BGP

CCNP Lab 4

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Period 6, 7, 8

*Lab 4: BGP*

**Purpose**

The objective of the lab was to understand and configure the External Border Gateway Protocol (EBGP) between two distinct Autonomous Systems for both IPv4 and IPv6. The internal routing protocols will be different for the two Autonomous Systems, one being configured for OSPF and the other, EIGRP. This simulates the relationship between two distinct networks with completely separate routing protocols, as well as reviewing previous interior routing protocols. Another objective was to understand its applications for the internet and its purpose in real life scenarios.

**Background Information**

External Border Gateway Protocol (eBGP) is an exterior routing protocol that exchanges routing and relationship information between independent Autonomous Systems, for both IPv4 and IPv6 routing. BGP is a path-vector routing protocol, which makes routing decisions based on paths, network policies, and rules configured by a network admin. It is the standardized and fundamental protocol for the Internet.

BGP routers on the boundary of its Autonomous System (AS) exchange information to other routers on the boundary of their Autonomous Systems. These routers are called Border Routers, and when properly connected as neighbors, are also called eBGP peers. These connections are often connected directly. These peer connections must be configured as a full mesh, with each peer connecting to all others.

To form a BGP peer connection, the border routers negotiate through a series of messages called OPEN messages and undergoes 6 different states. Namely, the states are: Idle, Connect, Active, OpenSent, OpenConfirm, and Established state. This peering handshake determines optional capabilities, policies, and restrictions of the BGP connection. Default peer connections were configured for basic BGP operation in the lab.

These eBGP routers will propagate its known networks to all other BGP peers in the form of BGP routes, which can be seen in their corresponding routing table or BGP routing topology. Configurations are made in a similar way to interior routing protocols, via a router configuration mode.

Previous OSPFv3 and EIGRP interior routing protocols were discussed in earlier labs.

**Lab Summary**

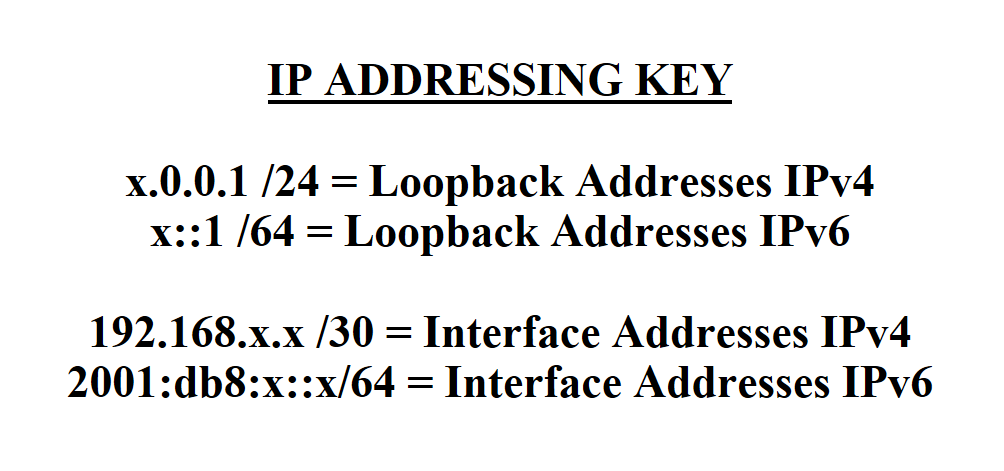
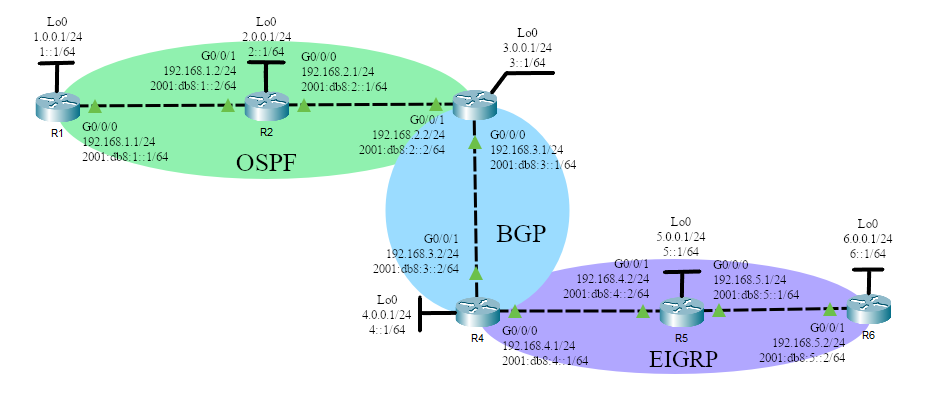
Six Cisco 4321 routers were set up once again in a bus-like topology, each chronologically following the other. The setup was split into two groups of 3 routers each. Each group was configured with their distinct interior routing protocol. The first group, routers R1-R3, were configured with OSPFv3. The second group, routers R4-R6, are configured with EIGRP. The connections between these two groups must solely be via a BGP connection. Default routes, static routes, and intertwining of the interior routing protocols are all prohibited to serve the objective of the lab. Thus, R3 and R4 serve as the Autonomous System Border Routers (ASBRs), which use BGP to communicate with the alternate group.

In terms of logical configuration, network and neighbor commands are entered in “Router BGP” mode of R3 and R4 to share known, connected networks to their opposing BGP router. Then, “redistribute” commands on both the BGP mode and its corresponding interior protocol mode allow for the external routing communication to assimilate into their internal Autonomous System. The exterior routes are seen as BGP routes on the BGP routers and seen as external (OSPF/EIGRP) routes on the internal routers. This can be seen in the “Show IP Route” verification command.

Ipv6 for the routers are configured using a special sub-configuration, “address-family ipv6” in the BGP configuration mode. All BGP network configurations are repeated again for IPv6 in this mode.

**Table of IP’s**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Router 1** | **Router 2** | **Router 3** | **Router 4** | **Router 5** | **Router 6** |
| **Gig Interfaces (Ipv4)**  *All subnets are of /24* | **-----**      **G0/0/0: 192.168.1.1** | **G0/0/1: 192.168.1.2**    **G0/0/0:**  **192.168.2.1** | **G0/0/1:**  **192.168.2.2**    **G0/0/0: 192.168.3.1** | **G0/0/1: 192.168.3.2**    **G0/0/0: 192.168.4.1** | **G0/0/1: 192.168.4.2**    **G0/0/0: 192.168.5.1** | **G0/0/1: 192.168.5.2**  **-----** |
| **Gig Interfaces (IPv6)**  *All subnets are of /64* | **-----**      **G0/0:**  **2001:db8:1::1** | **G0/1:**  **2001:db8:1::2**    **G0/0:**  **2001:db8:2::1** | **G0/1:**  **2001:db8:2::2**    **G0/0:**  **2001:db8:3::1** | **G0/1:**  **2001:db8:3::2**    **G0/0:**  **2001:db8:4::1** | **G0/1:**  **2001:db8:4::2**    **G0/0:**  **2001:db8:5::1** | **G0/1:**  **2001:db8:5::2**    **-----** |
| **Loopback** | **1.0.0.1**  **1::1** | **2.0.0.1**  **2::1** | **3.0.0.1**  **3::1** | **4.0.0.1**  **4::1** | **5.0.0.1**  **5::1** | **6.0.0.1**  **6::1** |
| **Router-IDs** | **1.1.1.1** | **2.2.2.2** | **3.3.3.3** | **4.4.4.4** | **5.5.5.5** | **6.6.6.6** |

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**Lab Commands**

Most commands were common network fundamentals. Others were unique to configuring OSPF and EIGRP, explained in previous labs. Key commands to this lab include:

**router bgp [*autonomous-system-number]*** *–* Enables BGP routing protocol on the router and enters the router configuration mode. Autonomous System Number of 100 was used on R3. Autonomous System Number of 200 was used of R4.

