iBGP

CCNP Lab 5

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*Lab 5: BGP with iBGP*

**Purpose**

The objective of the lab was to understand and configure the Internal Border Gateway Protocol (iBGP) within a transit Autonomous System (AS) for both IPv4 and IPv6. The transit AS serves as BGP continuation between two connected individual AS’s, with the goal to distribute BGP routes throughout all 3 AS’s without redistributing any Internal Gateway Protocols (OSPFv3 and EIGRP) through the transit AS. This is done because of iBGP. Another objective was to understand its applications for the internet and its purpose in real life scenarios.

**Background Information**

Internal Border Gateway Protocol (iBGP) is a unique property of BGP where it can exchange routing and relationship information on top of an existing Internal Gateway Protocol through a transit AS. It is used to connect independent Autonomous Systems through said transit ASs for both IPv4 and IPv6 routing without requiring redistributing through the various IGP’s of those networks. In other words, the purpose of iBGP is to directly allow eBGP route advertisements to be forwarded throughout the network.

iBGP is enabled when BGP devices are peered together in the same autonomous system. BGP uses the same message types on iBGP and external BGP (eBGP) sessions. iBGP follows the same peering and route learning processes as eBGP. The differences are in the peering session properties and message interpretations.

iBGP neighbors have to be in fully meshed peering through logical routes if not directly connected. Readvertising of iBGP-learned routes in iBGP peering has been prevented and full mesh peering is required to prevent routing loops within the AS. In other words, new routes learned from iBGP peering are only readvertised to eBGP peers, not to iBGP peers.

An alternative to the fully meshed convention is the use of Route Reflectors (RR). This is a method of internal scalability where the RR acts as a concentrated node, or a central point, where multiple iBGP routers can localize towards. Disadvantages include the lack of redundancy, as it is a can be a single point of failure in the network. Another practice would be the implementation of BGP confederations, used for the simplification of AS naming in the grand scheme of the internet. It is composed of several manageable internal ASs connected with each other under the confederation which is seen as a single AS to the internet. ASs within the confederation exchange routing as if they used iBGP, meaning that the confederation then preserves all routing information.

Complex uses of iBGP were not used in this lab. This project served as a standard understanding of iBGP properties and basic structural visualization.

**Lab Summary**

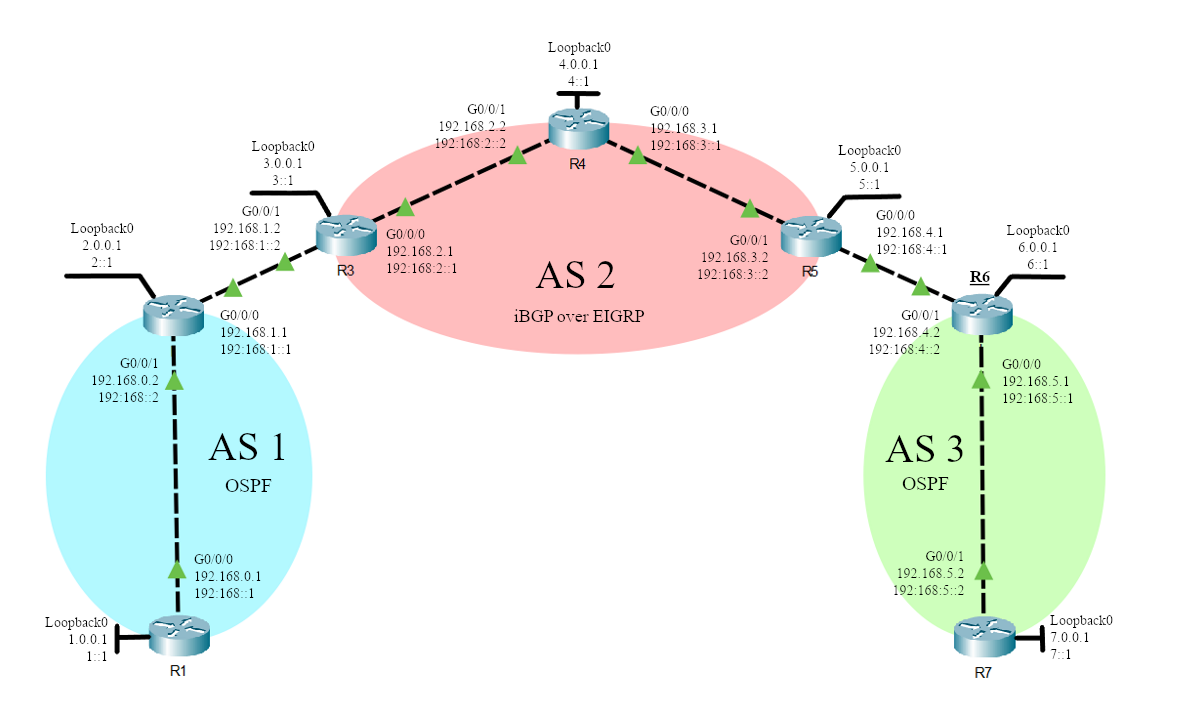
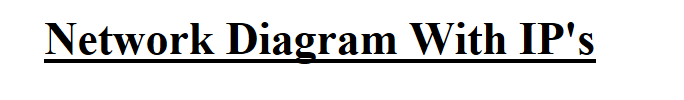
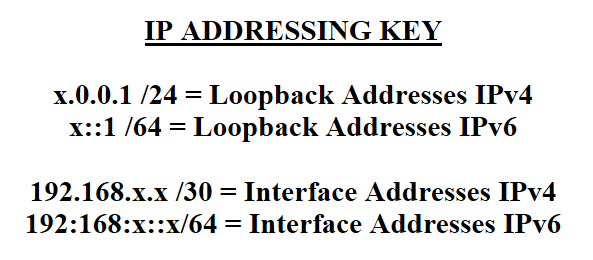
Seven Cisco 4321 routers were set up once again in a bus-like topology, split into 3 groups. Two of these groups consist of 2 routers each running OSPF. The last group was configured as EIGRP, consisting of the 3 other routers and serving as the transit Autonomous System that connects between the two OSPF AS’s (See Network Diagram with IP’s).

After the internal gateway protocols were set up in respect to each one’s AS, BGP neighboring was done between the border routers for eBGP connections. Within the transit AS, the 3 routers have a mesh BGP neighboring where each router sees all the others. Because they are all within the same AS, this is considered iBGP. On the border routers of the OSPF domains, the router is configured to redistribute its BGP received routes to OSPF-visible ones. However, it is extremely important to clarify that redistributing cannot be done on the transit AS border routers or else it would undermine the use of iBGP. No redistributing is done on R3 nor R5.

When the entire network is functional for both IPv4 and IPv6, OSPF domains of AS 1 and AS 3 will be able to interact and see each other on the routing table. To emphasize that the routes are discovered and shared through iBGP rather than protocol redistribution, various show commands can be used to determine BGP internal link functionality (See Verification Commands – Other Show Commands).

**Table of IP’s**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Router 1** | **Router 2** | **Router 3** | **Router 4** | **Router 5** | **Router 6** | **Router 7** |
| **Gig Interfaces (Ipv4)**  *All subnets are of /24* | **-----**      **G0/0/0: 192.168.0.1** | **G0/0/1: 192.168.0.2**    **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* | **-----**      **G0/0/0: 192:168::1** | **G0/0/1: 192:168::2**    **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**    **-----** |
| **Loopback Interfaces** | **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** | **7.0.0.1**  **7::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** | **7.7.7.7** |

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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.

