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BGP 3 Modifiers and IPv6 Lab

**Purpose:**

The purpose of this lab was to understand the uses of BGP in the real world and how it interacts with other IGP protocols like OSPF, RIP, or EIGRP. This was our first assigned use of BGP and got us introduced to how to configurate it as the protocol is very commonly used by ISP’s. It also helped us learned more networking concepts because of how broadly BGP is used and interacts with many different aspects of networking like IGP’s. The purpose of BGP to run the internet as efficiently as possible with connecting different AS’s .

**Background Information on lab concepts:**

BGP (Border Gateway Protocol) is a routing protocol that exchanges routing information between Autonomous areas (AS are groups of smaller networks ran by single organizations) to choose the best route for the data packet. It does this to get the packet from point A to point B as quickly as possible with using as little resources. This is mainly used by ISP to have the internet function smoothly. The way BGP choose a route is based off 13 different variables to pick the closest and fastest route; Highest weight, highest local preference value, local router originated, shortest AS path, Lowest origin code, lowest MED, external path over internal path, lowest IGP metric, multiple path load sharing, oldest route, lowest neighbor BGP router ID value, and lowest neighbor IP address.

Prioritization Order:

1. Highest Weight: The weight is a Cisco proprietary function meaning only cisco routers will recognize it and is local to each router. Any route that is not originated from the router itself (any external routes) will have a weight of 0. You can adjust the weight with commands to always prioritize a certain neighbor for a route.
2. Prefer the route with the highest local preference value: The local preference is a just a value same with the weight. It is locally assigned and by default is set to 100 for all networks. This is not cisco proprietary so it is used on all BGP routers.
3. Prefer the route that the local router original: This means a route that has a next hop of 0.0.0.0 which is an internal network distributed from iBGP (internal BGP) to BGP. This makes sense because 0.0.0.0 is not a valid address so the router will not look for a new next hop address and stay internal. If a route is internally learned that means it is a close path.
4. Shortest AS path: The router prioritizes the path with the least jumps to other AS areas. BGP best path as-path ignore bypasses this and doesn’t prioritize it.
5. Lowest origin type: The router determines what route to use based on the origin of that route. Prioritizes IGP -> EGP -> INCOMPLETE. IGP is the lowest origin code and means it came from an Interior Gateway Protocol. The router chooses this over the others because if it came internally then there will be a shorter time to get the packet to the location because it is closer. EGP is the old BGP and means Exterior Gateway Protocol. Incomplete means that BGP is unsure how it got the prefix into the table. This can happen when using the redistribute command from another IGP routing protocol like EIGRP or OSPF.
6. Lowest Multi-exit Discriminator (MED): This is a value is given to adjacent AS areas and is shown as the metric in the BGP table. If the metric is configured in a router, the metric learned from BGP is ignored.
7. eBGP over iBGP: This is essentially the opposite of the origin type because externally learned routes are preferred over internal routes. eBGP has a lower Administrative Distance than iBGP so it is preferred.
8. Lowest IGP metric: This determines the BGP next hop. The IGP metric is the sum of all value of the links along the path within a single domain/AS. The router chooses which ever IGP has the lower cost.
9. Multiple Paths: If multiple paths require installation in the routing table to enable BGP multipath. BGP multipath allows multiple paths used to simultaneously to reach the same destination. This is load-balancing and adds redundancy to the network.
10. Oldest Route: This ensures that the routing table stays stable because if the old path is still functioning, there is no need for the new one to be used over it. This cleans the routing table and requires the router to do less computation.
11. Lowest Router ID: Whichever router has the lowest router BGP ID is preferred.
12. Minimum Cluster List: If the path received is internally routed, the router prefers the path with the minimum cluster-list length. Cluster List is essentially an advertisement of the router ID on the path to the destinations. For example if there were 2 router ID on path A and 1 router ID in path B, path B would be chosen.
13. Lowest Neighbor IP: If all else is matching, the router chooses the lowest neighbor IP to send the packet to.

**Lab Summary:**

First we drew a diagram and came up with an IP scheme of how we’re going to set up the routers. We had to redo the diagram many times because we added in RIP after setting up our diagram initially and had to change subnets very often to account for our problems. We attempted to use packet tracer to set up the diagram digitally and learn the commands but BGP was severely limited in Packet Tracer so we used the physical routers. To set it up fully we researched how to make connections with BGP and what BGP actually was so we could understand what we were doing. For the most part all the routers we configured similarly with one different commands for networks and different redistribute commands for the routers EIGRP, OSPF, and RIP. After setting these all up correctly and testing for connectivity we double checked we met all the requirements of the lab. Once the rack was set up correctly we looked over IP BGP tables and routing table to confirm once more.

