is directly connected, Serial0/1/0

L 192.168.6.2/32 is directly connected, Serial0/1/0

D\*EX 0.0.0.0/0 [170/3097600] via 192.168.6.1, 00:02:25, Serial0/1/0

***Show IP EIGRP neighbor***

Router#show ip eigrp neighbor

IP-EIGRP neighbors for process 10

H Address Interface Hold Uptime SRTT RTO Q Seq

(sec) (ms) Cnt Num

0 192.168.6.1 Se0/1/0 11 00:02:37 40 1000 0 2

IP-EIGRP neighbors for process 1

***Show IP EIGRP interface***

Router#show ip eigrp interface

IP-EIGRP interfaces for process 10

Xmit Queue Mean Pacing Time Multicast Pending

Interface Peers Un/Reliable SRTT Un/Reliable Flow Timer Routes

Se0/1/0 1 0/0 1236 0/10 0 0

IP-EIGRP interfaces for process 1

Xmit Queue Mean Pacing Time Multicast Pending

Interface Peers Un/Reliable SRTT Un/Reliable Flow Timer Routes

**Router 7:**

***Show run***

Router#show run

Building configuration...

Current configuration : 863 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.7.2 255.255.255.0

interface Serial0/1/1

ip address 192.168.8.1 255.255.255.0

clock rate 2000000

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

area 2 stub no-summary

network 192.168.8.0 0.0.0.255 area 2

network 192.168.7.0 0.0.0.255 area 0

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

end

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

O IA 192.168.1.0/24 [110/192] via 192.168.7.1, 00:02:20, Serial0/1/0

O 192.168.2.0/24 [110/128] via 192.168.7.1, 00:02:20, Serial0/1/0

O 192.168.3.0/24 [110/128] via 192.168.7.1, 00:02:20, Serial0/1/0

O IA 192.168.4.0/24 [110/192] via 192.168.7.1, 00:02:20, Serial0/1/0

192.168.7.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.7.0/24 is directly connected, Serial0/1/0

L 192.168.7.2/32 is directly connected, Serial0/1/0

192.168.8.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.8.0/24 is directly connected, Serial0/1/1

L 192.168.8.1/32 is directly connected, Serial0/1/1

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.8.2 0 FULL/ - 00:00:34 192.168.8.2 Serial0/1/1

192.168.7.1 0 FULL/ - 00:00:34 192.168.7.1 Serial0/1/0

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.8.1/24, Area 2

Process ID 10, Router ID 192.168.8.1, 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 00:00:04

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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.8.2

Suppress hello for 0 neighbor(s)

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

Internet address is 192.168.7.2/24, Area 0

Process ID 10, Router ID 192.168.8.1, 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 192.168.7.1

Suppress hello for 0 neighbor(s)

**Router 8:**

***Show run***

Router#show run

Building configuration...

Current configuration : 986 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.8.2 255.255.255.0

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router eigrp 10

redistribute ospf 10 metric 1000 33 255 1 1500

network 192.168.6.0

network 192.168.1.0

network 192.168.2.0

network 192.168.3.0

network 192.168.5.0

router ospf 10

log-adjacency-changes

area 2 stub no-summary

network 192.168.8.0 0.0.0.255 area 2

ip classless

ip flow-export version 9

no cdp run

line con 0

line aux 0

line vty 0 4

login

End

***Show IP route***

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is 192.168.8.1 to network 0.0.0.0

192.168.8.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.8.0/24 is directly connected, Serial0/1/0

L 192.168.8.2/32 is directly connected, Serial0/1/0

O\*IA 0.0.0.0/0 [110/65] via 192.168.8.1, 00:02:30, Serial0/1/0

***Show IP OSPF neighbor***

Router#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface

192.168.8.1 0 FULL/ - 00:00:34 192.168.8.1 Serial0/1/0

***Show IP OSPF interface***

Router#show ip ospf interface

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

Internet address is 192.168.8.2/24, Area 2

Process ID 10, Router ID 192.168.8.2, 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 00:00:04

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 1 , Adjacent neighbor count is 1

Adjacent with neighbor 192.168.8.1

Suppress hello for 0 neighbor(s)

**LSA messages:**   
Type 3-

Table

Description automatically generated

Type 4-

Table

Description automatically generated

**Problem Section:**

The first problem that I encountered was with the NSSA. After configuring routes, my CLI was spammed every couple of seconds with an error message stating that my router ID was mismatched. However, after pinging, to and from the NSSA around the rest of the network, I found that there was no connectivity issue. Confused, I consulted classmates and found that they had the same issue. Since the mismatched ID does not impact the network’s functionality, I will assume that it is a glitch in the Packet Tracer system or an error none of us were able to detect. The second error I encountered was with the EIGRP area. After configuring the three OSPF and backbone areas, I entered the appropriate network route and rip commands in the EIGRP routers but was unable to ping them afterwards. I checked with classmates and online and found that I had forgotten to enter the metric command.

**Conclusion:**

This lab enhanced my understanding of OSPF areas and EIGRP. In future labs, I will continue configure stub, totally stub, NSSA, and EIGRP areas when appropriate based on what my network needs. I also gained a clearer understanding of LSA messages, as I had to keep track of them for this lab and analyze the information inside of each header. While tracking LSA messages in Packet Tracer’s simulation mode, I became more aware of the movement of information packets around the network and the other data they contain (network layers, packet type, etc.).

**Teacher Signoff:**

Diagram

Description automatically generated

Elaine Zhang

Completed 1/4/2021

eBGP in GNS3

**Purpose:**

This lab requires students to divide a network of six routers into three different areas: OSPF, BGP, and EIGRP, so that routers can successfully communicate within and across areas operating with different IPv6 routing protocols.