**neighbor [*neighbor address]* remote-as [*autonomous-system-number]*** *–* Sets the BGP neighbor network for the BGP router to see. Neighbors of the same Autonomous System numbers are considered iBGP peers.

**network [network address] [wildcard mask]** – Enables said network to be advertised to the respective protocol’s 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 current protocol.

**show ip bgp // show bgp ipv6 –** Displays entries in the BGP routing table.

**show ip bgp neighbors // show bgp ipv6 unicast neighbors | include BGP –** Displays the status of BGP neighbor link.

**show ip bgp summary // show bgp ipv6 unicast summary–** Displays the status of BGP routes.

**Configurations**

Show Running-Configurations:

**R1 (OSPF)**

**R1#show run**

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

negotiation auto

**router ospfv3 10**

**router-id 1.1.1.1**

**address-family ipv6 unicast**

**exit-address-family**

**router ospf 10**

**router-id 1.1.1.1**

**network 1.0.0.0 0.0.0.255 area 1**

**network 192.168.0.0 0.0.0.255 area 1**

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

wsma agent exec

wsma agent config

wsma agent filesys

wsma agent notify

end

Building configuration...

Current configuration : 2277 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

**hostname R1**

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

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 enable**

**ipv6 ospf 10 area 1**

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

**interface GigabitEthernet0/0/0**

**ip address 192.168.0.1 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168::1/64**

**ipv6 enable**

**ipv6 ospf 10 area 1**

**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

**R2 (OSPF/BGP)**

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

**router ospfv3 10**

**router-id 2.2.2.2**

**address-family ipv4 unicast**

**exit-address-family**

**address-family ipv6 unicast**

**redistribute bgp 1**

**exit-address-family**

**router ospf 10**

**router-id 2.2.2.2**

**redistribute bgp 1 subnets**

**network 2.0.0.0 0.0.0.255 area 1**

**network 192.168.0.0 0.0.0.255 area 1**

**network 192.168.1.0 0.0.0.255 area 1**

**router bgp 1**

**bgp log-neighbor-changes**

**neighbor 192:168:1::2 remote-as 2**

**neighbor 192.168.1.2 remote-as 2**

**address-family ipv4**

**network 2.0.0.0**

**network 192.168.0.0**

**network 192.168.1.0**

**redistribute ospfv3 10**

**redistribute ospf 10**

**no neighbor 192:168:1::2 activate**

**neighbor 192.168.1.2 activate**

**exit-address-family**

**address-family ipv6**

**redistribute ospf 10**

**network 2::/64**

**network 192:168::/64**

**network 192:168:1::/64**

**neighbor 192:168:1::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

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R2#show run**

Building configuration...

Current configuration : 2277 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

**hostname R2**

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

**ipv6 unicast-routing**

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21482DXE

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

**interface Loopback0**

**ip address 2.0.0.1 255.255.255.0**

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

**ipv6 enable**

**ipv6 ospf 10 area 1**

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

**interface GigabitEthernet0/0/0**

**ip address 192.168.1.1 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:1::1/64**

**ipv6 enable**

**ipv6 ospf 10 area 1**

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

**interface GigabitEthernet0/0/1**

**ip address 192.168.0.2 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168::2/64**

**ipv6 enable**

**ipv6 ospf 10 area 1**

**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

**R3 (EIGRP/BGP)**

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

**router eigrp 2**

**network 3.0.0.0**

**network 192.168.1.0**

**network 192.168.2.0**

**eigrp router-id 3.3.3.3**

**router bgp 2**

**bgp log-neighbor-changes**

**neighbor 192:168:1::1 remote-as 1**

**neighbor 192:168:2::2 remote-as 2**

**neighbor 192:168:3::2 remote-as 2**

**neighbor 192.168.1.1 remote-as 1**

**neighbor 192.168.2.2 remote-as 2**

**neighbor 192.168.3.2 remote-as 2**

**address-family ipv4**

**network 3.0.0.0**

**network 192.168.1.0**

**network 192.168.2.0**

**no neighbor 192:168:1::1 activate**

**no neighbor 192:168:2::2 activate**

**no neighbor 192:168:3::2 activate**

**neighbor 192.168.1.1 activate**

**neighbor 192.168.2.2 activate**

**neighbor 192.168.3.2 activate**

**exit-address-family**

**address-family ipv6**

**network 3::/64**

**network 192:168:1::/64**

**network 192:168:2::/64**

**neighbor 192:168:1::1 activate**

**neighbor 192:168:2::2 activate**

**neighbor 192:168:3::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 eigrp 2**

**eigrp router-id 3.3.3.3**

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R3#show run**

Building configuration...

Current configuration : 2277 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

**hostname R3**

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

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 enable**

**ipv6 eigrp 2**

**interface GigabitEthernet0/0/0**

**ip address 192.168.2.1 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:2::1/64**

**ipv6 enable**

**ipv6 eigrp 2**

**interface GigabitEthernet0/0/1**

**ip address 192.168.1.2 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:1::2/64**

**ipv6 enable**

**ipv6 eigrp 2**

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

**R4 (EIGRP/BGP)**

**R4#show run**

**router eigrp 2**

**network 4.0.0.0**

**network 192.168.2.0**

**network 192.168.3.0**

**eigrp router-id 4.4.4.4**

**router bgp 2**

**bgp log-neighbor-changes**

**neighbor 192:168:2::1 remote-as 2**

**neighbor 192:168:3::2 remote-as 2**

**neighbor 192.168.2.1 remote-as 2**

**neighbor 192.168.3.2 remote-as 2**

**address-family ipv4**

**network 4.0.0.0**

**network 192.168.2.0**

**network 192.168.3.0**

**no neighbor 192:168:2::1 activate**

**no neighbor 192:168:3::2 activate**

**neighbor 192.168.2.1 activate**

**neighbor 192.168.3.2 activate**

**exit-address-family**

**address-family ipv6**

**network 4::/64**

**network 192:168:2::/64**

**network 192:168:3::/64**

**neighbor 192:168:2::1 activate**

**neighbor 192:168:3::2 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 2**

**eigrp router-id 4.4.4.4**

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

Building configuration...

Current configuration : 2278 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 2**

**interface GigabitEthernet0/0/0**

**ip address 192.168.3.1 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:3::1/64**

**ipv6 enable**

**ipv6 eigrp 2**

**interface GigabitEthernet0/0/1**

**ip address 192.168.2.2 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:2::2/64**

**ipv6 enable**

**ipv6 eigrp 2**

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

**R5 (EIGRP/BGP)**

**router eigrp 2**

**network 5.0.0.0**

**network 192.168.3.0**

**network 192.168.4.0**

**eigrp router-id 5.5.5.5**

**router bgp 2**

**bgp log-neighbor-changes**

**neighbor 192:168:2::1 remote-as 2**

**neighbor 192:168:3::1 remote-as 2**

**neighbor 192:168:4::2 remote-as 3**

**neighbor 192.168.2.1 remote-as 2**

**neighbor 192.168.3.1 remote-as 2**

**neighbor 192.168.4.2 remote-as 3**

**address-family ipv4**

**network 5.0.0.0**

**network 192.168.3.0**

**network 192.168.4.0**

**no neighbor 192:168:2::1 activate**

**no neighbor 192:168:3::1 activate**

**no neighbor 192:168:4::2 activate**

**neighbor 192.168.2.1 activate**

**neighbor 192.168.3.1 activate**

**neighbor 192.168.4.2 activate**

**exit-address-family**

**address-family ipv6**

**network 5::/64**

**network 192:168:3::/64**

**network 192:168:4::/64**

**neighbor 192:168:2::1 activate**

**neighbor 192:168:3::1 activate**

**neighbor 192:168:4::2 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 2**

**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

**R5#show run**

Building configuration...