**Lab Commands:**

Router:

show bgp ipv6 unicast – shows is the ipv6 connections using bgp

router rip – enters rip configuration

network [x.x.x.x] – advertises what networks the router is connected to

ipv6 router rip [NAME] – enables ipv6 routing with rip

(in interface) ipv6 rip [NAME] – enables ipv6 RIP on an interface

Router bgp [as number] – enters bgp configuration

Neighbor [x.x.x.x] (address of directly connected neighbor) remote-as [as number of neighbor] – enables bgp connection between routers

Network [x.x.x.x] mask [x.x.x.x] – advertises that network over bgp

Neighbor [x.x.x.x] weight [x] – sets a static weight to a preconfigured neighbor

Address-family ipv6 – allows ipv6 addresses on bpg

Network [::x/x] – configures an ipv6 network to advertise group bgp

Neighbor [::x/x] activate – activates the connection to a directly connected neighbor

Redistribute [ospf x/eigrp x/rip [NAME]] – converts routes learned from these ipv6 routing protocols to bgp routes to advertise

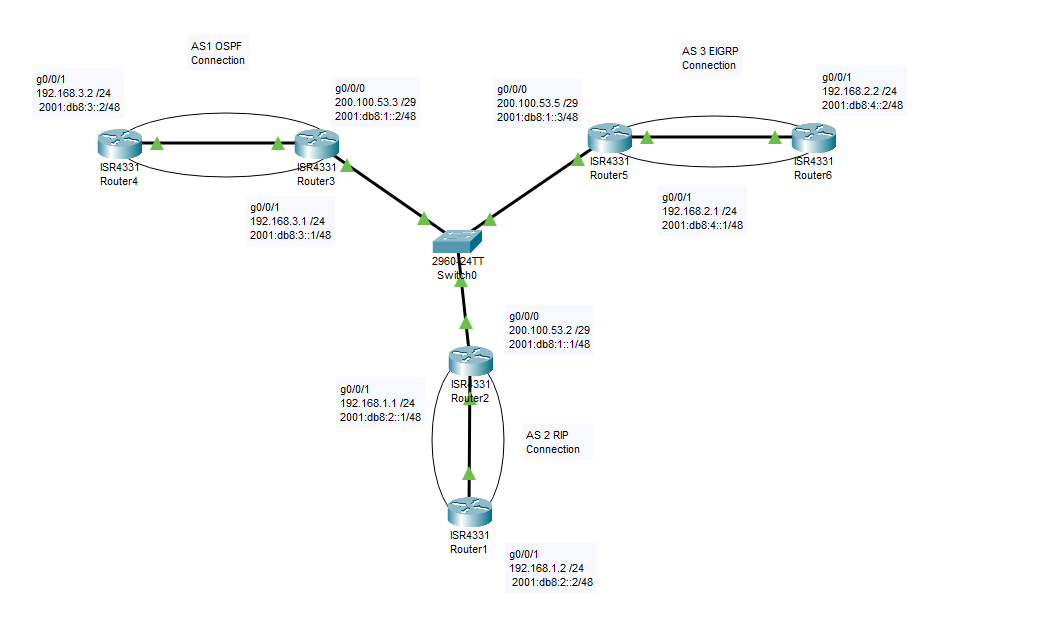
Address-family ipv4 – if you have address-family ipv6 you must also use this command to reenable ipv4

Neighbor [x.x.x.x] activate – activates a neighbor that has already been defined with neighbor [x.x.x.x] remote-as [x]

Network [x.x.x.x] mask [x.x.x.x] – advertises ipv4 address

Redistribute [ospf x/eigrp x/rip] – converts routes learned from these protocols to bgp routes to advertise

**Network Diagram with IP’s:**

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**Configurations:**

**R1 Ip routes:**

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

o

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

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

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

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

C 1.1.1.0/24 is directly connected, Loopback0

L 1.1.1.1/32 is directly connected, Loopback0

R 2.0.0.0/8 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

R 3.0.0.0/8 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

R 4.0.0.0/8 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

R 5.0.0.0/8 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

R 6.0.0.0/8 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

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

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

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

R 192.168.2.0/24 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

R 192.168.3.0/24 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

R 200.100.53.0/24 [120/1] via 192.168.1.1, 00:00:23, GigabitEthernet0/0/1

**IPV6:**

C 2001:DB8:2::/48 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

R 2001:DB8:3::/48 [120/2]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/1

R 2001:DB8:4::/48 [120/2]

via FE80::521C:B0FF:FE2C:5101, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

**R1 Running config:**

Building configuration...