**neighbor [*neighbor address]* remote-as [*autonomous-system-number]*** *–* Sets the BGP neighbor network for the BGP router to see.

**network [network address] [wildcard mask]** – Enables said network to be advertised to the BGP database. In other words, enables that network for the BGP topology.

**redistribute [*routing protocol*] [*routing protocol autonomous-system-number*] metric [*metric numbers*] –** Allows the protocol to interpret and introduce the new routing protocol into their autonomous system.

**address-family ipv6–** Enters IPv6 sub-configuration of BGP.

**show ip(v6) protocols –** Displays (IPv4/IPv6) protocols enabled on the interface. Can be used to view BGP configurations along with other active protocols.

**show ip bgp summary–** Displays a summary of the contents of the BGP routing table.

**Configurations**

Show Running-Configurations:

**R1 (OSPF)**

**R1#show run**

shutdown

negotiation auto

**router ospf 1**

**router-id 1.1.1.1**

**network 1.0.0.0 0.0.0.255 area 0**

**network 192.168.1.0 0.0.0.255 area 0**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 1.1.1.1

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

wsma agent exec

wsma agent config

wsma agent filesys

wsma agent notify

end

Building configuration...

Current configuration : 1918 bytes

version 16.7

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

hostname R1

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

subscriber templating

**ipv6 unicast-routing**

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO220523GF

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

**interface Loopback0**

**ip address 1.0.0.1 255.255.255.0**

**ipv6 address 1::1/64**

**ipv6 ospf 1 area 0**

**interface GigabitEthernet0/0/0**

**ip address 192.168.1.1 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 ospf 1 area 0**

**ipv6 ospf network point-to-point**

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

**R2 (OSPF)**

**R2#show run**

negotiation auto

**router ospf 1**

**router-id 2.2.2.2**

**network 2.0.0.0 0.0.0.255 area 0**

**network 192.168.1.0 0.0.0.255 area 0**

**network 192.168.2.0 0.0.0.255 area 0**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 2.2.2.2

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 4345 byte R2#show run

Building configuration...

\*Nov 16 23:03:58.482: %SYS-5-CONFIG\_I: Configured from console by console

Current configuration : 4192 bytes

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

platform punt-keepalive disable-kernel-core

hostname R2

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

**ipv6 unicast-routing**

multilink bundle-name authenticated

redundancy

mode none

**interface Loopback0**

**ip address 2.0.0.1 255.255.255.0**

**ipv6 address 2::1/64**

**ipv6 ospf 1 area 0**

**interface GigabitEthernet0/0/0**

**ip address 192.168.2.1 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 ospf 1 area 0**

**ipv6 ospf network point-to-point**

**interface GigabitEthernet0/0/1**

**ip address 192.168.1.2 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 ospf 1 area 0**

**ipv6 ospf network point-to-point**

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

**R3 (BGP/OSPF)**

**R3#show run**

no ip address

shutdown

negotiation auto

**router ospf 1**

**router-id 3.3.3.3**

**redistribute bgp 100 subnets**

**network 3.0.0.0 0.0.0.255 area 0**

**network 192.168.2.0 0.0.0.255 area 0**

**network 192.168.3.0 0.0.0.255 area 0**

**router bgp 100**

**bgp log-neighbor-changes**

**neighbor 2001:DB8:3::2 remote-as 200**

**neighbor 192.168.3.2 remote-as 200**

**address-family ipv4**

**network 3.0.0.0**

**network 192.168.2.0**

**network 192.168.3.0**

**redistribute ospf 1**

**no neighbor 2001:DB8:3::2 activate**

**neighbor 192.168.3.2 activate**

**exit-address-family**

**address-family ipv6**

**redistribute ospf 1**

**network 3::/64**

**network 2001:DB8:2::/64**

**network 2001:DB8:3::/64**

**neighbor 2001:DB8:3::2 activate**

**exit-address-family**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

eigrp router-id 3.3.3.3

redistribute bgp 100 metric 10000

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 4780 bytes

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

platform punt-keepalive disable-kernel-core

hostname R3

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

**ipv6 unicast-routing**

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21500G1N

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

**interface Loopback0**

**ip address 3.0.0.1 255.255.255.0**

**ipv6 address 3::1/64**

**ipv6 ospf 1 area 0**

**interface GigabitEthernet0/0/0**

**ip address 192.168.3.1 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 ospf 1 area 0**

**ipv6 ospf network point-to-point**

**interface GigabitEthernet0/0/1**

**ip address 192.168.2.2 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 ospf 1 area 0**

**ipv6 ospf network point-to-point**

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

**R4 (BGP/EIGRP)**

**R4#show run**

**neighbor 2001:DB8:3::1 remote-as 100**

**neighbor 192.168.3.1 remote-as 100**

**address-family ipv4**

**network 4.0.0.0**

**network 192.168.3.0**

**network 192.168.4.0**

**redistribute eigrp 10**

**no neighbor 2001:DB8:3::1 activate**

**neighbor 192.168.3.1 activate**

**exit-address-family**

**address-family ipv6**

**redistribute eigrp 10**

**network 4::/64**

**network 2001:DB8:3::/64**

**network 2001:DB8:4::/64**

**neighbor 2001:DB8:3::1 activate**

exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router eigrp 10

eigrp router-id 4.4.4.4

redistribute bgp 200 metric 10000 100 255 1 1500

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 2284 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname R4

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

**ipv6 unicast-routing**

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21441WDF

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

**interface Loopback0**

**ip address 4.0.0.1 255.255.255.0**

**ipv6 address 4::1/64**

**ipv6 enable**

**ipv6 eigrp 10**

**interface GigabitEthernet0/0/0**

**ip address 192.168.4.1 255.255.255.0**

**negotiation auto**

**ipv6 address 2001:DB8:4::1/64**

**ipv6 enable**

**ipv6 eigrp 10**

**interface GigabitEthernet0/0/1**

**ip address 192.168.3.2 255.255.255.0**

**negotiation auto**

**ipv6 address 2001:DB8:3::2/64**

**ipv6 enable**

**ipv6 eigrp 10**

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

interface Vlan1

no ip address

shutdown

**router eigrp 10**

**network 4.0.0.0 0.0.0.255**

**network 192.168.3.0**

**network 192.168.4.0**

**redistribute bgp 200 metric 10000 100 255 1 1500**

**eigrp router-id 4.4.4.4**

**router bgp 200**

**bgp log-neighbor-changes**

**R5 (EIGRP)**

**R5#show run**

ip tftp source-interface GigabitEthernet0

**ipv6 router eigrp 10**

**eigrp router-id 5.5.5.5**

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 1695 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname R5