Current configuration : 2448 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 2**

**interface GigabitEthernet0/0/0**

**ip address 192.168.4.1 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:4::1/64**

**ipv6 enable**

**ipv6 eigrp 2**

**interface GigabitEthernet0/0/1**

**ip address 192.168.3.2 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:3::2/64**

**ipv6 enable**

**ipv6 eigrp 2**

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

**R6 (OSPF/BGP)**

**router ospfv3 30**

**router-id 6.6.6.6**

**address-family ipv4 unicast**

**exit-address-family**

**address-family ipv6 unicast**

**redistribute bgp 3**

**exit-address-family**

**router ospf 30**

**router-id 6.6.6.6**

**redistribute bgp 3 subnets**

**network 6.0.0.0 0.0.0.255 area 3**

**network 192.168.4.0 0.0.0.255 area 3**

**network 192.168.5.0 0.0.0.255 area 3**

**router bgp 3**

**bgp log-neighbor-changes**

**neighbor 192:168:4::1 remote-as 2**

**neighbor 192.168.4.1 remote-as 2**

**address-family ipv4**

**network 6.0.0.0**

**network 192.168.4.0**

**network 192.168.5.0**

**redistribute ospfv3 30**

**redistribute ospf 30**

**no neighbor 192:168:4::1 activate**

**neighbor 192.168.4.1 activate**

**exit-address-family**

**address-family ipv6**

**redistribute ospf 30**

**network 6::/64**

**network 192:168:4::/64**

**network 192:168:5::/64**

**neighbor 192:168:4::1 activate**

**exit-address-family**

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R6#show run**

Building configuration...

Current configuration : 2478 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 ospf 30 area 3**

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

**interface GigabitEthernet0/0/0**

**ip address 192.168.5.1 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:5::1/64**

**ipv6 enable**

**ipv6 ospf 30 area 3**

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

**interface GigabitEthernet0/0/1**

**ip address 192.168.4.2 255.255.255.0**

**negotiation auto**

**ipv6 address 192:168:4::2/64**

**ipv6 ospf 30 area 3**

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

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

**R7 (OSPF)**

**router ospfv3 30**

**router-id 7.7.7.7**

**address-family ipv6 unicast**

**exit-address-family**

**router ospf 30**

**router-id 7.7.7.7**

**network 7.0.0.0 0.0.0.255 area 3**

**network 192.168.5.0 0.0.0.255 area 3**

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R7#show run**

Building configuration...

Current configuration : 1739 bytes

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

**hostname R7**

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 FDO214414DZ

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

**interface Loopback0**

**ip address 7.0.0.1 255.255.255.0**

**ipv6 address 7::1/64**

**ipv6 enable**

**ipv6 ospf 30 area 3**

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

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 192:168:5::2/64**

**ipv6 enable**

**ipv6 ospf 30 area 3**

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

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

Show IP Routes:

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 192.168.0.2, 00:13:24, GigabitEthernet0/0/0

6.0.0.0/24 is subnetted, 1 subnets

O E2 6.0.0.0 [110/1] via 192.168.0.2, 00:08:29, GigabitEthernet0/0/0

7.0.0.0/32 is subnetted, 1 subnets

O E2 7.0.0.1 [110/1] via 192.168.0.2, 00:08:29, GigabitEthernet0/0/0

192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.0.0/24 is directly connected, GigabitEthernet0/0/0

L 192.168.0.1/32 is directly connected, GigabitEthernet0/0/0

O 192.168.1.0/24 [110/2] via 192.168.0.2, 00:12:27, GigabitEthernet0/0/0

O E2 192.168.2.0/24 [110/1] via 192.168.0.2, 00:09:00, GigabitEthernet0/0/0

O E2 192.168.3.0/24 [110/1] via 192.168.0.2, 00:08:29, GigabitEthernet0/0/0

O E2 192.168.4.0/24 [110/1] via 192.168.0.2, 00:08:29, GigabitEthernet0/0/0

O E2 192.168.5.0/24 [110/1] via 192.168.0.2, 00:08:29, GigabitEthernet0/0/0

**R2 (OSPF/BGP)**

1.0.0.0/32 is subnetted, 1 subnets

O 1.0.0.1 [110/2] via 192.168.0.1, 00:08:17, 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

6.0.0.0/24 is subnetted, 1 subnets

B 6.0.0.0 [20/0] via 192.168.1.2, 00:03:22

7.0.0.0/32 is subnetted, 1 subnets

B 7.0.0.1 [20/0] via 192.168.1.2, 00:03:22

192.168.0.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.0.0/24 is directly connected, GigabitEthernet0/0/1

L 192.168.0.2/32 is directly connected, GigabitEthernet0/0/1

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

B 192.168.2.0/24 [20/0] via 192.168.1.2, 00:03:52

B 192.168.3.0/24 [20/0] via 192.168.1.2, 00:03:22

B 192.168.4.0/24 [20/0] via 192.168.1.2, 00:03:22

B 192.168.5.0/24 [20/0] via 192.168.1.2, 00:03:22

**R3 (EIGRP/BGP)**

1.0.0.0/32 is subnetted, 1 subnets

B 1.0.0.1 [20/2] via 192.168.1.1, 00:02:38

2.0.0.0/24 is subnetted, 1 subnets

B 2.0.0.0 [20/0] via 192.168.1.1, 00:02:38

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

D 4.0.0.0 [90/130816] via 192.168.2.2, 00:00:19, GigabitEthernet0/0/0

5.0.0.0/24 is subnetted, 1 subnets

D 5.0.0.0 [90/131072] via 192.168.2.2, 00:00:19, GigabitEthernet0/0/0

6.0.0.0/24 is subnetted, 1 subnets

B 6.0.0.0 [200/0] via 192.168.4.2, 00:00:18

7.0.0.0/32 is subnetted, 1 subnets

B 7.0.0.1 [200/2] via 192.168.4.2, 00:00:18

B 192.168.0.0/24 [20/0] via 192.168.1.1, 00:02:38

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

D 192.168.3.0/24 [90/3072] via 192.168.2.2, 00:00:19, GigabitEthernet0/0/0

D 192.168.4.0/24 [90/3328] via 192.168.2.2, 00:00:19, GigabitEthernet0/0/0

B 192.168.5.0/24 [200/0] via 192.168.4.2, 00:00:18

**R4 (EIGRP/BGP)**

1.0.0.0/32 is subnetted, 1 subnets

B 1.0.0.1 [200/2] via 192.168.1.1, 00:08:51

2.0.0.0/24 is subnetted, 1 subnets

B 2.0.0.0 [200/0] via 192.168.1.1, 00:08:51

3.0.0.0/24 is subnetted, 1 subnets

D 3.0.0.0 [90/130816] via 192.168.2.1, 00:08:56, GigabitEthernet0/0/1

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 192.168.3.2, 00:08:56, GigabitEthernet0/0/0