Current configuration : 2153 bytes

Last configuration change at 19:25:58 UTC Fri Oct 27 2023

version 16.7

service timestamps debug datetime msec

service timestamps log datetime msec

service password-encryption

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

enable secret 5 $1$msev$xO82iWi6mZci2gniMao91.

no aaa new-model

no ip domain lookup

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO220523GF

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 1.1.1.1 255.255.255.0

interface GigabitEthernet0/0/0

ip address 192.168.1.65 255.255.255.0

shutdown

negotiation auto

interface GigabitEthernet0/0/1

ip address 192.168.1.2 255.255.255.0

negotiation auto

ipv6 address 2001:DB8:2::2/48

ipv6 rip 1 enable

interface Serial0/1/0

no ip address

interface Serial0/1/1

no ip address

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 rip

redistribute bgp 2 metric transparent

network 1.0.0.0

network 192.168.1.0

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router rip 1

control-plane

banner motd ^Cno unauthorized access^C

line con 0

password 7 110A1016141D

logging synchronous

login

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

password 7 045802150C2E0C

login

line vty 5 15

password 7 045802150C2E0C

login

wsma agent exec

wsma agent config

wsma agent filesys

wsma agent notify

end

**R2 Ip routes:**

Gateway of last resort is not set

R 1.0.0.0/8 [120/1] via 192.168.1.2, 00:00:27, GigabitEthernet0/0/1

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

C 2.2.2.0/24 is directly connected, Loopback0

L 2.2.2.2/32 is directly connected, Loopback0

3.0.0.0/24 is subnetted, 1 subnets

B 3.3.3.0 [20/0] via 200.100.53.3, 00:35:22

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

B 4.4.4.0/24 [20/0] via 200.100.53.3, 00:35:22

B 4.4.4.4/32 [20/2] via 200.100.53.3, 00:35:22

5.0.0.0/24 is subnetted, 1 subnets

B 5.5.5.0 [20/0] via 200.100.53.5, 00:35:22

6.0.0.0/24 is subnetted, 1 subnets

B 6.6.6.0 [20/0] via 200.100.53.5, 00:35:22

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 192.168.1.1/32 is directly connected, GigabitEthernet0/0/1

B 192.168.2.0/24 [20/0] via 200.100.53.5, 00:35:22

B 192.168.3.0/24 [20/0] via 200.100.53.3, 00:35:22

200.100.53.0/24 is variably subnetted, 2 subnets, 2 masks

C 200.100.53.0/29 is directly connected, GigabitEthernet0/0/0

L 200.100.53.2/32 is directly connected, GigabitEthernet0/0/0

**IPV6:**

C 2001:DB8:1::/48 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

C 2001:DB8:2::/48 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

B 2001:DB8:3::/48 [20/0]

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

B 2001:DB8:4::/48 [20/0]

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

L FF00::/8 [0/0]

via Null0, receive

**R2 Running config:**

Current configuration : 5020 bytes

Last configuration change at 18:58:06 UTC Fri Oct 27 2023

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

service password-encryption

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

enable secret 5 $1$J5Vw$eJ.8CbKDERXS8ALzNUlyK0

no aaa new-model

no ip domain lookup

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2189345785

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2189345785

revocation-check none

rsakeypair TP-self-signed-2189345785

crypto pki certificate chain TP-self-signed-2189345785

certificate self-signed 01

quit

license udi pid ISR4321/K9 sn FDO21482DXE

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 2.2.2.2 255.255.255.0

interface GigabitEthernet0/0/0

ip address 200.100.53.2 255.255.255.248

negotiation auto

ipv6 address 2001:DB8:1::1/48

interface GigabitEthernet0/0/1

ip address 192.168.1.1 255.255.255.0

negotiation auto

ipv6 address 2001:DB8:2::1/48

ipv6 rip 1 enable

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0/2/0

no ip address

negotiation auto

interface GigabitEthernet0/2/1

no ip address

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

negotiation auto

router rip

redistribute bgp 2 metric transparent

network 2.0.0.0

network 192.168.1.0

router bgp 2

bgp log-neighbor-changes

neighbor 2001:DB8:1::2 remote-as 1

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

neighbor 200.100.53.3 remote-as 1

neighbor 200.100.53.5 remote-as 3

address-family ipv4

network 2.2.2.0 mask 255.255.255.0

network 192.168.1.0

network 200.100.53.0 mask 255.255.255.248

redistribute rip

no neighbor 2001:DB8:1::2 activate

no neighbor 2001:DB8:1::3 activate

neighbor 200.100.53.3 activate

neighbor 200.100.53.3 weight 500

neighbor 200.100.53.5 activate

exit-address-family

address-family ipv6

redistribute rip 1

network 2001:DB8:1::/48

network 2001:DB8:2::/48

neighbor 2001:DB8:1::2 activate

neighbor 2001:DB8:1::3 activate

exit-address-family

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip http client source-interface GigabitEthernet0/0/0