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

**ipv6 unicast-routing**

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO215009QY

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

**interface Loopback0**

**ip address 5.0.0.1 255.255.255.0**

**ipv6 address 5::1/64**

**ipv6 enable**

**ipv6 eigrp 10**

**interface GigabitEthernet0/0/0**

**ip address 192.168.5.1 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 eigrp 10**

**interface GigabitEthernet0/0/1**

**ip address 192.168.4.2 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 eigrp 10**

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

interface Vlan1

no ip address

shutdown

**router eigrp 10**

**network 5.0.0.0 0.0.0.255**

**network 192.168.4.0**

**network 192.168.5.0**

**eigrp router-id 5.5.5.5**

ip forward-protocol nd

no ip http server

no ip http secure-server

**R6 (EIGRP)**

R6#show run

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 1602 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname R6

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

**ipv6 unicast-routing**

subscriber templating

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO214420HM

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

**interface Loopback0**

**ip address 6.0.0.1 255.255.255.0**

**ipv6 address 6::1/64**

**ipv6 enable**

**ipv6 eigrp 10**

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

**interface GigabitEthernet0/0/1**

**ip address 192.168.5.2 255.255.255.0**

**negotiation auto**

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

**ipv6 enable**

**ipv6 eigrp 10**

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

interface Vlan1

no ip address

shutdown

**router eigrp 10**

**network 6.0.0.0 0.0.0.255**

**network 192.168.5.0**

**eigrp router-id 6.6.6.6**

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

**ipv6 router eigrp 10**

**eigrp router-id 6.6.6.6**

IPv4 BGP Verification Commands (R3 & R4):

**R3 and Routing Table**

**R3#show ip bgp**

BGP table version is 16, local router ID is 3.0.0.1

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

r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,

x best-external, a additional-path, c RIB-compressed,

t secondary path, L long-lived-stale,

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

RPKI validation codes: V valid, I invalid, N Not found

Network Next Hop Metric LocPrf Weight Path

\*> 1.0.0.1/32 192.168.2.1 3 32768 ?

\*> 2.0.0.1/32 192.168.2.1 2 32768 ?

\*> 3.0.0.0/24 0.0.0.0 0 32768 ?

\*> 4.0.0.0/24 192.168.3.2 0 0 200 ?

\*> 5.0.0.0/24 192.168.3.2 130816 0 200 ?

\*> 6.0.0.0/24 192.168.3.2 131072 0 200 ?

\*> 192.168.1.0 192.168.2.1 2 32768 ?

\*> 192.168.2.0 0.0.0.0 0 32768 i

\* 192.168.3.0 192.168.3.2 0 0 200 i

\*> 0.0.0.0 0 32768 i

\*> 192.168.4.0 192.168.3.2 0 0 200 i

\*> 192.168.5.0 192.168.3.2 3072 0 200 ?

**R3#show ip bgp summary**

BGP router identifier 3.0.0.1, local AS number 100

BGP table version is 16, main routing table version 16

11 network entries using 2728 bytes of memory

12 path entries using 1632 bytes of memory

9/9 BGP path/bestpath attribute entries using 2520 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 6904 total bytes of memory

BGP activity 24/2 prefixes, 28/4 paths, scan interval 60 secs

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

192.168.3.2 4 200 57 55 16 0 0 00:44:40 6

**R3#show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

O 1.0.0.1 [110/3] via 192.168.2.1, 00:36:45, GigabitEthernet0/0/1

2.0.0.0/32 is subnetted, 1 subnets

O 2.0.0.1 [110/2] via 192.168.2.1, 00:38:29, GigabitEthernet0/0/1

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

C 3.0.0.0/24 is directly connected, Loopback0

L 3.0.0.1/32 is directly connected, Loopback0

4.0.0.0/24 is subnetted, 1 subnets

B 4.0.0.0 [20/0] via 192.168.3.2, 00:39:30

5.0.0.0/24 is subnetted, 1 subnets

B 5.0.0.0 [20/130816] via 192.168.3.2, 00:39:30

6.0.0.0/24 is subnetted, 1 subnets

B 6.0.0.0 [20/131072] via 192.168.3.2, 00:39:30

O 192.168.1.0/24 [110/2] via 192.168.2.1, 00:37:30, GigabitEthernet0/0/1

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

C 192.168.2.0/24 is directly connected, GigabitEthernet0/0/1

L 192.168.2.2/32 is directly connected, GigabitEthernet0/0/1

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

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

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

B 192.168.4.0/24 [20/0] via 192.168.3.2, 00:39:30

B 192.168.5.0/24 [20/3072] via 192.168.3.2, 00:39:30

**R4 and Routing Table**

**R4#show ip bgp**

BGP table version is 14, local router ID is 4.0.0.1

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

r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,

x best-external, a additional-path, c RIB-compressed,

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

RPKI validation codes: V valid, I invalid, N Not found

Network Next Hop Metric LocPrf Weight Path

\*> 1.0.0.1/32 192.168.3.1 3 0 100 ?

\*> 2.0.0.1/32 192.168.3.1 2 0 100 ?

\*> 3.0.0.0/24 192.168.3.1 0 0 100 ?

\*> 4.0.0.0/24 0.0.0.0 0 32768 ?

\*> 5.0.0.0/24 192.168.4.2 130816 32768 ?

\*> 6.0.0.0/24 192.168.4.2 131072 32768 ?

\*> 192.168.1.0 192.168.3.1 2 0 100 ?

\*> 192.168.2.0 192.168.3.1 0 0 100 i

\* 192.168.3.0 192.168.3.1 0 0 100 i

\*> 0.0.0.0 0 32768 i

\*> 192.168.4.0 0.0.0.0 0 32768 i

\*> 192.168.5.0 192.168.4.2 3072 32768 ?

**R4#show ip bgp summary**

BGP router identifier 4.0.0.1, local AS number 200

BGP table version is 14, main routing table version 14

11 network entries using 2728 bytes of memory

12 path entries using 1440 bytes of memory

9/9 BGP path/bestpath attribute entries using 2232 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 6424 total bytes of memory

BGP activity 23/1 prefixes, 28/4 paths, scan interval 60 secs

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

192.168.3.1 4 100 33 34 14 0 0 00:23:49 6

**R4#show ip route**

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

B 1.0.0.1 [20/3] via 192.168.3.1, 00:17:33

2.0.0.0/32 is subnetted, 1 subnets

B 2.0.0.1 [20/2] via 192.168.3.1, 00:19:16

3.0.0.0/24 is subnetted, 1 subnets

B 3.0.0.0 [20/0] via 192.168.3.1, 00:20:17

4.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 4.0.0.0/24 is directly connected, Loopback0

L 4.0.0.1/32 is directly connected, Loopback0

5.0.0.0/24 is subnetted, 1 subnets

D 5.0.0.0 [90/130816] via 192.168.4.2, 00:23:52, GigabitEthernet0/0/0

6.0.0.0/24 is subnetted, 1 subnets

D 6.0.0.0 [90/131072] via 192.168.4.2, 00:23:52, GigabitEthernet0/0/0

B 192.168.1.0/24 [20/2] via 192.168.3.1, 00:18:15

B 192.168.2.0/24 [20/0] via 192.168.3.1, 00:19:47

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

C 192.168.3.0/24 is directly connected, GigabitEthernet0/0/1

L 192.168.3.2/32 is directly connected, GigabitEthernet0/0/1

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

C 192.168.4.0/24 is directly connected, GigabitEthernet0/0/0

L 192.168.4.1/32 is directly connected, GigabitEthernet0/0/0

D 192.168.5.0/24 [90/3072] via 192.168.4.2, 00:23:52, GigabitEthernet0/0/0

Show IP Routes (non-BGP):