6.0.0.0/24 is subnetted, 1 subnets

B 6.0.0.0 [200/0] via 192.168.4.2, 00:08:56

7.0.0.0/32 is subnetted, 1 subnets

B 7.0.0.1 [200/2] via 192.168.4.2, 00:08:56

B 192.168.0.0/24 [200/0] via 192.168.1.1, 00:08:51

D 192.168.1.0/24 [90/3072] via 192.168.2.1, 00:08:56, 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

D 192.168.4.0/24 [90/3072] via 192.168.3.2, 00:08:56, GigabitEthernet0/0/0

B 192.168.5.0/24 [200/0] via 192.168.4.2, 00:08:56

**R5 (EIGRP/BGP)**

1.0.0.0/32 is subnetted, 1 subnets

B 1.0.0.1 [200/2] via 192.168.1.1, 01:08:13

2.0.0.0/24 is subnetted, 1 subnets

B 2.0.0.0 [200/0] via 192.168.1.1, 01:08:13

3.0.0.0/24 is subnetted, 1 subnets

D 3.0.0.0 [90/131072] via 192.168.3.1, 01:08:46, GigabitEthernet0/0/1

4.0.0.0/24 is subnetted, 1 subnets

D 4.0.0.0 [90/130816] via 192.168.3.1, 01:08:51, 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

B 6.0.0.0 [20/0] via 192.168.4.2, 01:10:27

7.0.0.0/32 is subnetted, 1 subnets

B 7.0.0.1 [20/2] via 192.168.4.2, 01:10:27

B 192.168.0.0/24 [200/0] via 192.168.1.1, 01:08:13

D 192.168.1.0/24 [90/3328] via 192.168.3.1, 01:08:46, GigabitEthernet0/0/1

D 192.168.2.0/24 [90/3072] via 192.168.3.1, 01:08:51, GigabitEthernet0/0/1

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

C 192.168.3.0/24 is directly connected, 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

B 192.168.5.0/24 [20/0] via 192.168.4.2, 01:10:27

**R6 (OSPF/BGP)**

1.0.0.0/32 is subnetted, 1 subnets

B 1.0.0.1 [20/0] via 192.168.4.1, 01:18:19

2.0.0.0/24 is subnetted, 1 subnets

B 2.0.0.0 [20/0] via 192.168.4.1, 01:18:19

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

7.0.0.0/32 is subnetted, 1 subnets

O 7.0.0.1 [110/2] via 192.168.5.2, 01:22:41, GigabitEthernet0/0/0

B 192.168.0.0/24 [20/0] via 192.168.4.1, 01:18:19

B 192.168.1.0/24 [20/0] via 192.168.4.1, 01:18:19

B 192.168.2.0/24 [20/0] via 192.168.4.1, 01:18:19

B 192.168.3.0/24 [20/0] via 192.168.4.1, 01:18:55

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

**R7 (OSPF)**

1.0.0.0/32 is subnetted, 1 subnets

O E2 1.0.0.1 [110/1] via 192.168.5.1, 00:01:27, GigabitEthernet0/0/1

2.0.0.0/24 is subnetted, 1 subnets

O E2 2.0.0.0 [110/1] via 192.168.5.1, 00:01:27, GigabitEthernet0/0/1

6.0.0.0/32 is subnetted, 1 subnets

O 6.0.0.1 [110/2] via 192.168.5.1, 00:04:09, GigabitEthernet0/0/1

7.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 7.0.0.0/24 is directly connected, Loopback0

L 7.0.0.1/32 is directly connected, Loopback0

O E2 192.168.0.0/24 [110/1] via 192.168.5.1, 00:01:27, GigabitEthernet0/0/1

O E2 192.168.1.0/24 [110/1] via 192.168.5.1, 00:01:27, GigabitEthernet0/0/1

O E2 192.168.2.0/24 [110/1] via 192.168.5.1, 00:01:27, GigabitEthernet0/0/1

O E2 192.168.3.0/24 [110/1] via 192.168.5.1, 00:01:27, GigabitEthernet0/0/1

O 192.168.4.0/24 [110/2] via 192.168.5.1, 00:03:07, 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:

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::/64 [110/2]

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

OE2 3::/64 [110/1]

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

OE2 4::/64 [110/1]

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

OE2 5::/64 [110/1]

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

OE2 6::/64 [110/1]

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

OE2 7::/64 [110/1]

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

C 192:168::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 192:168::1/128 [0/0]

via GigabitEthernet0/0/0, receive

O 192:168:1::/64 [110/2]

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

OE2 192:168:2::/64 [110/1]

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

OE2 192:168:3::/64 [110/1]

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

OE2 192:168:4::/64 [110/1]

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

OE2 192:168:5::/64 [110/1]

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

L FF00::/8 [0/0]

via Null0, receive

**R2 (OSPF/BGP)**

O 1::/64 [110/2]

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

B 3::/64 [20/0]

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

B 4::/64 [20/0]

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

B 5::/64 [20/0]

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

B 6::/64 [20/0]

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

B 7::/64 [20/0]

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

C 192:168::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 192:168::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 192:168:1::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 192:168:1::1/128 [0/0]

via GigabitEthernet0/0/0, receive

B 192:168:2::/64 [20/0]

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

B 192:168:3::/64 [20/0]

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

B 192:168:4::/64 [20/0]

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

B 192:168:5::/64 [20/0]

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

L FF00::/8 [0/0]

via Null0, receive

**R3 (EIGRP/BGP)**

B 1::/64 [20/2]

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

B 2::/64 [20/0]

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

D 4::/64 [90/130816]

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

D 5::/64 [90/131072]

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

B 6::/64 [200/0]

via 192:168:4::2

B 7::/64 [200/2]

via 192:168:4::2

B 192:168::/64 [20/0]

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

C 192:168:1::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 192:168:1::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 192:168:2::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 192:168:2::1/128 [0/0]

via GigabitEthernet0/0/0, receive

D 192:168:3::/64 [90/3072]

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

D 192:168:4::/64 [90/3328]

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

B 192:168:5::/64 [200/0]

via 192:168:4::2

L FF00::/8 [0/0]

via Null0, receive

**R4 (EIGRP/BGP)**

B 1::/64 [200/2]

via 192:168:1::1

B 2::/64 [200/0]

via 192:168:1::1

D 3::/64 [90/130816]

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

B 6::/64 [200/0]

via 192:168:4::2

B 7::/64 [200/2]

via 192:168:4::2

B 192:168::/64 [200/0]

via 192:168:1::1

D 192:168:1::/64 [90/3072]

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

C 192:168:2::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 192:168:2::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 192:168:3::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 192:168:3::1/128 [0/0]

via GigabitEthernet0/0/0, receive

D 192:168:4::/64 [90/3072]

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

B 192:168:5::/64 [200/0]

via 192:168:4::2

L FF00::/8 [0/0]

via Null0, receive

**R5 (EIGRP/BGP)**

B1::/64 [200/2]

via 192:168:1::1

B 2::/64 [200/0]

via 192:168:1::1

D 3::/64 [90/131072]

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

B 6::/64 [20/0]

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

B 7::/64 [20/2]

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

B 192:168::/64 [200/0]

via 192:168:1::1

D 192:168:1::/64 [90/3328]

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

D 192:168:2::/64 [90/3072]

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

C 192:168:3::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 192:168:3::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 192:168:4::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 192:168:4::1/128 [0/0]

via GigabitEthernet0/0/0, receive

B 192:168:5::/64 [20/0]

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

L FF00::/8 [0/0]

via Null0, receive

**R6 (OSPF/BGP)**

B 1::/64 [20/0]

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

B 2::/64 [20/0]