**Background Info:**

The External Border Gateway Protocol (eBGP), is a routing protocol used in IP networks for the specific purpose of exchanging routing information between two neighbors with different Autonomous Systems (AS). On the other hand, the Internal Border Gateway Protocol (iBGP) routes between neighbors of the same AS, and most networks function with a combination of both eBGP and iBGP. Both eBGP and iBGP can be configured with IPv6 addresses in addition to the usual IPv4 addresses.

**Lab Summary:**

For this lab, I created six routers and divided them into three separate areas: OSPF, BGP, and EIGRP. After completing the IPv6 addressing scheme for each router, I configured the respective routing protocols on each device with the appropriate commands, as well as those specific for border/BGP routers 3 and 4. Because this lab required me to configure BGP for IPv6, I implemented several new commands such as the neighbor activate and network commands in the address-family IPv6 interface.

**Network Diagram:**



**Commands:**

Router 1:

***Show run***

R1#sh run

Building configuration...

Current configuration : 1057 bytes

version 12.4

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

hostname R1

boot-start-marker

boot-end-marker

no aaa new-model

memory-size iomem 5

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ip auth-proxy max-nodata-conns 3

ip admission max-nodata-conns 3

ipv6 unicast-routing

ip tcp synwait-time 5

interface FastEthernet0/0

 no ip address

 duplex auto

 speed auto

 ipv6 address 2001:DB8:1::1/127

 ipv6 enable

 ipv6 ospf 10 area 0

interface FastEthernet0/1

 no ip address

 shutdown

 duplex auto

 speed auto

router ospf 10

 log-adjacency-changes

no ip http server

no ip http secure-server

ip forward-protocol nd

no cdp log mismatch duplex

ipv6 router ospf 10

 router-id 1.1.1.1

 log-adjacency-changes

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

line vty 0 4

 login

end

***Show ipv6 route***

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

       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

C   2001:DB8:1::/127 [0/0]

     via ::, FastEthernet0/0

L   2001:DB8:1::1/128 [0/0]

     via ::, FastEthernet0/0

O   2001:DB8:1::2/127 [110/1]

     via ::, FastEthernet0/0

O   2001:DB8:2::/127 [110/2]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

O   2001:DB8:2::2/127 [110/2]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

OE2  2001:DB8:3::/126 [110/20]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

OE2  2001:DB8:4::/127 [110/1]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

OE2  2001:DB8:4::2/127 [110/1]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

OE2  2001:DB8:5::/127 [110/1]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

OE2  2001:DB8:5::2/127 [110/1]

     via FE80::CE02:2CFF:FED8:0, FastEthernet0/0

L   FE80::/10 [0/0]

     via ::, Null0

L   FF00::/8 [0/0]

     via ::, Null0

Router 2:

***Show run***

R2#sh run

Building configuration...

Current configuration : 1073 bytes

version 12.4

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

hostname R2

boot-start-marker

boot-end-marker

no aaa new-model

memory-size iomem 5

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ip auth-proxy max-nodata-conns 3

ip admission max-nodata-conns 3

ipv6 unicast-routing

ip tcp synwait-time 5

interface FastEthernet0/0

 no ip address

 duplex auto

 speed auto

 ipv6 address 2001:DB8:1::2/127

 ipv6 enable

 ipv6 ospf 10 area 0

interface FastEthernet0/1

 no ip address

 duplex auto

 speed auto

 ipv6 address 2001:DB8:2::1/127

 ipv6 enable

 ipv6 ospf 10 area 0

no ip http server

no ip http secure-server

ip forward-protocol nd

no cdp log mismatch duplex

ipv6 router ospf 10

 router-id 2.2.2.2

 log-adjacency-changes

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

line vty 0 4

 login

end

***Show ipv6 route***

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

       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

O   2001:DB8:1::/127 [110/1]

     via ::, FastEthernet0/0

C   2001:DB8:1::2/127 [0/0]

     via ::, FastEthernet0/0

L   2001:DB8:1::2/128 [0/0]

     via ::, FastEthernet0/0

C   2001:DB8:2::/127 [0/0]

     via ::, FastEthernet0/1

L   2001:DB8:2::1/128 [0/0]

     via ::, FastEthernet0/1

O   2001:DB8:2::2/127 [110/1]

     via ::, FastEthernet0/1

OE2  2001:DB8:3::/126 [110/20]

     via FE80::CE03:24FF:FEB4:0, FastEthernet0/1

OE2  2001:DB8:4::/127 [110/1]

     via FE80::CE03:24FF:FEB4:0, FastEthernet0/1

OE2  2001:DB8:4::2/127 [110/1]

     via FE80::CE03:24FF:FEB4:0, FastEthernet0/1

OE2  2001:DB8:5::/127 [110/1]

     via FE80::CE03:24FF:FEB4:0, FastEthernet0/1

OE2  2001:DB8:5::2/127 [110/1]

     via FE80::CE03:24FF:FEB4:0, FastEthernet0/1

L   FE80::/10 [0/0]

     via ::, Null0

L   FF00::/8 [0/0]

     via ::, Null0

Router 3:

***Show run***

R3#sh run

Building configuration...