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, \* - candidate default, U - per-user static route

o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

a - application route

+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

**R1 (OSPF)**

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

C 1.0.0.0/24 is directly connected, Loopback0

L 1.0.0.1/32 is directly connected, Loopback0

2.0.0.0/32 is subnetted, 1 subnets

O 2.0.0.1 [110/2] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

3.0.0.0/32 is subnetted, 1 subnets

O 3.0.0.1 [110/3] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

4.0.0.0/24 is subnetted, 1 subnets

O E2 4.0.0.0 [110/1] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

5.0.0.0/24 is subnetted, 1 subnets

O E2 5.0.0.0 [110/1] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

6.0.0.0/24 is subnetted, 1 subnets

O E2 6.0.0.0 [110/1] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

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

C 192.168.1.0/24 is directly connected, GigabitEthernet0/0/0

L 192.168.1.1/32 is directly connected, GigabitEthernet0/0/0

O 192.168.2.0/24 [110/2] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

O 192.168.3.0/24 [110/3] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

O E2 192.168.4.0/24 [110/1] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

O E2 192.168.5.0/24 [110/1] via 192.168.1.2, 00:18:45, GigabitEthernet0/0/0

**R2 (OSPF)**

1.0.0.0/32 is subnetted, 1 subnets

O 1.0.0.1 [110/2] via 192.168.1.1, 00:38:52, GigabitEthernet0/0/1

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

C 2.0.0.0/24 is directly connected, Loopback0

L 2.0.0.1/32 is directly connected, Loopback0

3.0.0.0/32 is subnetted, 1 subnets

O 3.0.0.1 [110/2] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

4.0.0.0/24 is subnetted, 1 subnets

O E2 4.0.0.0 [110/1] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

5.0.0.0/24 is subnetted, 1 subnets

O E2 5.0.0.0 [110/1] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

6.0.0.0/24 is subnetted, 1 subnets

O E2 6.0.0.0 [110/1] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

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

C 192.168.1.0/24 is directly connected, GigabitEthernet0/0/1

L 192.168.1.2/32 is directly connected, GigabitEthernet0/0/1

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

C 192.168.2.0/24 is directly connected, GigabitEthernet0/0/0

L 192.168.2.1/32 is directly connected, GigabitEthernet0/0/0

O 192.168.3.0/24 [110/2] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

O E2 192.168.4.0/24 [110/1] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

O E2 192.168.5.0/24 [110/1] via 192.168.2.2, 00:40:31, GigabitEthernet0/0/0

**R5 (EIGRP)**

1.0.0.0/32 is subnetted, 1 subnets

D EX 1.0.0.1 [170/281856] via 192.168.4.1, 00:26:13, GigabitEthernet0/0/1

2.0.0.0/32 is subnetted, 1 subnets

D EX 2.0.0.1 [170/281856] via 192.168.4.1, 00:27:56, GigabitEthernet0/0/1

3.0.0.0/24 is subnetted, 1 subnets

D EX 3.0.0.0 [170/281856] via 192.168.4.1, 00:28:57, GigabitEthernet0/0/1

4.0.0.0/24 is subnetted, 1 subnets

D 4.0.0.0 [90/130816] via 192.168.4.1, 00:32:36, GigabitEthernet0/0/1

5.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 5.0.0.0/24 is directly connected, Loopback0

L 5.0.0.1/32 is directly connected, Loopback0

6.0.0.0/24 is subnetted, 1 subnets

D 6.0.0.0 [90/130816] via 192.168.5.2, 00:58:57, GigabitEthernet0/0/0

D EX 192.168.1.0/24

[170/281856] via 192.168.4.1, 00:26:54, GigabitEthernet0/0/1

D EX 192.168.2.0/24

[170/281856] via 192.168.4.1, 00:28:26, GigabitEthernet0/0/1

D 192.168.3.0/24 [90/3072] via 192.168.4.1, 00:29:52, GigabitEthernet0/0/1

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

C 192.168.4.0/24 is directly connected, GigabitEthernet0/0/1

L 192.168.4.2/32 is directly connected, GigabitEthernet0/0/1

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

C 192.168.5.0/24 is directly connected, GigabitEthernet0/0/0

L 192.168.5.1/32 is directly connected, GigabitEthernet0/0/0

**R6 (EIGRP)**

1.0.0.0/32 is subnetted, 1 subnets

D EX 1.0.0.1 [170/282112] via 192.168.5.1, 00:30:11, GigabitEthernet0/0/1

2.0.0.0/32 is subnetted, 1 subnets

D EX 2.0.0.1 [170/282112] via 192.168.5.1, 00:31:54, GigabitEthernet0/0/1

3.0.0.0/24 is subnetted, 1 subnets

D EX 3.0.0.0 [170/282112] via 192.168.5.1, 00:32:55, GigabitEthernet0/0/1

4.0.0.0/24 is subnetted, 1 subnets

D 4.0.0.0 [90/131072] via 192.168.5.1, 00:36:35, GigabitEthernet0/0/1

5.0.0.0/24 is subnetted, 1 subnets

D 5.0.0.0 [90/130816] via 192.168.5.1, 01:02:58, GigabitEthernet0/0/1

6.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 6.0.0.0/24 is directly connected, Loopback0

L 6.0.0.1/32 is directly connected, Loopback0

D EX 192.168.1.0/24

[170/282112] via 192.168.5.1, 00:30:53, GigabitEthernet0/0/1

D EX 192.168.2.0/24

[170/282112] via 192.168.5.1, 00:32:25, GigabitEthernet0/0/1

D 192.168.3.0/24 [90/3328] via 192.168.5.1, 00:33:50, GigabitEthernet0/0/1

D 192.168.4.0/24 [90/3072] via 192.168.5.1, 00:36:40, GigabitEthernet0/0/1

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

C 192.168.5.0/24 is directly connected, GigabitEthernet0/0/1

L 192.168.5.2/32 is directly connected, GigabitEthernet0/0/1

Show IPv6 Routes (All):

IPv6 Routing Table - default - 16 entries

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

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

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

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

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

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

**R1 (OSPF)**

C 1::/64 [0/0]

via Loopback0, directly connected

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

via Loopback0, receive

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

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

O 3::1/128 [110/2]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

OE2 4::/64 [110/10000]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

OE2 5::/64 [110/10000]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

OE2 6::/64 [110/10000]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

C 2001:DB8:1::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:1::1/128 [0/0]

via GigabitEthernet0/0/0, receive

O 2001:DB8:2::/64 [110/2]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

O 2001:DB8:3::/64 [110/3]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

OE2 2001:DB8:4::/64 [110/10000]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

OE2 2001:DB8:5::/64 [110/10000]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**R2 (OSPF)**