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

B 3::/64 [20/0]

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

B 4::/64 [20/0]

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

B 5::/64 [20/0]

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

O 7::/64 [110/2]

via FE80::227:90FF:FED5:F801, GigabitEthernet0/0/0

B 192:168::/64 [20/0]

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

B 192:168:1::/64 [20/0]

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

B 192:168:2::/64 [20/0]

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

B 192:168:3::/64 [20/0]

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

C 192:168:4::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 192:168:4::2/128 [0/0]

via GigabitEthernet0/0/1, receive

C 192:168:5::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 192:168:5::1/128 [0/0]

via GigabitEthernet0/0/0, receive

L FF00::/8 [0/0]

via Null0, receive

**R7 (OSPF)**

OE2 1::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 2::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 3::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 4::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 5::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

O 6::/64 [110/2]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

C 7::/64 [0/0]

via Loopback0, directly connected

L 7::1/128 [0/0]

via Loopback0, receive

OE2 192:168::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 192:168:1::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 192:168:2::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

OE2 192:168:3::/64 [110/1]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

O 192:168:4::/64 [110/2]

via FE80::B6A8:B9FF:FE47:9350, GigabitEthernet0/0/1

C 192:168:5::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 192:168:5::2/128 [0/0]

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

Verification Commands – Pings/Traceroutes from Edge to Edge of Topology:

**R1**

**R1#traceroute 192.168.5.2**

**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 = 1/1/1 ms

**R1#ping 7.0.0.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 7.0.0.1, timeout is 2 seconds:

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

**R1#ping 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 = 1/1/1 ms

**R1#ping 7::1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 7::1, timeout is 2 seconds:

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

Type escape sequence to abort.

Tracing the route to 192.168.5.2

VRF info: (vrf in name/id, vrf out name/id)

1 192.168.0.2 1 msec 1 msec 1 msec

2 192.168.1.2 1 msec 1 msec 1 msec

3 192.168.2.2 1 msec 1 msec 1 msec

4 192.168.3.2 1 msec 1 msec 1 msec

5 192.168.4.2 1 msec 1 msec 1 msec

6 192.168.5.2 1 msec 2 msec \*

**R1#traceroute 7.0.0.1**

Type escape sequence to abort.

Tracing the route to 7.0.0.1

VRF info: (vrf in name/id, vrf out name/id)

1 192.168.0.2 1 msec 1 msec 1 msec

2 192.168.1.2 1 msec 1 msec 1 msec

3 192.168.2.2 1 msec 1 msec 0 msec

4 192.168.3.2 1 msec 1 msec 1 msec

5 192.168.4.2 1 msec 1 msec 1 msec

6 192.168.5.2 1 msec 2 msec \*

**R1#traceroute 192:168:5::2**

Type escape sequence to abort.

Tracing the route to 192:168:5::2

1 192:168::2 1 msec 1 msec 0 msec

2 192:168:1::2 1 msec 2 msec 1 msec

3 192:168:2::2 1 msec 2 msec 1 msec

4 192:168:3::2 1 msec 2 msec 1 msec

5 192:168:4::2 1 msec 1 msec 2 msec

6 192:168:5::2 1 msec 2 msec 1 msec

**R1#traceroute 7::1**

Type escape sequence to abort.

Tracing the route to 7::1

1 192:168::2 1 msec 1 msec 1 msec

2 192:168:1::2 2 msec 2 msec 1 msec

3 192:168:2::2 2 msec 1 msec 1 msec

4 192:168:3::2 1 msec 2 msec 1 msec

5 192:168:4::2 1 msec 1 msec 1 msec

6 192:168:5::2 2 msec 2 msec 1 msec

**R7**

**R7#traceroute 192.168.0.1**

Type escape sequence to abort.

**R7#ping 192.168.0.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.0.1, timeout is 2 seconds:

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/17/81 ms

**R7#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 = 1/1/2 ms

**R7#ping 192:168::1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192:168::1, timeout is 2 seconds:

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

**R7#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

Tracing the route to 192.168.0.1

VRF info: (vrf in name/id, vrf out name/id)

1 192.168.5.1 3 msec 0 msec 1 msec

2 192.168.4.1 0 msec 1 msec 0 msec

3 192.168.3.1 1 msec 0 msec 1 msec

4 192.168.2.1 1 msec 1 msec 1 msec

5 192.168.1.1 1 msec 2 msec 1 msec

6 192.168.0.1 1 msec 1 msec \*

**R7#traceroute 1.0.0.1**

Type escape sequence to abort.

Tracing the route to 1.0.0.1

VRF info: (vrf in name/id, vrf out name/id)

1 192.168.5.1 1 msec 0 msec 0 msec

2 192.168.4.1 0 msec 1 msec 0 msec

3 192.168.3.1 1 msec 1 msec 1 msec

4 192.168.2.1 1 msec 1 msec 1 msec

5 192.168.1.1 1 msec 2 msec 1 msec

6 192.168.0.1 1 msec 1 msec \*

**R7#traceroute 192:168::1**

Type escape sequence to abort.

Tracing the route to 192:168::1

1 192:168:5::1 5 msec 0 msec 0 msec

2 192:168:4::1 1 msec 2 msec 0 msec

3 192:168:3::1 1 msec 1 msec 0 msec

4 192:168:2::1 2 msec 2 msec 1 msec

5 192:168:1::1 2 msec 2 msec 1 msec

6 192:168::1 19 msec 1 msec 2 msec

**R7#traceroute 1::1**

Type escape sequence to abort.

Tracing the route to 1::1

1 192:168:5::1 1 msec 1 msec 0 msec

2 192:168:4::1 1 msec 1 msec 1 msec

3 192:168:3::1 1 msec 2 msec 0 msec

4 192:168:2::1 1 msec 2 msec 1 msec

5 192:168:1::1 1 msec 2 msec 1 msec

6 192:168::1 2 msec 2 msec 1 msec

Verification Commands – Other Show Commands

Commands include: **Show ip bgp (ipv6) \\** **Show bgp ipv6 unicast summary \\**

**show bgp ipv6 unicast neighbors | include BGP \\ Show ip bgp neighbors | include BGP**

**R2 (OSPF/BGP)**

**R2#sh ip bgp**

BGP table version is 13, local router ID is 2.0.0.1

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

\*> 1.0.0.1/32 192.168.0.1 2 32768 ?

\*> 2.0.0.0/24 0.0.0.0 0 32768 ?

\*> 6.0.0.0/24 192.168.1.2 0 2 3 ?

\*> 7.0.0.1/32 192.168.1.2 0 2 3 ?

\*> 192.168.0.0 0.0.0.0 0 32768 i

\* 192.168.1.0 192.168.1.2 0 0 2 i

\*> 0.0.0.0 0 32768 i

\*> 192.168.2.0 192.168.1.2 0 0 2 i

\*> 192.168.3.0 192.168.1.2 0 2 i

\*> 192.168.4.0 192.168.1.2 0 2 i

\*> 192.168.5.0 192.168.1.2 0 2 3 i

\\

**R2#sh bgp ipv6**

BGP table version is 19, local router ID is 2.0.0.1

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::/64 FE80::272:78FF:FED6:D4A0

2 32768 ?

\*> 2::/64 :: 0 32768 i

\*> 3::/64 192:168:1::2 0 0 2 i

\*> 4::/64 192:168:1::2 0 2 i

\*> 5::/64 192:168:1::2 0 2 i

\*> 6::/64 192:168:1::2 0 2 3 i

\*> 7::/64 192:168:1::2 0 2 3 ?