Current configuration : 1501 bytes

version 12.4

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

hostname R3

boot-start-marker

boot-end-marker

no aaa new-model

memory-size iomem 5

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ip auth-proxy max-nodata-conns 3

ip admission max-nodata-conns 3

ipv6 unicast-routing

ip tcp synwait-time 5

interface FastEthernet0/0

 no ip address

 duplex auto

 speed auto

 ipv6 address 2001:DB8:2::2/127

 ipv6 enable

 ipv6 ospf 10 area 0

interface FastEthernet0/1

 no ip address

 duplex auto

 speed auto

 ipv6 address 2001:DB8:3::1/126

 ipv6 enable

router bgp 100

 bgp router-id 3.3.3.3

 no bgp default ipv4-unicast

 bgp log-neighbor-changes

 neighbor 2001:DB8:3::2 remote-as 200

 address-family ipv6

  neighbor 2001:DB8:3::2 activate

  network 2001:DB8:3::/126

  network 2001:DB8:3::/127

  redistribute connected

  redistribute static

  redistribute ospf 10 match internal external 1 external 2

  no synchronization

 exit-address-family

no ip http server

no ip http secure-server

ip forward-protocol nd

no cdp log mismatch duplex

ipv6 router ospf 10

 router-id 3.3.3.3

 log-adjacency-changes

 redistribute connected

 redistribute bgp 100 metric 1

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

line vty 0 4

 login

end

***Show ipv6 route***

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

       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

O   2001:DB8:1::/127 [110/2]

     via FE80::CE02:2CFF:FED8:1, FastEthernet0/0

O   2001:DB8:1::2/127 [110/2]

     via FE80::CE02:2CFF:FED8:1, FastEthernet0/0

O   2001:DB8:2::/127 [110/1]

     via ::, FastEthernet0/0

C   2001:DB8:2::2/127 [0/0]

     via ::, FastEthernet0/0

L   2001:DB8:2::2/128 [0/0]

     via ::, FastEthernet0/0

C   2001:DB8:3::/126 [0/0]

     via ::, FastEthernet0/1

L   2001:DB8:3::1/128 [0/0]

     via ::, FastEthernet0/1

B   2001:DB8:4::/127 [20/0]

     via FE80::C804:2BFF:FE54:0, FastEthernet0/1

B   2001:DB8:4::2/127 [20/21504]

     via FE80::C804:2BFF:FE54:0, FastEthernet0/1

B   2001:DB8:5::/127 [20/21504]

     via FE80::C804:2BFF:FE54:0, FastEthernet0/1

B   2001:DB8:5::2/127 [20/24064]

     via FE80::C804:2BFF:FE54:0, FastEthernet0/1

L   FE80::/10 [0/0]

     via ::, Null0

L   FF00::/8 [0/0]

     via ::, Null0

Router 4:

***Show run***

R4#sh run

Building configuration...

Current configuration : 1368 bytes

Last configuration change at 12:44:55 UTC Mon Jan 4 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R4

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface FastEthernet0/0

 no ip address

 duplex full

 ipv6 address 2001:DB8:3::2/126

 ipv6 enable

interface POS1/0

 no ip address

 ipv6 address 2001:DB8:4::1/127

 ipv6 enable

 ipv6 eigrp 10

router bgp 200

 bgp router-id 4.4.4.4

 bgp log-neighbor-changes

 no bgp default ipv4-unicast

 neighbor 2001:DB8:3::1 remote-as 100

 address-family ipv4

 exit-address-family

 address-family ipv6

  redistribute connected

  redistribute eigrp 10

  network 2001:DB8:3::/126

  neighbor 2001:DB8:3::1 activate

 exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

ipv6 router eigrp 10

 eigrp router-id 4.4.4.4

 redistribute bgp 200 metric 100 1 255 1 1500

 redistribute connected

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

end

***Show ipv6 route***

R4#sh ipv6 route

IPv6 Routing Table - default - 12 entries

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

       B - BGP, R - RIP, H - NHRP, 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, l - LISP

B   2001:DB8:1::/127 [20/2]

     via FE80::CE03:24FF:FEB4:1, FastEthernet0/0

B   2001:DB8:1::2/127 [20/2]

     via FE80::CE03:24FF:FEB4:1, FastEthernet0/0

B   2001:DB8:2::/127 [20/1]

     via FE80::CE03:24FF:FEB4:1, FastEthernet0/0

B   2001:DB8:2::2/127 [20/0]

     via FE80::CE03:24FF:FEB4:1, FastEthernet0/0

C   2001:DB8:3::/126 [0/0]

     via FastEthernet0/0, directly connected

L   2001:DB8:3::2/128 [0/0]

     via FastEthernet0/0, receive

C   2001:DB8:4::/127 [0/0]

     via POS1/0, directly connected

L   2001:DB8:4::1/128 [0/0]

     via POS1/0, receive

D   2001:DB8:4::2/127 [90/21504]

     via FE80::C805:3EFF:FEA4:0, POS1/0

D   2001:DB8:5::/127 [90/21504]

     via FE80::C805:3EFF:FEA4:0, POS1/0

D   2001:DB8:5::2/127 [90/24064]

     via FE80::C805:3EFF:FEA4:0, POS1/0

L   FF00::/8 [0/0]

     via Null0, receive

Router 5:

***Show run***

R5#sh run

Building configuration...