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

via FE80::272:78FF:FED6:D4A0, GigabitEthernet0/0/1

C 2::/64 [0/0]

via Loopback0, directly connected

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

via Loopback0, receive

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

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

OE2 4::/64 [110/10000]

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

OE2 5::/64 [110/10000]

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

OE2 6::/64 [110/10000]

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

C 2001:DB8:1::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:1::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 2001:DB8:2::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:2::1/128 [0/0]

via GigabitEthernet0/0/0, receive

O 2001:DB8:3::/64 [110/2]

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

OE2 2001:DB8:4::/64 [110/10000]

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

OE2 2001:DB8:5::/64 [110/10000]

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**R3 (BGP/OSPF)**

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

via FE80::521C:B0FF:FE2C:5100, GigabitEthernet0/0/1

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

via FE80::521C:B0FF:FE2C:5100, GigabitEthernet0/0/1

C 3::/64 [0/0]

via Loopback0, directly connected

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

via Loopback0, receive

B 4::/64 [20/0]

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/0

B 5::/64 [20/130816]

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/0

B 6::/64 [20/131072]

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/0

O 2001:DB8:1::/64 [110/2]

via FE80::521C:B0FF:FE2C:5100, GigabitEthernet0/0/1

C 2001:DB8:2::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:2::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 2001:DB8:3::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:3::1/128 [0/0]

via GigabitEthernet0/0/0, receive

B 2001:DB8:4::/64 [20/0]

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/0

B 2001:DB8:5::/64 [20/3072]

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**R4 (BGP/EIGRP)**

B 1::1/128 [20/2]

via FE80::521C:B0FF:FE63:3830, GigabitEthernet0/0/1

B 2::1/128 [20/1]

via FE80::521C:B0FF:FE63:3830, GigabitEthernet0/0/1

B 3::/64 [20/0]

via FE80::521C:B0FF:FE63:3830, GigabitEthernet0/0/1

C 4::/64 [0/0]

via Loopback0, directly connected

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

via Loopback0, receive

D 5::/64 [90/130816]

via FE80::CE8E:71FF:FE1E:22E1, GigabitEthernet0/0/0

D 6::/64 [90/131072]

via FE80::CE8E:71FF:FE1E:22E1, GigabitEthernet0/0/0

B 2001:DB8:1::/64 [20/2]

via FE80::521C:B0FF:FE63:3830, GigabitEthernet0/0/1

B 2001:DB8:2::/64 [20/0]

via FE80::521C:B0FF:FE63:3830, GigabitEthernet0/0/1

C 2001:DB8:3::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:3::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 2001:DB8:4::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:4::1/128 [0/0]

via GigabitEthernet0/0/0, receive

D 2001:DB8:5::/64 [90/3072]

via FE80::CE8E:71FF:FE1E:22E1, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**R5 (EIGRP)**

EX 1::1/128 [170/281856]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

EX 2::1/128 [170/281856]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

EX 3::/64 [170/281856]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

D 4::/64 [90/130816]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

C 5::/64 [0/0]

via Loopback0, directly connected

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

via Loopback0, receive

D 6::/64 [90/130816]

via FE80::B6A8:B9FF:FE47:9351, GigabitEthernet0/0/0

EX 2001:DB8:1::/64 [170/281856]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

EX 2001:DB8:2::/64 [170/281856]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

D 2001:DB8:3::/64 [90/3072]

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/1

C 2001:DB8:4::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:4::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 2001:DB8:5::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:5::1/128 [0/0]

via GigabitEthernet0/0/0, receive

L FF00::/8 [0/0]

via Null0, receive

**R6 (EIGRP)**

EX 1::1/128 [170/282112]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

EX 2::1/128 [170/282112]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

EX 3::/64 [170/282112]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

D 4::/64 [90/131072]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

D 5::/64 [90/130816]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

C 6::/64 [0/0]

via Loopback0, directly connected

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

via Loopback0, receive

EX 2001:DB8:1::/64 [170/282112]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

EX 2001:DB8:2::/64 [170/282112]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

D 2001:DB8:3::/64 [90/3328]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

D 2001:DB8:4::/64 [90/3072]

via FE80::CE8E:71FF:FE1E:22E0, GigabitEthernet0/0/1

C 2001:DB8:5::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:5::2/128 [0/0]

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

Verification Commands – Pings from Edge to Edge of Topology:

**R1**

**R1#ping 192.168.5.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.5.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/13 ms

**R1#ping 2001:db8:5::2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 2001:DB8:5::2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/6/28 ms

**R1#ping 6.0.0.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 6.0.0.1, timeout is 2 seconds:

!!!!!

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

**R1#ping 6::1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 6::1, timeout is 2 seconds:

!!!!!

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

**R6**

**R6#ping 192.168.1.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/14/70 ms

**R6#ping 2001:db8:1::1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 2001:DB8:1::1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms

**R6#ping 1.0.0.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 1.0.0.1, timeout is 2 seconds:

!!!!!

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

**R6#ping 1::1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 1::1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms

Verification Commands – Other Show Commands:

**R1 (OSPF)**

**#show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "application"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Maximum path: 32

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

Distance: (default is 4)

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 1.1.1.1

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

Maximum path: 4

Routing for Networks:

1.0.0.0 0.0.0.255 area 0

192.168.1.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

2.2.2.2 110 00:19:21

3.3.3.3 110 00:19:21

Distance: (default is 110)

**R1#show ipv6 protocols**

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "ospf 1"

Router ID 1.1.1.1

Number of areas: 1 normal, 0 stub, 0 nssa

Interfaces (Area 0):

Loopback0

GigabitEthernet0/0/0

Redistribution:

None

**R1#show ip ospf**

Routing Process "ospf 1" with ID 1.1.1.1

Start time: 00:39:36.172, Time elapsed: 00:20:49.053

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log enabled, Maximum number of events: 1000, Mode: cyclic

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

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

Number of external LSA 5. Checksum Sum 0x0157EE

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 2 (1 loopback)

Area has no authentication

SPF algorithm last executed 00:19:39.712 ago

SPF algorithm executed 7 times

Area ranges are

Number of LSA 5. Checksum Sum 0x021869

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

**R1#show ipv6 ospf**

Routing Process "ospfv3 1" with ID 1.1.1.1

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log enabled, Maximum number of events: 1000, Mode: cyclic

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

Retransmission limit dc 24 non-dc 24

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

Number of external LSA 5. Checksum Sum 0x03EE05

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

Graceful restart helper support enabled

Reference bandwidth unit is 100 mbps

RFC1583 compatibility enabled

Area BACKBONE(0)

Number of interfaces in this area is 2

SPF algorithm executed 5 times

Number of LSA 8. Checksum Sum 0x04E9A8

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

**R2 (OSPF)**

**R2#show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "application"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Maximum path: 32

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

Distance: (default is 4)

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 2.2.2.2

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

Maximum path: 4

Routing for Networks:

2.0.0.0 0.0.0.255 area 0

192.168.1.0 0.0.0.255 area 0

192.168.2.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

1.1.1.1 110 00:39:25

3.3.3.3 110 00:41:03

Distance: (default is 110)

**R2#show ipv6 protocols**

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "ospf 1"

Router ID 2.0.0.1

Number of areas: 1 normal, 0 stub, 0 nssa

Interfaces (Area 0):