\*> 192:168::/64 :: 0 32768 i

\* 192:168:1::/64 192:168:1::2 0 0 2 i

\*> :: 0 32768 i

\*> 192:168:2::/64 192:168:1::2 0 0 2 i

\*> 192:168:3::/64 192:168:1::2 0 2 i

Network Next Hop Metric LocPrf Weight Path

\*> 192:168:4::/64 192:168:1::2 0 2 i

\*> 192:168:5::/64 192:168:1::2 0 2 3 i

\\

**R2#sh bgp ipv6 unicast neighbors | include BGP**

BGP neighbor is 192:168:1::2, remote AS 2, external link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 00:09:10

BGP table version 19, neighbor version 19/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R2#sh ip bgp neighbors | include BGP**

BGP neighbor is 192.168.1.2, remote AS 2, external link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 00:09:41

BGP table version 13, neighbor version 13/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R2#sh bgp ipv6 unicast neighbors | include BGP**

BGP neighbor is 192:168:1::2, remote AS 2, external link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 00:09:10

BGP table version 19, neighbor version 19/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R2#sh ip bgp summary**

BGP router identifier 2.0.0.1, local AS number 1

BGP table version is 13, main routing table version 13

10 network entries using 2480 bytes of memory

11 path entries using 1496 bytes of memory

7/7 BGP path/bestpath attribute entries using 1960 bytes of memory

2 BGP AS-PATH entries using 64 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 6000 total bytes of memory

BGP activity 25/2 prefixes, 29/4 paths, scan interval 60 secs

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

192.168.1.2 4 2 20 17 13 0 0 00:10:49 7

\\

**R2#sh bgp ipv6 unicast summary**

BGP router identifier 2.0.0.1, local AS number 1

BGP table version is 19, main routing table version 19

13 network entries using 3536 bytes of memory

14 path entries using 2128 bytes of memory

6/6 BGP path/bestpath attribute entries using 1680 bytes of memory

2 BGP AS-PATH entries using 64 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 7408 total bytes of memory

BGP activity 25/2 prefixes, 29/4 paths, scan interval 60 secs

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

192:168:1::2 4 2 20 17 19 0 0 00:11:19 10

**R3 (EIGRP/BGP)**

**R3#sh ip bgp**

BGP table version is 17, 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

\*> 1.0.0.1/32 192.168.1.1 2 0 1 ?

\*> 2.0.0.0/24 192.168.1.1 0 0 1 ?

\*>i 6.0.0.0/24 192.168.4.2 0 100 0 3 ?

\*>i 7.0.0.1/32 192.168.4.2 2 100 0 3 ?

\*> 192.168.0.0 192.168.1.1 0 0 1 i

\* 192.168.1.0 192.168.1.1 0 0 1 i

\*> 0.0.0.0 0 32768 i

\* i 192.168.2.0 192.168.2.2 0 100 0 i

\*> 0.0.0.0 0 32768 i

r i 192.168.3.0 192.168.3.2 0 100 0 i

r>i 192.168.2.2 0 100 0 i

r>i 192.168.4.0 192.168.3.2 0 100 0 i

\*>i 192.168.5.0 192.168.4.2 0 100 0 3 i

\\

**R3#sh bgp ipv6**

BGP table version is 19, 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::/64 192:168:1::1 2 0 1 ?

\*> 2::/64 192:168:1::1 0 0 1 i

\*> 3::/64 :: 0 32768 i

r>i 4::/64 192:168:2::2 0 100 0 i

r>i 5::/64 192:168:3::2 0 100 0 i

\*>i 6::/64 192:168:4::2 0 100 0 3 i

\*>i 7::/64 192:168:4::2 2 100 0 3 ?

\*> 192:168::/64 192:168:1::1 0 0 1 i

\* 192:168:1::/64 192:168:1::1 0 0 1 i

\*> :: 0 32768 i

\* i 192:168:2::/64 192:168:2::2 0 100 0 i

\*> :: 0 32768 i

r i 192:168:3::/64 192:168:3::2 0 100 0 i

Network Next Hop Metric LocPrf Weight Path

r>i 192:168:2::2 0 100 0 i

r>i 192:168:4::/64 192:168:3::2 0 100 0 i

\*>i 192:168:5::/64 192:168:4::2 0 100 0 3 i

//

**R3#sh ip bgp neighbors | include BGP**

BGP neighbor is 192.168.1.1, remote AS 1, external link

BGP version 4, remote router ID 2.0.0.1

BGP state = Established, up for 00:05:27

BGP table version 17, neighbor version 17/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

BGP neighbor is 192.168.2.2, remote AS 2, internal link

BGP version 4, remote router ID 4.0.0.1

BGP state = Established, up for 00:02:02

BGP table version 17, neighbor version 17/0

Bestpath from iBGP peer: 5 n/a

BGP neighbor is 192.168.3.2, remote AS 2, internal link

BGP version 4, remote router ID 5.0.0.1

BGP state = Established, up for 00:02:00

BGP table version 17, neighbor version 17/0

Bestpath from iBGP peer: 5 n/a

//

**R3#sh bgp ipv6 unicast neighbors | include BGP**

BGP neighbor is 192:168:1::1, remote AS 1, external link

BGP version 4, remote router ID 2.0.0.1

BGP state = Established, up for 00:05:09

BGP table version 19, neighbor version 19/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

BGP neighbor is 192:168:2::2, remote AS 2, internal link

BGP version 4, remote router ID 4.0.0.1

BGP state = Established, up for 00:01:42

BGP table version 19, neighbor version 19/0

Bestpath from iBGP peer: 5 n/a

BGP neighbor is 192:168:3::2, remote AS 2, internal link

BGP version 4, remote router ID 5.0.0.1

BGP state = Established, up for 00:01:36

BGP table version 19, neighbor version 19/0

Bestpath from iBGP peer: 5 n/a

//

**R3#sh ip bgp summary**

BGP router identifier 3.0.0.1, local AS number 2

BGP table version is 17, main routing table version 17

10 network entries using 2480 bytes of memory

13 path entries using 1768 bytes of memory

8/8 BGP path/bestpath attribute entries using 2240 bytes of memory

2 BGP AS-PATH entries using 48 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 6536 total bytes of memory

BGP activity 25/2 prefixes, 31/2 paths, scan interval 60 secs

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

192.168.1.1 4 1 12 14 17 0 0 00:05:42 4

192.168.2.2 4 2 7 10 17 0 0 00:02:16 2

192.168.3.2 4 2 12 12 17 0 0 00:02:15 5

//

**R3#sh bgp ipv6 unicast summary**

BGP router identifier 3.0.0.1, local AS number 2

BGP table version is 19, main routing table version 19

13 network entries using 3536 bytes of memory

16 path entries using 2432 bytes of memory

6/6 BGP path/bestpath attribute entries using 1680 bytes of memory

2 BGP AS-PATH entries using 48 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 7696 total bytes of memory

BGP activity 25/2 prefixes, 31/2 paths, scan interval 60 secs

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

192:168:1::1 4 1 11 14 19 0 0 00:06:12 4

192:168:2::2 4 2 8 10 19 0 0 00:02:45 3

192:168:3::2 4 2 14 11 19 0 0 00:02:39 6

**R4 (EIGRP/BGP)**

**R4#show ip bgp**

BGP table version is 15, 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

\*>i 1.0.0.1/32 192.168.1.1 2 100 0 1 ?