Current configuration : 1024 bytes

Last configuration change at 10:30:48 UTC Mon Jan 4 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R5

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface FastEthernet0/0

 no ip address

 shutdown

 duplex full

interface POS1/0

 no ip address

 ipv6 address 2001:DB8:5::1/127

 ipv6 enable

 ipv6 eigrp 10

interface POS2/0

 no ip address

 ipv6 address 2001:DB8:4::2/127

 ipv6 enable

 ipv6 eigrp 10

ip forward-protocol nd

no ip http server

no ip http secure-server

ipv6 router eigrp 10

 eigrp router-id 5.5.5.5

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

end

***Show ipv6 route***

R5#sh ipv6 route

IPv6 Routing Table - default - 12 entries

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

       B - BGP, R - RIP, H - NHRP, 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, l - LISP

EX  2001:DB8:1::/127 [170/25602816]

     via FE80::C804:2BFF:FE54:0, POS2/0

EX  2001:DB8:1::2/127 [170/25602816]

     via FE80::C804:2BFF:FE54:0, POS2/0

EX  2001:DB8:2::/127 [170/25602816]

     via FE80::C804:2BFF:FE54:0, POS2/0

EX  2001:DB8:2::2/127 [170/25602816]

     via FE80::C804:2BFF:FE54:0, POS2/0

EX  2001:DB8:3::/126 [170/30720]

     via FE80::C804:2BFF:FE54:0, POS2/0

D   2001:DB8:4::/127 [90/21504]

     via FE80::C804:2BFF:FE54:0, POS2/0

C   2001:DB8:4::2/127 [0/0]

     via POS2/0, directly connected

L   2001:DB8:4::2/128 [0/0]

     via POS2/0, receive

C   2001:DB8:5::/127 [0/0]

     via POS1/0, directly connected

L   2001:DB8:5::1/128 [0/0]

     via POS1/0, receive

D   2001:DB8:5::2/127 [90/21504]

     via FE80::C806:30FF:FE58:0, POS1/0

L   FF00::/8 [0/0]

     via Null0, receive

Router 6:

***Show run***

R6#sh run

Building configuration...

Current configuration : 948 bytes

Last configuration change at 10:32:47 UTC Mon Jan 4 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R6

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface FastEthernet0/0

 no ip address

 duplex full

 ipv6 enable

 ipv6 eigrp 10

interface POS1/0

 no ip address

 ipv6 address 2001:DB8:5::2/127

 ipv6 enable

 ipv6 eigrp 10

ip forward-protocol nd

no ip http server

no ip http secure-server

ipv6 router eigrp 10

 eigrp router-id 6.6.6.6

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

end

***Show ipv6 route***

R6#sh ipv6 route

IPv6 Routing Table - default - 11 entries

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

       B - BGP, R - RIP, H - NHRP, 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, l - LISP

EX  2001:DB8:1::/127 [170/25605376]

     via FE80::C805:3EFF:FEA4:0, POS1/0

EX  2001:DB8:1::2/127 [170/25605376]

     via FE80::C805:3EFF:FEA4:0, POS1/0

EX  2001:DB8:2::/127 [170/25605376]

     via FE80::C805:3EFF:FEA4:0, POS1/0

EX  2001:DB8:2::2/127 [170/25605376]

     via FE80::C805:3EFF:FEA4:0, POS1/0

EX  2001:DB8:3::/126 [170/33280]

     via FE80::C805:3EFF:FEA4:0, POS1/0

D   2001:DB8:4::/127 [90/24064]

     via FE80::C805:3EFF:FEA4:0, POS1/0

D   2001:DB8:4::2/127 [90/21504]

     via FE80::C805:3EFF:FEA4:0, POS1/0

D   2001:DB8:5::/127 [90/21504]

     via FE80::C805:3EFF:FEA4:0, POS1/0

C   2001:DB8:5::2/127 [0/0]

     via POS1/0, directly connected

L   2001:DB8:5::2/128 [0/0]

     via POS1/0, receive

L   FF00::/8 [0/0]

     via Null0, receive

**Pings (from R6):**





**Problem Section**

The first issue I found was that my OSPF routers could not ping the OSPF ABR, but this was quickly resolved after entering the “redistribute OSPF 10…” statement into the ABR, specifically into the BGP 100 interface. However, the main problem I ran into during this lab was that the two BGP routers (R3 and R4) were unable to ping one another, nor could any outside routers ping their inner BGP interfaces. To start, I entered the “redistribute connected command” into each router’s respective BGP interface, but the main issue was each BGP router’s subnet mask. Originally, I issued each of them a /127 subnet mask which caused overlap between routers 3 and 4, consequently resulting in the route between the two to malfunction. After changing the /127 mask to /126, however, the two routers were able to ping one another and across the network as well.

**Conclusion**

This lab built upon my understanding of the OSPF, BGP, and EIGRP routing protocols from previous labs, along with the additional element of configuring the same routers in IPv6. I also learned new network and distribution statements to implement IPv6 BGP into a multi-area network with different routing protocols, as well as commands used to redistribute packets across areas in IPv6. Lastly, I began to develop an understanding of using the GNS3 software since all previous labs were conducted in packet tracer.

**Teacher Signoff**

Diagram

Description automatically generated

Elaine Zhang

Completed 12/12/2020

IPv4 in Packet Tracer

**Purpose:**

This lab requires students to divide a network of six routers into three different areas: OSPF, BGP, and EIGRP, so that routers can successfully communicate within and across areas operating with different routing protocols.

**Background Info:**

The Border Gateway Protocol (BGP), is a routing protocol used in IP networks for the specific purpose of exchanging routing information with the internet and other Autonomous Systems (AS). To determine which network is best for a router to send its information to, BGP uses peering, where it finds the router closest to the packet’s destination and directs it there. The use of peering can be applied to routers with the same AS number (internal BGP) and those without the same AS number (external BGP), creating two separate BGP protocols. An example of how these protocols are separately used is that external BGP receives packets from outside the network, while internal BGP redistributes those outside packets to routers within the network. However, despite BGP’s many benefits, it is important to be aware that it tends to be more vulnerable to attacks from outside of the network.

**Lab Summary:**

For this lab, I created six routers and divided them into three separate areas: OSPF, BGP, and EIGRP. After completing the IP addressing scheme, I configured the respective routing protocols on each device with the appropriate commands, as well as those specific for border routers 4 and

**Network Diagram:**

Graphical user interface, text

Description automatically generated



**Commands**

Router 1

*Show run*

Router#sh run

Building configuration...