Loopback0

GigabitEthernet0/0/1

GigabitEthernet0/0/0

Redistribution:

None

**R2#show ip ospf**

Routing Process "ospf 1" with ID 2.2.2.2

Start time: 00:37:41.732, Time elapsed: 00:42:32.799

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log enabled, Maximum number of events: 1000, Mode: cyclic

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

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

Number of external LSA 5. Checksum Sum 0x014DF3

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 3 (1 loopback)

Area has no authentication

SPF algorithm last executed 00:39:40.339 ago

SPF algorithm executed 13 times

Area ranges are

Number of LSA 5. Checksum Sum 0x020D6F

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

**R2#show ipv6 ospf**

Routing Process "ospfv3 1" with ID 2.0.0.1

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log enabled, Maximum number of events: 1000, Mode: cyclic

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

Retransmission limit dc 24 non-dc 24

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

Number of external LSA 5. Checksum Sum 0x03EE05

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

Graceful restart helper support enabled

Reference bandwidth unit is 100 mbps

RFC1583 compatibility enabled

Area BACKBONE(0)

Number of interfaces in this area is 3

SPF algorithm executed 12 times

Number of LSA 10. Checksum Sum 0x058132

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

**R3 (BGP/OSPF)**

**R3#show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "application"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Maximum path: 32

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

Distance: (default is 4)

Routing Protocol is "ospf 1"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Router ID 3.3.3.3

It is an autonomous system boundary router

Redistributing External Routes from,

bgp 100, includes subnets in redistribution

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

Maximum path: 4

Routing for Networks:

3.0.0.0 0.0.0.255 area 0

192.168.2.0 0.0.0.255 area 0

192.168.3.0 0.0.0.255 area 0

Routing Information Sources:

Gateway Distance Last Update

1.1.1.1 110 00:37:24

2.2.2.2 110 00:38:09

Distance: (default is 110)

Routing Protocol is "bgp 100"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

IGP synchronization is disabled

Automatic route summarization is disabled

Redistributing: ospf 1 (internal)

Neighbor(s):

Address FiltIn FiltOut DistIn DistOut Weight RouteMap

192.168.3.2

Maximum path: 1

Routing Information Sources:

Gateway Distance Last Update

192.168.3.2 20 00:40:09

Distance: external 20 internal 200 local 200

**R3#show ipv6 protocols**

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "ospf 1"

Router ID 3.0.0.1

Autonomous system boundary router

Number of areas: 1 normal, 0 stub, 0 nssa

Interfaces (Area 0):

Loopback0

GigabitEthernet0/0/1

GigabitEthernet0/0/0

Redistribution:

Redistributing protocol bgp 100 with metric 10000

IPv6 Routing Protocol is "bgp 100"

IGP synchronization is disabled

Redistribution:

Redistributing protocol ospf 1 (internal)

Neighbor(s):

Address FiltIn FiltOut Weight RoutemapIn RoutemapOut

2001:DB8:3::2

Distance:

R3#show ipv6 protocols

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "ospf 1"

Router ID 3.0.0.1

Autonomous system boundary router

Number of areas: 1 normal, 0 stub, 0 nssa

Interfaces (Area 0):

Loopback0

GigabitEthernet0/0/1

GigabitEthernet0/0/0

Redistribution:

Redistributing protocol bgp 100 with metric 10000

IPv6 Routing Protocol is "bgp 100"

IGP synchronization is disabled

Redistribution:

Redistributing protocol ospf 1 (internal)

Neighbor(s):

Address FiltIn FiltOut Weight RoutemapIn RoutemapOut

2001:DB8:3::2

Distance:

**R3#show ip ospf**

Routing Process "ospf 1" with ID 3.3.3.3

Start time: 00:36:38.956, Time elapsed: 00:43:13.102

Supports only single TOS(TOS0) routes

Supports opaque LSA

Supports Link-local Signaling (LLS)

Supports area transit capability

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log enabled, Maximum number of events: 1000, Mode: cyclic

It is an autonomous system boundary router

Redistributing External Routes from,

bgp 100, includes subnets in redistribution

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Incremental-SPF disabled

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

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

Number of external LSA 5. Checksum Sum 0x014DF3

Number of opaque AS LSA 0. Checksum Sum 0x000000

Number of DCbitless external and opaque AS LSA 0

Number of DoNotAge external and opaque AS LSA 0

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

Number of areas transit capable is 0

External flood list length 0

IETF NSF helper support enabled

Cisco NSF helper support enabled

Reference bandwidth unit is 100 mbps

Area BACKBONE(0)

Number of interfaces in this area is 3 (1 loopback)

Area has no authentication

SPF algorithm last executed 00:39:13.872 ago

SPF algorithm executed 15 times

Area ranges are

Number of LSA 5. Checksum Sum 0x020D6F

Number of opaque link LSA 0. Checksum Sum 0x000000

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

**R3#show ipv6 ospf**

Routing Process "ospfv3 1" with ID 3.0.0.1

Supports NSSA (compatible with RFC 3101)

Supports Database Exchange Summary List Optimization (RFC 5243)

Event-log enabled, Maximum number of events: 1000, Mode: cyclic

It is an autonomous system boundary router

Redistributing External Routes from,

bgp 100 with metric 10000

Router is not originating router-LSAs with maximum metric

Initial SPF schedule delay 50 msecs

Minimum hold time between two consecutive SPFs 200 msecs

Maximum wait time between two consecutive SPFs 5000 msecs

Initial LSA throttle delay 50 msecs

Minimum hold time for LSA throttle 200 msecs

Maximum wait time for LSA throttle 5000 msecs

Minimum LSA arrival 100 msecs

LSA group pacing timer 240 secs

Interface flood pacing timer 33 msecs

Retransmission pacing timer 66 msecs

Retransmission limit dc 24 non-dc 24

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

Number of external LSA 5. Checksum Sum 0x03EE05

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

Graceful restart helper support enabled

Reference bandwidth unit is 100 mbps

RFC1583 compatibility enabled

Area BACKBONE(0)

Number of interfaces in this area is 3

SPF algorithm executed 12 times

Number of LSA 9. Checksum Sum 0x044BFC

Number of DCbitless LSA 0

Number of indication LSA 0

Number of DoNotAge LSA 0

Flood list length 0

**R4 (BGP/EIRGP)**

**R4#show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "application"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Maximum path: 32

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

Distance: (default is 4)

Routing Protocol is "eigrp 10"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Default networks flagged in outgoing updates

Default networks accepted from incoming updates

Redistributing: bgp 200

EIGRP-IPv4 Protocol for AS(10)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

Soft SIA disabled

NSF-aware route hold timer is 240

EIGRP NSF disabled

NSF signal timer is 20s

NSF converge timer is 120s

Router-ID: 4.4.4.4

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 4

Maximum hopcount 100

Maximum metric variance 1

Automatic Summarization: disabled

Maximum path: 4

Routing for Networks:

4.0.0.0/24

192.168.3.0

192.168.4.0

Routing Information Sources:

Gateway Distance Last Update

192.168.4.2 90 00:25:09

Distance: internal 90 external 170

Routing Protocol is "bgp 200"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

IGP synchronization is disabled

Automatic route summarization is disabled

Redistributing: eigrp 10

Neighbor(s):