\*>i 2.0.0.0/24 192.168.1.1 0 100 0 1 ?

\*>i 6.0.0.0/24 192.168.4.2 0 100 0 3 ?

\*>i 7.0.0.1/32 192.168.4.2 2 100 0 3 ?

\*>i 192.168.0.0 192.168.1.1 0 100 0 1 i

r>i 192.168.1.0 192.168.2.1 0 100 0 i

\* i 192.168.2.0 192.168.2.1 0 100 0 i

\*> 0.0.0.0 0 32768 i

\* i 192.168.3.0 192.168.3.2 0 100 0 i

\*> 0.0.0.0 0 32768 i

r>i 192.168.4.0 192.168.3.2 0 100 0 i

\*>i 192.168.5.0 192.168.4.2 0 100 0 3 i

\\

**R4#show bgp ipv6**

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

\*>i 1::/64 192:168:1::1 2 100 0 1 ?

\*>i 2::/64 192:168:1::1 0 100 0 1 i

r>i 3::/64 192:168:2::1 0 100 0 i

\*> 4::/64 :: 0 32768 i

r>i 5::/64 192:168:3::2 0 100 0 i

\*>i 6::/64 192:168:4::2 0 100 0 3 i

\*>i 7::/64 192:168:4::2 2 100 0 3 ?

\*>i 192:168::/64 192:168:1::1 0 100 0 1 i

r>i 192:168:1::/64 192:168:2::1 0 100 0 i

\* i 192:168:2::/64 192:168:2::1 0 100 0 i

\*> :: 0 32768 i

\* i 192:168:3::/64 192:168:3::2 0 100 0 i

\*> :: 0 32768 i

r>i 192:168:4::/64 192:168:3::2 0 100 0 i

\*>i 192:168:5::/64 192:168:4::2 0 100 0 3 i

\\

**R4#show ip bgp neighbors | include BGP**

BGP neighbor is 192.168.2.1, remote AS 2, internal link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 00:10:40

BGP table version 15, neighbor version 15/0

Bestpath from iBGP peer: 4 n/a

BGP neighbor is 192.168.3.2, remote AS 2, internal link

BGP version 4, remote router ID 5.0.0.1

BGP state = Established, up for 00:10:44

BGP table version 15, neighbor version 15/0

Bestpath from iBGP peer: 4 n/a

\\

**R4#show bgp ipv6 unicast neighbors | include BGP**

BGP neighbor is 192:168:2::1, remote AS 2, internal link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 00:10:02

BGP table version 20, neighbor version 20/0

Bestpath from iBGP peer: 5 n/a

BGP neighbor is 192:168:3::2, remote AS 2, internal link

BGP version 4, remote router ID 5.0.0.1

BGP state = Established, up for 00:10:04

BGP table version 20, neighbor version 20/0

Bestpath from iBGP peer: 5 n/a

\\

**R4#show ip bgp summary**

BGP router identifier 4.0.0.1, local AS number 2

BGP table version is 15, main routing table version 15

10 network entries using 2480 bytes of memory

12 path entries using 1440 bytes of memory

8/8 BGP path/bestpath attribute entries using 1984 bytes of memory

2 BGP AS-PATH entries using 48 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 5952 total bytes of memory

BGP activity 23/0 prefixes, 27/0 paths, scan interval 60 secs

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

192.168.2.1 4 2 20 16 15 0 0 00:10:58 5

192.168.3.2 4 2 20 16 15 0 0 00:11:02 5

\\

**R4#show bgp ipv6 unicast summary**

BGP router identifier 4.0.0.1, local AS number 2

BGP table version is 20, main routing table version 20

13 network entries using 3536 bytes of memory

15 path entries using 2160 bytes of memory

6/6 BGP path/bestpath attribute entries using 1488 bytes of memory

2 BGP AS-PATH entries using 48 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 7232 total bytes of memory

BGP activity 23/0 prefixes, 27/0 paths, scan interval 60 secs

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

192:168:2::1 4 2 19 18 20 0 0 00:11:13 6

192:168:3::2 4 2 26 18 20 0 0 00:11:15 6

**R5 (EIGRP/BGP)**

**R5#show ip bgp**

BGP table version is 16, local router ID is 5.0.0.1

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

\*>i 1.0.0.1/32 192.168.1.1 2 100 0 1 ?

\*>i 2.0.0.0/24 192.168.1.1 0 100 0 1 ?

\*> 6.0.0.0/24 192.168.4.2 0 0 3 ?

\*> 7.0.0.1/32 192.168.4.2 2 0 3 ?

\*>i 192.168.0.0 192.168.1.1 0 100 0 1 i

r>i 192.168.1.0 192.168.2.1 0 100 0 i

r>i 192.168.2.0 192.168.3.1 0 100 0 i

r i 192.168.2.1 0 100 0 i

\* i 192.168.3.0 192.168.3.1 0 100 0 i

\*> 0.0.0.0 0 32768 i

\* 192.168.4.0 192.168.4.2 0 0 3 i

\*> 0.0.0.0 0 32768 i

\*> 192.168.5.0 192.168.4.2 0 0 3 i

\\

**R5#show bgp ipv6**

BGP table version is 37, local router ID is 5.0.0.1

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

\*>i 1::/64 192:168:1::1 2 100 0 1 ?

\*>i 2::/64 192:168:1::1 0 100 0 1 i

r>i 3::/64 192:168:2::1 0 100 0 i

r>i 4::/64 192:168:3::1 0 100 0 i

\*> 5::/64 :: 0 32768 i

\*> 6::/64 192:168:4::2 0 0 3 i

\*> 7::/64 192:168:4::2 2 0 3 ?

\*>i 192:168::/64 192:168:1::1 0 100 0 1 i

r>i 192:168:1::/64 192:168:2::1 0 100 0 i

r>i 192:168:2::/64 192:168:3::1 0 100 0 i

r i 192:168:2::1 0 100 0 i

\* i 192:168:3::/64 192:168:3::1 0 100 0 i

\*> :: 0 32768 i

\* 192:168:4::/64 192:168:4::2 0 0 3 i

\*> :: 0 32768 i

\*> 192:168:5::/64 192:168:4::2 0 0 3 i

\\

**R5#show ip bgp neighbors | include BGP**

BGP neighbor is 192.168.2.1, remote AS 2, internal link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 01:10:30

BGP table version 16, neighbor version 16/0

Bestpath from iBGP peer: 1 n/a

BGP neighbor is 192.168.3.1, remote AS 2, internal link

BGP version 4, remote router ID 4.0.0.1

BGP state = Established, up for 01:10:37

BGP table version 16, neighbor version 16/0

Bestpath from iBGP peer: 1 n/a

BGP neighbor is 192.168.4.2, remote AS 3, external link

BGP version 4, remote router ID 6.0.0.1

BGP state = Established, up for 01:13:23

BGP table version 16, neighbor version 16/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R5#show bgp ipv6 unicast neighbors | include BGP**

BGP neighbor is 192:168:2::1, remote AS 2, internal link

BGP version 4, remote router ID 3.0.0.1

BGP state = Established, up for 01:10:08

BGP table version 37, neighbor version 37/0

Bestpath from iBGP peer: 2 n/a

BGP neighbor is 192:168:3::1, remote AS 2, internal link

BGP version 4, remote router ID 4.0.0.1

BGP state = Established, up for 01:10:15

BGP table version 37, neighbor version 37/0

Bestpath from iBGP peer: 2 n/a

BGP neighbor is 192:168:4::2, remote AS 3, external link

BGP version 4, remote router ID 6.0.0.1

BGP state = Established, up for 01:13:02

BGP table version 37, neighbor version 37/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R5#show ip bgp summary**