Current configuration : 952 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.1.1 255.255.255.0

ipv6 address 2001:DB8:1::1/64

clock rate 2000000

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

redistribute eigrp 10 subnets

redistribute bgp 100 subnets

redistribute bgp 200 subnets

redistribute static subnets

network 192.168.0.0 0.0.255.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

*Show IP route*

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

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

C 192.168.1.0/24 is directly connected, Serial0/1/0

L 192.168.1.1/32 is directly connected, Serial0/1/0

O 192.168.2.0/24 [110/128] via 192.168.1.2, 01:24:26, Serial0/1/0

O 192.168.3.0/24 [110/192] via 192.168.1.2, 01:16:50, Serial0/1/0

Serial0/1/0

O E2 192.168.4.0/24 [110/20] via 192.168.1.2, 00:01:46, Serial0/1/0

O E2 192.168.5.0/24 [110/20] via 192.168.1.2, 00:01:46, Serial0/1/0

Router 2

*Show run*

Router#show run

Building configuration...

Current configuration : 913 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.1.2 255.255.255.0

ipv6 address 2001:DB8:1::2/64

interface Serial0/1/1

ip address 192.168.2.1 255.255.255.0

ipv6 address 2001:DB8:2::1/64

clock rate 2000000

interface Vlan1

no ip address

shutdown

router ospf 10

log-adjacency-changes

redistribute eigrp 10 subnets

redistribute bgp 100 subnets

redistribute bgp 200 subnets

redistribute static subnets

network 192.168.0.0 0.0.255.255 area 0

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

*Show IP route*

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

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

C 192.168.1.0/24 is directly connected, Serial0/1/0

L 192.168.1.2/32 is directly connected, Serial0/1/0

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

C 192.168.2.0/24 is directly connected, Serial0/1/1

L 192.168.2.1/32 is directly connected, Serial0/1/1

O 192.168.3.0/24 [110/128] via 192.168.2.2, 00:02:11, Serial0/1/1

Serial0/1/1

O E2 192.168.4.0/24 [110/20] via 192.168.2.2, 00:02:45, Serial0/1/1

O E2 192.168.5.0/24 [110/20] via 192.168.2.2, 00:02:45, Serial0/1/1

Router 3

*Show run*

Router#sh run

Building configuration...

Current configuration : 1266 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

!

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.2.2 255.255.255.0

ipv6 address 2001:DB8:2::2/64

interface Serial0/1/1

ip address 192.168.3.1 255.255.255.0

ipv6 address 2001:DB8:3::1/64

clock rate 2000000

interface Vlan1

no ip address

shutdown

router eigrp 10

router ospf 10

log-adjacency-changes

redistribute eigrp 10 subnets

redistribute bgp 100 subnets

redistribute static subnets

network 192.168.0.0 0.0.255.255 area 0

router bgp 100

bgp log-neighbor-changes

no synchronization

neighbor 192.168.3.2 remote-as 200

network 0.0.0.0 mask 0.0.255.255

redistribute eigrp 10

redistribute ospf 10 match internal external 1 external 2

redistribute static

redistribute connected

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

*Show IP route*

Router#

%SYS-5-CONFIG\_I: Configured from console by console

sh 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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

O 192.168.1.0/24 [110/128] via 192.168.2.1, 00:29:41, Serial0/1/0

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

C 192.168.2.0/24 is directly connected, Serial0/1/0

L 192.168.2.2/32 is directly connected, Serial0/1/0

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

C 192.168.3.0/24 is directly connected, Serial0/1/1

L 192.168.3.1/32 is directly connected, Serial0/1/1

B 192.168.4.0/24 [20/2169856] via 192.168.3.2, 00:00:00

B 192.168.5.0/24 [20/2681856] via 192.168.3.2, 00:00:00

*Show IP BGP*

Router#sh ip bgp

BGP table version is 52, local router ID is 192.168.3.1

Status codes: s suppressed, d damped, h history, \* valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Next Hop Metric LocPrf Weight Path

\*> 192.168.1.0/24 192.168.2.1 0 0 0 100 ?

\* 192.168.2.0/24 192.168.2.0 0 0 0 100 ?

\*> 0.0.0.0 0 0 32768 i

\*> 0.0.0.0 0 0 32768 i

\* 192.168.3.0/24 192.168.3.0 0 0 0 100 ?

\*> 0.0.0.0 0 0 32768 i

\*> 0.0.0.0 0 0 32768 i

\* 192.168.3.2 0 0 0 200 ?

\*> 192.168.4.0/24 192.168.3.2 0 0 0 200 ?

\*> 192.168.5.0/24 192.168.3.2 0 0 0 200 ?

Router 4

*Show run*

Router#show run

Building configuration...

Current configuration : 1100 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.3.2 255.255.255.0

ipv6 address 2001:DB8:4::2/64

interface Serial0/1/1

ip address 192.168.4.1 255.255.255.0

ipv6 address 2001:DB8:5::1/64

clock rate 2000000

interface Vlan1

no ip address

shutdown

router eigrp 10

redistribute ospf 10 metric 5000 10 255 255 200

redistribute bgp 200 metric 100 1 255 1 1500

redistribute static

network 192.168.0.0 0.0.255.255

router bgp 200

bgp log-neighbor-changes

no synchronization

neighbor 192.168.3.1 remote-as 100

network 192.168.0.0 mask 255.255.0.0

network 0.0.0.0 mask 255.255.0.0

redistribute eigrp 10

redistribute ospf 10 match internal external 1 external 2

redistribute static

redistribute connected

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

*Show IP route*

Router#sh 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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

B 192.168.1.0/24 [20/128] via 192.168.3.1, 00:00:00

B 192.168.2.0/24 [20/20] via 192.168.3.1, 00:00:00

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

C 192.168.3.0/24 is directly connected, Serial0/1/0

L 192.168.3.2/32 is directly connected, Serial0/1/0

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

C 192.168.4.0/24 is directly connected, Serial0/1/1

L 192.168.4.1/32 is directly connected, Serial0/1/1

D 192.168.5.0/24 [90/2681856] via 192.168.4.2, 00:29:32, Serial0/1/1

*Show IP BGP*

Router#sh ip bgp

BGP table version is 28, local router ID is 192.168.4.1

Status codes: s suppressed, d damped, h history, \* valid, > best, i - internal,

r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

Network Next Hop Metric LocPrf Weight Path

\*> 192.168.1.0/24 192.168.3.1 0 0 0 100 ?