Address FiltIn FiltOut DistIn DistOut Weight RouteMap

192.168.3.1

Maximum path: 1

Routing Information Sources:

Gateway Distance Last Update

192.168.3.1 20 00:18:53

Distance: external 20 internal 200 local 200

**R4#show ipv6 protocols**

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "bgp 200"

IGP synchronization is disabled

Redistribution:

Redistributing protocol eigrp 10

Neighbor(s):

Address FiltIn FiltOut Weight RoutemapIn RoutemapOut

2001:DB8:3::1

IPv6 Routing Protocol is "eigrp 10"

EIGRP-IPv6 Protocol for AS(10)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

Soft SIA disabled

NSF-aware route hold timer is 240

EIGRP NSF disabled

NSF signal timer is 20s

NSF converge timer is 120s

Router-ID: 4.4.4.4

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 16

Maximum hopcount 100

Maximum metric variance 1

Interfaces:

Loopback0

GigabitEthernet0/0/0

GigabitEthernet0/0/1

Redistribution:

Redistributing protocol bgp 200 with metric 10000 100 255 1 1500

**R4#show ip eigrp 10 topology**

EIGRP-IPv4 Topology Table for AS(10)/ID(4.4.4.4)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 192.168.3.0/24, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/1

P 6.0.0.0/24, 1 successors, FD is 131072

via 192.168.4.2 (131072/130816), GigabitEthernet0/0/0

P 192.168.2.0/24, 1 successors, FD is 281600, tag is 100

via Redistributed (281600/0)

P 5.0.0.0/24, 1 successors, FD is 130816

via 192.168.4.2 (130816/128256), GigabitEthernet0/0/0

P 4.0.0.0/24, 1 successors, FD is 128256

via Connected, Loopback0

P 1.0.0.1/32, 1 successors, FD is 281600, tag is 100

via Redistributed (281600/0)

P 192.168.1.0/24, 1 successors, FD is 281600, tag is 100

via Redistributed (281600/0)

P 192.168.4.0/24, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/0

P 3.0.0.0/24, 1 successors, FD is 281600, tag is 100

via Redistributed (281600/0)

P 192.168.5.0/24, 1 successors, FD is 3072

via 192.168.4.2 (3072/2816), GigabitEthernet0/0/0

P 2.0.0.1/32, 1 successors, FD is 281600, tag is 100

via Redistributed (281600/0)

**R4#show ipv6 eigrp 10 topology**

EIGRP-IPv6 Topology Table for AS(10)/ID(4.4.4.4)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 6::/64, 1 successors, FD is 131072

via FE80::CE8E:71FF:FE1E:22E1 (131072/130816), GigabitEthernet0/0/0

P 2001:DB8:3::/64, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/1

P 5::/64, 1 successors, FD is 130816

via FE80::CE8E:71FF:FE1E:22E1 (130816/128256), GigabitEthernet0/0/0

P 2001:DB8:5::/64, 1 successors, FD is 3072

via FE80::CE8E:71FF:FE1E:22E1 (3072/2816), GigabitEthernet0/0/0

P 2::1/128, 1 successors, FD is 281600

via Redistributed (281600/0)

P 2001:DB8:4::/64, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/0

P 1::1/128, 1 successors, FD is 281600

via Redistributed (281600/0)

P 2001:DB8:2::/64, 1 successors, FD is 281600

via Redistributed (281600/0)

P 3::/64, 1 successors, FD is 281600

via Redistributed (281600/0)

P 4::/64, 1 successors, FD is 128256

via Connected, Loopback0

P 2001:DB8:1::/64, 1 successors, FD is 281600

via Redistributed (281600/0)

**R5 (EIGRP)**

**R5#show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "application"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Maximum path: 32

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

Distance: (default is 4)

Routing Protocol is "eigrp 10"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Default networks flagged in outgoing updates

Default networks accepted from incoming updates

EIGRP-IPv4 Protocol for AS(10)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

Soft SIA disabled

NSF-aware route hold timer is 240

EIGRP NSF disabled

NSF signal timer is 20s

NSF converge timer is 120s

Router-ID: 5.5.5.5

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 4

Maximum hopcount 100

Maximum metric variance 1

Automatic Summarization: disabled

Maximum path: 4

Routing for Networks:

5.0.0.0/24

192.168.4.0

192.168.5.0

Routing Information Sources:

Gateway Distance Last Update

192.168.4.1 90 00:26:56

192.168.5.2 90 00:26:56

Distance: internal 90 external 170

**R5#show ipv6 protocols**

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "eigrp 10"

EIGRP-IPv6 Protocol for AS(10)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

Soft SIA disabled

NSF-aware route hold timer is 240

EIGRP NSF disabled

NSF signal timer is 20s

NSF converge timer is 120s

Router-ID: 5.5.5.5

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 16

Maximum hopcount 100

Maximum metric variance 1

Interfaces:

Loopback0

GigabitEthernet0/0/0

GigabitEthernet0/0/1

Redistribution:

None

**R5#show ip eigrp 10 topology**

EIGRP-IPv4 Topology Table for AS(10)/ID(5.5.5.5)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 192.168.3.0/24, 1 successors, FD is 3072

via 192.168.4.1 (3072/2816), GigabitEthernet0/0/1

P 6.0.0.0/24, 1 successors, FD is 130816

via 192.168.5.2 (130816/128256), GigabitEthernet0/0/0

P 192.168.2.0/24, 1 successors, FD is 281856, tag is 100

via 192.168.4.1 (281856/281600), GigabitEthernet0/0/1

P 5.0.0.0/24, 1 successors, FD is 128256

via Connected, Loopback0

P 4.0.0.0/24, 1 successors, FD is 130816

via 192.168.4.1 (130816/128256), GigabitEthernet0/0/1

P 1.0.0.1/32, 1 successors, FD is 281856, tag is 100

via 192.168.4.1 (281856/281600), GigabitEthernet0/0/1

P 192.168.1.0/24, 1 successors, FD is 281856, tag is 100

via 192.168.4.1 (281856/281600), GigabitEthernet0/0/1

P 192.168.4.0/24, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/1

P 3.0.0.0/24, 1 successors, FD is 281856, tag is 100

via 192.168.4.1 (281856/281600), GigabitEthernet0/0/1

P 192.168.5.0/24, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/0

P 2.0.0.1/32, 1 successors, FD is 281856, tag is 100

via 192.168.4.1 (281856/281600), GigabitEthernet0/0/1

**R5#show ipv6 eigrp 10 topology**

EIGRP-IPv6 Topology Table for AS(10)/ID(5.5.5.5)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 6::/64, 1 successors, FD is 130816

via FE80::B6A8:B9FF:FE47:9351 (130816/128256), GigabitEthernet0/0/0

P 2001:DB8:3::/64, 1 successors, FD is 3072

via FE80::B6A8:B9FF:FE47:9230 (3072/2816), GigabitEthernet0/0/1

P 5::/64, 1 successors, FD is 128256

via Connected, Loopback0

P 2001:DB8:5::/64, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/0

P 2::1/128, 1 successors, FD is 281856

via FE80::B6A8:B9FF:FE47:9230 (281856/281600), GigabitEthernet0/0/1

P 2001:DB8:4::/64, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/1

P 1::1/128, 1 successors, FD is 281856

via FE80::B6A8:B9FF:FE47:9230 (281856/281600), GigabitEthernet0/0/1

P 2001:DB8:2::/64, 1 successors, FD is 281856

via FE80::B6A8:B9FF:FE47:9230 (281856/281600), GigabitEthernet0/0/1

P 3::/64, 1 successors, FD is 281856

via FE80::B6A8:B9FF:FE47:9230 (281856/281600), GigabitEthernet0/0/1

P 4::/64, 1 successors, FD is 130816

via FE80::B6A8:B9FF:FE47:9230 (130816/128256), GigabitEthernet0/0/1

P 2001:DB8:1::/64, 1 successors, FD is 281856

via FE80::B6A8:B9FF:FE47:9230 (281856/281600), GigabitEthernet0/0/1

**R6 (EIGRP)**

**R6#show ip protocols**

\*\*\* IP Routing is NSF aware \*\*\*

Routing Protocol is "application"