BGP router identifier 5.0.0.1, local AS number 2

BGP table version is 16, main routing table version 16

10 network entries using 2480 bytes of memory

13 path entries using 1560 bytes of memory

8/8 BGP path/bestpath attribute entries using 1984 bytes of memory

2 BGP AS-PATH entries using 48 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 6072 total bytes of memory

BGP activity 25/2 prefixes, 31/2 paths, scan interval 60 secs

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

192.168.2.1 4 2 90 92 16 0 0 01:14:31 5

192.168.3.1 4 2 86 90 16 0 0 01:14:38 2

192.168.4.2 4 3 91 97 16 0 0 01:17:24 4

\\

**R5#show bgp ipv6 unicast summary**

BGP router identifier 5.0.0.1, local AS number 2

BGP table version is 37, main routing table version 37

13 network entries using 3536 bytes of memory

16 path entries using 2304 bytes of memory

6/6 BGP path/bestpath attribute entries using 1488 bytes of memory

2 BGP AS-PATH entries using 48 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 7376 total bytes of memory

BGP activity 25/2 prefixes, 31/2 paths, scan interval 60 secs

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

192:168:2::1 4 2 89 97 37 0 0 01:15:35 6

192:168:3::1 4 2 89 95 37 0 0 01:15:41 3

192:168:4::2 4 3 95 97 37 0 0 01:18:29 4

**R6 (OSPF/BGP)**

**R6#show ip bgp**

BGP table version is 11, local router ID is 6.0.0.1

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

\*> 1.0.0.1/32 192.168.4.1 0 2 1 ?

\*> 2.0.0.0/24 192.168.4.1 0 2 1 ?

\*> 6.0.0.0/24 0.0.0.0 0 32768 ?

\*> 7.0.0.1/32 192.168.5.2 2 32768 ?

\*> 192.168.0.0 192.168.4.1 0 2 1 i

\*> 192.168.1.0 192.168.4.1 0 2 i

\*> 192.168.2.0 192.168.4.1 0 2 i

\*> 192.168.3.0 192.168.4.1 0 0 2 i

\* 192.168.4.0 192.168.4.1 0 0 2 i

\*> 0.0.0.0 0 32768 i

\*> 192.168.5.0 0.0.0.0 0 32768 i

\\

**R6#show bgp ipv6**

BGP table version is 33, local router ID is 6.0.0.1

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::/64 192:168:4::1 0 2 1 ?

\*> 2::/64 192:168:4::1 0 2 1 i

\*> 3::/64 192:168:4::1 0 2 i

\*> 4::/64 192:168:4::1 0 2 i

\*> 5::/64 192:168:4::1 0 0 2 i

\*> 6::/64 :: 0 32768 i

\*> 7::/64 FE80::227:90FF:FED5:F801

2 32768 ?

\*> 192:168::/64 192:168:4::1 0 2 1 i

\*> 192:168:1::/64 192:168:4::1 0 2 i

\*> 192:168:2::/64 192:168:4::1 0 2 i

\*> 192:168:3::/64 192:168:4::1 0 0 2 i

\* 192:168:4::/64 192:168:4::1 0 0 2 i

\*> :: 0 32768 i

\*> 192:168:5::/64 :: 0 32768 i

\\

**R6#show ip bgp neighbors | include BGP**

BGP neighbor is 192.168.4.1, remote AS 2, external link

BGP version 4, remote router ID 5.0.0.1

BGP state = Established, up for 01:33:26

BGP table version 11, neighbor version 11/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R6#show bgp ipv6 unicast neighbors | include BGP**

BGP neighbor is 192:168:4::1, remote AS 2, external link

BGP version 4, remote router ID 5.0.0.1

BGP state = Established, up for 01:32:45

BGP table version 33, neighbor version 33/0

External BGP neighbor configured for connected checks (single-hop no-disable-connected-check)

\\

**R6#show ip bgp summary**

BGP router identifier 6.0.0.1, local AS number 3

BGP table version is 11, main routing table version 11

10 network entries using 2480 bytes of memory

11 path entries using 1320 bytes of memory

7/7 BGP path/bestpath attribute entries using 1736 bytes of memory

2 BGP AS-PATH entries using 64 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 5600 total bytes of memory

BGP activity 23/0 prefixes, 27/2 paths, scan interval 60 secs

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

192.168.4.1 4 2 115 109 11 0 0 01:33:41 7

\\

**R6#show bgp ipv6 unicast summary**

BGP router identifier 6.0.0.1, local AS number 3

BGP table version is 33, main routing table version 33

13 network entries using 3536 bytes of memory

14 path entries using 2016 bytes of memory

6/6 BGP path/bestpath attribute entries using 1488 bytes of memory

2 BGP AS-PATH entries using 64 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 7104 total bytes of memory

BGP activity 23/0 prefixes, 27/2 paths, scan interval 60 secs

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

192:168:4::1 4 2 114 112 33 0 0 01:33:56 10

**Problems**

There were several issues relating to configuration of iBGP as we were foreign to its properties. In the prior lab, we were reliant to redistributing routes on all border routers. Now that redistributing was no longer an option on the transit AS border routers, they were many configuration complications. Luckily, we discovered a new strategy to combat configuration nuances. This strategy was to compare pasted running-configurations side-by-side on a notepad application to check for parallel accuracy. This method is incredibly efficient since the layout of the running-configuration is the exact same across identical routers, allowing slight nuances and missing commands to quickly catch the eye. This was also a way to share and check the other partner’s work. With this method, we were able to root out missing network commands, incorrect remote AS numbers on neighbor commands, and simple addressing errors. This fixed their corresponding problems, such as idle BGP sessions and fragmented routing tables.

Another problem that led to a completely new finding was the improper redistribution of OSPF on the edge Autonomous Systems. At this point, all BGP affiliated routers were fully peered, including the edge routers on the OSPF Autonomous Systems (AS 1 and AS 3). However, routers 1 and 7 were still not connected via IPv6 with the rest of the network, and we deduced it to be a redistributing error. IPv4 was fully operational. We originally used OSPFv3 and OSPF concurrently to visual distinguish between the two address families, but even after many attempts, we could not redistribute IPv6 on the OSPFv3 using the standard redistribute command used on “router ospf” mode nor other BGP modes. It took further investigation to realize that OSPFv3 had address-families. This meant that we could run IPv4 and IPv6 simultaneously with only OSPFv3 and can remove OSPFv2 for concision. We will practice this in future OSPF-related projects.

**Conclusion**

Looking back, configuring iBGP was a minefield of errors and fixes that pushed us to discover new ways of managing configurations. These crucial aspects of organization will become essential as labs become increasingly advanced and teamwork efficiency is, and will always be, of great importance. Internal BGP as a concept was a fascinating system to understand in its relevancy to the internet, as well as understanding why standard redistributing cannot be used since all the routes would be overwhelming to the routing table. This lab was also a good review of all the routing protocols used so far, since it did not require any jarring differences in command use and syntax structure. One mention would be the helpful organizational command in OSPFv3 and BGP, the “address-family *ipv4/ipv6*” command that we recently discovered was applicable in OSPF. In conclusion, this assignment ran smoothly and helped further all the skills required in the CCNP lab.