\*> 192.168.2.0/24 192.168.3.1 0 0 0 100 ?

\*> 192.168.3.0/24 0.0.0.0 0 0 32768 i

\*> 0.0.0.0 0 0 32768 i

\* 192.168.3.1 0 0 0 100 ?

\*> 192.168.4.0/24 0.0.0.0 0 0 32768 i

\*> 0.0.0.0 0 0 32768 i

\*> 192.168.5.0/24 192.168.4.2 0 0 0 200 ?

Router 5

*Show run*

Router#sh run

Building configuration...

Current configuration : 943 bytes

!

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.4.2 255.255.255.0

ipv6 address 2001:DB8:5::2/64

interface Serial0/1/1

ip address 192.168.5.1 255.255.255.0

ipv6 address 2001:DB8:6::1/64

clock rate 2000000

interface Vlan1

no ip address

shutdown

router eigrp 10

redistribute ospf 10 metric 1000 33 255 1 1500

redistribute bgp 200 metric 100 1 255 1 1500

redistribute static

network 192.168.0.0 0.0.255.255

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

*Show IP route*

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

D 192.168.3.0/24 [90/2681856] via 192.168.4.1, 00:07:25, Serial0/1/0

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

C 192.168.4.0/24 is directly connected, Serial0/1/0

L 192.168.4.2/32 is directly connected, Serial0/1/0

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

C 192.168.5.0/24 is directly connected, Serial0/1/1

L 192.168.5.1/32 is directly connected, Serial0/1/1

Router 6

Router#show run

Building configuration...

Current configuration : 850 bytes

version 15.4

no service timestamps log datetime msec

no service timestamps debug datetime msec

no service password-encryption

hostname Router

no ip cef

no ipv6 cef

spanning-tree mode pvst

interface GigabitEthernet0/0/0

no ip address

duplex auto

speed auto

shutdown

interface GigabitEthernet0/0/1

no ip address

duplex auto

speed auto

shutdown

interface Serial0/1/0

ip address 192.168.5.2 255.255.255.0

ipv6 address 2001:DB8:6::2/64

interface Serial0/1/1

no ip address

clock rate 2000000

shutdown

interface Vlan1

no ip address

shutdown

router eigrp 10

redistribute ospf 10 metric 1000 33 255 1 1500

redistribute bgp 200 metric 100 1 255 1 1500

redistribute static

network 192.168.0.0 0.0.255.255

ip classless

ip flow-export version 9

line con 0

line aux 0

line vty 0 4

login

end

*Show IP route*

Router#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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

D 192.168.3.0/24 [90/3193856] via 192.168.5.1, 00:08:10, Serial0/1/0

D 192.168.4.0/24 [90/2681856] via 192.168.5.1, 00:08:10, Serial0/1/0

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

C 192.168.5.0/24 is directly connected, Serial0/1/0

L 192.168.5.2/32 is directly connected, Serial0/1/0

**Pings (From router 4)**





**Problem Section**

The first issue I found was that my EIGRP routers could not ping the EIGRP ABR, but this was quickly resolved after entering the “redistribute eigrp 10” statement into the ABR. However, the main problem I ran into during this lab was that routers from the EIGRP and OSPF areas could only ping their respective ABRs and not into the other ABR or area. To fix this, I started by establishing a neighbor adjacency between the two BGP routers (routers 3 and 4). Now, routers 1 and 2 were able to ping router 4 and routers 5 and 6 were able to ping router 3.

**Conclusion**

This lab refreshed my understanding of distributing OSPF and EIGRP between routers with an additional component of BGP. I learned new network and distribution statements to implement BGP into a multi-area network with different routing protocols, as well as commands specific to border routers between areas.

**Teacher Signoff**

Diagram

Description automatically generated

Elaine Zhang

Completed 4/23/2021

iBGP and eBGP in GNS3

**Purpose**

This lab directs students to divide five routers into a network using the iBGP, eBGP, and OSPF routing protocols so that they can successfully communicate with and redistribute information between one another.

**Background Info**

Unlike the eBGP protocol, which routes information between routers of different autonomous systems, the iBGP protocol is useful when transferring information between routers of the same AS, hence the word “internal” in its title. Like its eBGP counterpart, iBGP routers can still communicate with global internet routes, making it more useful than a traditional IGP route. Some other notable differences are that iBGP networks require mesh topology while eBGP does not. iBGP routers also do not advertise newly learned routes to neighbors while eBGP routers do.

**Lab Summary**

**Network Diagram**

Diagram

Description automatically generated

**Commands**

Router 1:

***Show run***

R1#sh run

Building configuration...