Sending updates every 0 seconds

Invalid after 0 seconds, hold down 0, flushed after 0

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Maximum path: 32

Routing for Networks:

Routing Information Sources:

Gateway Distance Last Update

Distance: (default is 4)

Routing Protocol is "eigrp 10"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Default networks flagged in outgoing updates

Default networks accepted from incoming updates

EIGRP-IPv4 Protocol for AS(10)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

Soft SIA disabled

NSF-aware route hold timer is 240

EIGRP NSF disabled

NSF signal timer is 20s

NSF converge timer is 120s

Router-ID: 6.6.6.6

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 4

Maximum hopcount 100

Maximum metric variance 1

Automatic Summarization: disabled

Maximum path: 4

Routing for Networks:

6.0.0.0/24

192.168.5.0

Routing Information Sources:

Gateway Distance Last Update

192.168.5.1 90 00:30:54

Distance: internal 90 external 170

**R6#show ipv6 protocols**

IPv6 Routing Protocol is "connected"

IPv6 Routing Protocol is "application"

IPv6 Routing Protocol is "ND"

IPv6 Routing Protocol is "eigrp 10"

EIGRP-IPv6 Protocol for AS(10)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

Soft SIA disabled

NSF-aware route hold timer is 240

EIGRP NSF disabled

NSF signal timer is 20s

NSF converge timer is 120s

Router-ID: 6.6.6.6

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 16

Maximum hopcount 100

Maximum metric variance 1

Interfaces:

Loopback0

GigabitEthernet0/0/1

Redistribution:

None

**R6#show ip eigrp 10 topology**

EIGRP-IPv4 Topology Table for AS(10)/ID(6.6.6.6)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 192.168.3.0/24, 1 successors, FD is 3328

via 192.168.5.1 (3328/3072), GigabitEthernet0/0/1

P 6.0.0.0/24, 1 successors, FD is 128256

via Connected, Loopback0

P 192.168.2.0/24, 1 successors, FD is 282112, tag is 100

via 192.168.5.1 (282112/281856), GigabitEthernet0/0/1

P 5.0.0.0/24, 1 successors, FD is 130816

via 192.168.5.1 (130816/128256), GigabitEthernet0/0/1

P 4.0.0.0/24, 1 successors, FD is 131072

via 192.168.5.1 (131072/130816), GigabitEthernet0/0/1

P 1.0.0.1/32, 1 successors, FD is 282112, tag is 100

via 192.168.5.1 (282112/281856), GigabitEthernet0/0/1

P 192.168.1.0/24, 1 successors, FD is 282112, tag is 100

via 192.168.5.1 (282112/281856), GigabitEthernet0/0/1

P 192.168.4.0/24, 1 successors, FD is 3072

via 192.168.5.1 (3072/2816), GigabitEthernet0/0/1

P 3.0.0.0/24, 1 successors, FD is 282112, tag is 100

via 192.168.5.1 (282112/281856), GigabitEthernet0/0/1

P 192.168.5.0/24, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/1

P 2.0.0.1/32, 1 successors, FD is 282112, tag is 100

via 192.168.5.1 (282112/281856), GigabitEthernet0/0/1

**R6#show ipv6 eigrp 10 topology**

EIGRP-IPv6 Topology Table for AS(10)/ID(6.6.6.6)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 6::/64, 1 successors, FD is 128256

via Connected, Loopback0

P 2001:DB8:3::/64, 1 successors, FD is 3328

via FE80::CE8E:71FF:FE1E:22E0 (3328/3072), GigabitEthernet0/0/1

P 5::/64, 1 successors, FD is 130816

via FE80::CE8E:71FF:FE1E:22E0 (130816/128256), GigabitEthernet0/0/1

P 2001:DB8:5::/64, 1 successors, FD is 2816

via Connected, GigabitEthernet0/0/1

P 2::1/128, 1 successors, FD is 282112

via FE80::CE8E:71FF:FE1E:22E0 (282112/281856), GigabitEthernet0/0/1

P 2001:DB8:4::/64, 1 successors, FD is 3072

via FE80::CE8E:71FF:FE1E:22E0 (3072/2816), GigabitEthernet0/0/1

P 1::1/128, 1 successors, FD is 282112

via FE80::CE8E:71FF:FE1E:22E0 (282112/281856), GigabitEthernet0/0/1

P 2001:DB8:2::/64, 1 successors, FD is 282112

via FE80::CE8E:71FF:FE1E:22E0 (282112/281856), GigabitEthernet0/0/1

P 3::/64, 1 successors, FD is 282112

via FE80::CE8E:71FF:FE1E:22E0 (282112/281856), GigabitEthernet0/0/1

P 4::/64, 1 successors, FD is 131072

via FE80::CE8E:71FF:FE1E:22E0 (131072/130816), GigabitEthernet0/0/1

P 2001:DB8:1::/64, 1 successors, FD is 282112

via FE80::CE8E:71FF:FE1E:22E0 (282112/281856), GigabitEthernet0/0/1

**Problems**

There were several issues relating to configuration of the 3 separate routing protocols. Because the lab is done in pairs, my partner, Aidan Garner, and I split the work so each of us configured an interior routing protocol. However, the issue was that are naming preferences for subnet masks and IP addresses were different, and it wasn’t until many mismatch errors in the BGP link that we realized that our subnets were different. This also led to address inconsistencies for both IPv4 and IPv6. We solved this by mutually agreeing upon using a /24 subnet, and we also used an addressing table to determine with confidence which interface should be named what.

After many troubles of not seeing the BGP routes, it was with the help of Advanced CCNP lab partners, Tyler Chung and Adhvitha Sivaghanesh, who helped explicitly explain the nature of redistributing commands. Given the command, Aidan and I were able to configure BGP for IPv4. However, another redistributing error occurred. After a disarray of missing certain IPv6 routes and messing up Autonomous System numbers, we finally figured out the Address-Family IPv6 sub-configuration command for BGP. This command was essential to the proper functionality of the IPv6 portion of BGP configuration.

**Conclusion**

Knowing the applications, potential, and sophistication of BGP for its fundamental involvement with the internet, it was incredibly fascinating to be able to get a basic configuration of the protocol. The most crucial command, as well as the one that took the longest to discover and use, was the *redistributing* aspect of BGP. I will remember this command setup for the future of my networking journey and am fortunate enough to be able to have the opportunity to configure it.