Current configuration : 1387 bytes

Last configuration change at 22:23:16 UTC Thu Apr 22 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R1

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface FastEthernet0/0

 ip address 192.168.1.1 255.255.255.0

 duplex full

 ipv6 address 1::1/24

 ipv6 enable

interface Ethernet1/0

 no ip address

 shutdown

 duplex full

interface Ethernet1/1

 no ip address

 shutdown

 duplex full

interface Ethernet1/2

 no ip address

 shutdown

 duplex full

interface Ethernet1/3

 no ip address

 shutdown

 duplex full

router bgp 2

 bgp log-neighbor-changes

 neighbor 1::2 remote-as 3

 neighbor 192.168.1.2 remote-as 3

 address-family ipv4

  no neighbor 1::2 activate

  neighbor 192.168.1.2 activate

 exit-address-family

 address-family ipv6

  redistribute connected

  neighbor 1::2 activate

 exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

End

***Show IP BGP summary***

R1#show ip bgp summary

BGP router identifier 192.168.1.1, local AS number 2

BGP table version is 13, main routing table version 13

4 network entries using 576 bytes of memory

4 path entries using 320 bytes of memory

1/1 BGP path/bestpath attribute entries using 136 bytes of memory

1 BGP AS-PATH entries using 24 bytes of memory

0 BGP route-map cache entries using 0 bytes of memory

0 BGP filter-list cache entries using 0 bytes of memory

BGP using 1056 total bytes of memory

BGP activity 11/6 prefixes, 11/6 paths, scan interval 60 secs

Neighbor        V           AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd

192.168.1.2     4            3     162     162       13    0    0 02:23:50        4

Router 2:

***Show run***

R2#sh run

Building configuration...

Current configuration : 1878 bytes

Last configuration change at 22:27:38 UTC Thu Apr 22 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R2

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface Loopback0

 ip address 192.168.5.5 255.255.255.255

interface FastEthernet0/0

 ip address 192.168.1.2 255.255.255.0

 duplex full

 ipv6 address 1::2/24

interface Ethernet1/0

 ip address 192.168.2.1 255.255.255.0

 duplex full

 ipv6 address 2::1/24

 ipv6 enable

 ipv6 ospf 10 area 0

interface Ethernet1/1

 no ip address

 shutdown

 duplex full

interface Ethernet1/2

 no ip address

 shutdown

 duplex full

interface Ethernet1/3

 no ip address

 shutdown

 duplex full

router ospf 10

 network 192.168.2.0 0.0.0.255 area 0

router bgp 3

 bgp log-neighbor-changes

 neighbor internal peer-group

 neighbor internal remote-as 3

 neighbor 1::1 remote-as 2

 neighbor 2::2 remote-as 3

 neighbor 192.168.1.1 remote-as 2

 neighbor 192.168.6.6 remote-as 3

 neighbor 192.168.6.6 update-source Loopback0

 address-family ipv4

  no neighbor 1::1 activate

  no neighbor 2::2 activate

  neighbor 192.168.1.1 activate

  neighbor 192.168.6.6 activate

 exit-address-family

 address-family ipv6

  neighbor 1::1 activate

  neighbor 2::2 activate

 exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

ip route 192.168.6.6 255.255.255.255 192.168.2.2

ipv6 router ospf 10

 router-id 1.1.1.1

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

end

***Show IP BGP summary***

R2#show ip bgp summary

BGP router identifier 192.168.5.5, local AS number 3

BGP table version is 14, main routing table version 14

4 network entries using 576 bytes of memory

4 path entries using 320 bytes of memory

1/1 BGP path/bestpath attribute entries using 136 bytes of memory

1 BGP AS-PATH entries using 24 bytes of memory

0 BGP route-map cache entries using 0 bytes of memory

0 BGP filter-list cache entries using 0 bytes of memory

BGP using 1056 total bytes of memory

BGP activity 9/4 prefixes, 9/4 paths, scan interval 60 secs

Neighbor        V           AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd

192.168.1.1     4            2     166     166       14    0    0 02:27:23        0

192.168.6.6     4            3     170     166       14    0    0 02:27:09        4

Router 3:

***Show run***

R3#sh run

Building configuration...

Current configuration : 1721 bytes

Last configuration change at 19:30:03 UTC Wed Apr 21 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R3

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface Loopback0

 ip address 192.168.6.6 255.255.255.255

interface FastEthernet0/0

 ip address 192.168.2.2 255.255.255.0

 duplex full

 ipv6 address 2::2/24

interface Ethernet1/0

 ip address 192.168.3.1 255.255.255.0

 duplex full

 ipv6 address 3::1/24

 ipv6 ospf 10 area 0

interface Ethernet1/1

 no ip address

 shutdown

 duplex full

interface Ethernet1/2

 no ip address

 shutdown

 duplex full

interface Ethernet1/3

 no ip address

 shutdown

 duplex full

router ospf 10

 network 192.168.2.0 0.0.0.255 area 0

 network 192.168.3.0 0.0.0.255 area 0

router bgp 3

 bgp log-neighbor-changes

 redistribute connected

 redistribute static

 neighbor 192.168.5.5 remote-as 3

 neighbor 192.168.5.5 update-source Loopback0

 neighbor 192.168.7.7 remote-as 3

 neighbor 192.168.7.7 update-source Loopback0

ip forward-protocol nd

no ip http server

no ip http secure-server

ip route 192.168.5.5 255.255.255.255 192.168.2.1

ip route 192.168.7.7 255.255.255.255 192.168.3.2

ipv6 router ospf 10

 router-id 2.2.2.2

 redistribute connected

 redistribute bgp 3 metric 1

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

End

***Show IP BGP summary***

R3#sh ip bgp summary

BGP router identifier 192.168.6.6, local AS number 3

BGP table version is 6, main routing table version 6

5 network entries using 720 bytes of memory

5 path entries using 400 bytes of memory

1/1 BGP path/bestpath attribute entries using 136 bytes of memory

0 BGP route-map cache entries using 0 bytes of memory

0 BGP filter-list cache entries using 0 bytes of memory

BGP using 1256 total bytes of memory

BGP activity 5/0 prefixes, 5/0 paths, scan interval 60 secs

Neighbor        V           AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd

192.168.5.5     4            3     172     176        6    0    0 02:33:23        0

192.168.7.7     4            3     154     157        6    0    0 02:16:14        0

Router 4:

***Show run***

R4#sh run

Building configuration...

Current configuration : 1705 bytes

Last configuration change at 19:28:02 UTC Wed Apr 21 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R4

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface Loopback0

 ip address 192.168.7.7 255.255.255.255

interface FastEthernet0/0

 ip address 192.168.3.2 255.255.255.0

 duplex full

 ipv6 address 3::2/24

 ipv6 ospf 10 area 0

interface Ethernet1/0

 ip address 192.168.4.1 255.255.255.0

 duplex full

 ipv6 address 4::1/24

interface Ethernet1/1

 no ip address

 shutdown

 duplex full

interface Ethernet1/2

 no ip address

 shutdown

 duplex full

interface Ethernet1/3

 no ip address

 shutdown

 duplex full

router ospf 10

 network 192.168.3.0 0.0.0.255 area 0

router bgp 3

 bgp log-neighbor-changes

 neighbor 4::2 remote-as 4

 neighbor 192.168.4.2 remote-as 4

 neighbor 192.168.6.6 remote-as 3

 neighbor 192.168.6.6 update-source Loopback0

 address-family ipv4

  no neighbor 4::2 activate

  neighbor 192.168.4.2 activate

  neighbor 192.168.6.6 activate

 exit-address-family

 address-family ipv6

  neighbor 4::2 activate

 exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

ip route 192.168.6.6 255.255.255.255 192.168.3.1

ipv6 router ospf 10

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

End

***Show IP BGP summary***

R4#sh ip bgp summary

BGP router identifier 192.168.7.7, local AS number 3

BGP table version is 14, main routing table version 14

4 network entries using 576 bytes of memory

4 path entries using 320 bytes of memory

1/1 BGP path/bestpath attribute entries using 136 bytes of memory

0 BGP route-map cache entries using 0 bytes of memory

0 BGP filter-list cache entries using 0 bytes of memory

BGP using 1032 total bytes of memory

BGP activity 8/4 prefixes, 8/4 paths, scan interval 60 secs

Neighbor        V           AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd

192.168.4.2     4            4     152     152       14    0    0 02:13:37        0

192.168.6.6     4            3     160     157       14    0    0 02:19:07        4

Router 5:

***Show run***

R5#sh run

Building configuration...

Current configuration : 1349 bytes

Last configuration change at 19:31:05 UTC Wed Apr 21 2021

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

hostname R5

boot-start-marker

boot-end-marker

no aaa new-model

no ip icmp rate-limit unreachable

ip cef

no ip domain lookup

ipv6 unicast-routing

ipv6 cef

multilink bundle-name authenticated

ip tcp synwait-time 5

interface FastEthernet0/0

 ip address 192.168.4.2 255.255.255.0

 duplex full

 ipv6 address 4::2/24

interface Ethernet1/0

 no ip address

 shutdown

 duplex full

interface Ethernet1/1

 no ip address

 shutdown

 duplex full

interface Ethernet1/2

 no ip address

 shutdown

 duplex full

interface Ethernet1/3

 no ip address

 shutdown

 duplex full

router bgp 4

 bgp log-neighbor-changes

 neighbor 4::1 remote-as 3

 neighbor 192.168.4.1 remote-as 3

 address-family ipv4

  no neighbor 4::1 activate

  neighbor 192.168.4.1 activate

 exit-address-family

 address-family ipv6

  neighbor 4::1 activate

 exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

control-plane

line con 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line aux 0

 exec-timeout 0 0

 privilege level 15

 logging synchronous

 stopbits 1

line vty 0 4

 login

end

***Show IP BGP summary***

R5#show ip bgp summary

BGP router identifier 192.168.4.2, local AS number 4

BGP table version is 13, main routing table version 13

4 network entries using 576 bytes of memory

4 path entries using 320 bytes of memory

1/1 BGP path/bestpath attribute entries using 136 bytes of memory

1 BGP AS-PATH entries using 24 bytes of memory

0 BGP route-map cache entries using 0 bytes of memory

0 BGP filter-list cache entries using 0 bytes of memory

BGP using 1056 total bytes of memory

BGP activity 8/4 prefixes, 8/4 paths, scan interval 60 secs

Neighbor        V           AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd

192.168.4.1     4            3     154     154       13    0    0 02:15:35        4

**Problem Section**

The first issue I encountered was with my IPv6 addressing scheme. I initially configured them with a /127 subnet and the traditional 2001:db8 address. Routers were able to ping the IPv4 addresses of interfaces but not their IPv6 addresses. So, I changed them to a /24 addressing scheme, which fixed the connectivity issue. The next mistake I made was also unrelated to the BGP configuration. On routers 2 and 4, OSPF should have been configured on their inward facing interfaces, not those connected to the eBGP routers. Lastly, I had additional difficulty pinging between the IPv6 addresses of the 3 iBGP routers. But, after discussing with classmates, I realized that I needed to configure an IPv6 address family so that they could communicate with one another.

**Conclusion**

This lab reinforced my understanding of BGP routing in general. I was able to practice configuring routers for eBGP and OSPF again with the added introduction of iBGP configuration. Through this exercise, I also learned new commands to route information between eBGP and iBGP networks and within an iBGP/OSPF network.

**Teacher Signoff**