ipv6 router rip 1

redistribute bgp 2

control-plane

banner motd ^Cno unauthorized access^C

line con 0

exec-timeout 0 0

password 7 14141B180F0B

logging synchronous

login

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

password 7 070C285F4D0659

login

line vty 5 15

password 7 070C285F4D0659

login

end

**R3 Ip routes:**

Gateway of last resort is not set

B 1.0.0.0/8 [20/1] via 200.100.53.2, 00:47:14

2.0.0.0/24 is subnetted, 1 subnets

B 2.2.2.0 [20/0] via 200.100.53.2, 00:47:14

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

C 3.3.3.0/24 is directly connected, Loopback0

L 3.3.3.3/32 is directly connected, Loopback0

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

B 4.4.4.0/24 [200/0] via 4.4.4.4, 01:18:08

O 4.4.4.4/32 [110/2] via 192.168.3.2, 01:18:59, GigabitEthernet0/0/1

5.0.0.0/24 is subnetted, 1 subnets

B 5.5.5.0 [20/0] via 200.100.53.5, 01:18:06

6.0.0.0/24 is subnetted, 1 subnets

B 6.6.6.0 [20/130816] via 200.100.53.5, 01:18:06

B 192.168.1.0/24 [20/0] via 200.100.53.2, 00:47:14

B 192.168.2.0/24 [20/0] via 200.100.53.5, 01:18:06

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 192.168.3.1/32 is directly connected, GigabitEthernet0/0/1

200.100.53.0/24 is variably subnetted, 2 subnets, 2 masks

C 200.100.53.0/29 is directly connected, GigabitEthernet0/0/0

L 200.100.53.3/32 is directly connected, GigabitEthernet0/0/0

**IPV6:**

C 2001:DB8:1::/48 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

B 2001:DB8:2::/48 [20/0]

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

C 2001:DB8:3::/48 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

B 2001:DB8:4::/48 [20/0]

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

L FF00::/8 [0/0]

via Null0, receive

**R3 Running config:**

Current configuration : 5260 bytes

Last configuration change at 17:10:10 UTC Fri Oct 27 2023

version 16.9

service config

service timestamps debug datetime msec

service timestamps log datetime msec

service password-encryption

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

enable secret 5 $1$uQqG$c5UFPW2TLKplNyIo18Z.U1

no aaa new-model

no ip domain lookup

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2557841031

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2557841031

revocation-check none

rsakeypair TP-self-signed-2557841031

crypto pki certificate chain TP-self-signed-2557841031

certificate self-signed 01

quit

license udi pid ISR4321/K9 sn FDO21500G1N

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 3.3.3.3 255.255.255.0

interface GigabitEthernet0/0/0

ip address 200.100.53.3 255.255.255.248

negotiation auto

ipv6 address 2001:DB8:1::2/48

interface GigabitEthernet0/0/1

ip address 192.168.3.1 255.255.255.0

negotiation auto

ipv6 address 2001:DB8:3::1/48

ipv6 ospf 1 area 1

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0/2/0

no ip address

negotiation auto

interface GigabitEthernet0/2/1

no ip address

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

negotiation auto

router ospfv3 1

router-id 3.3.3.3

address-family ipv6 unicast

exit-address-family

router ospf 1

network 3.3.3.0 0.0.0.255 area 1

network 192.168.3.0 0.0.0.255 area 1

router bgp 1

bgp log-neighbor-changes

neighbor 4.4.4.4 remote-as 1

neighbor 4.4.4.4 update-source Loopback0

neighbor 2001:DB8:1::1 remote-as 2

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

neighbor 2001:DB8:3::2 remote-as 1

neighbor 200.100.53.2 remote-as 2

neighbor 200.100.53.5 remote-as 3

address-family ipv4

network 3.3.3.0 mask 255.255.255.0

network 192.168.3.0

network 200.100.53.0 mask 255.255.255.248

redistribute ospf 1

neighbor 4.4.4.4 activate

no neighbor 2001:DB8:1::1 activate

no neighbor 2001:DB8:1::3 activate

no neighbor 2001:DB8:3::2 activate

neighbor 200.100.53.2 activate

neighbor 200.100.53.5 activate

exit-address-family

address-family ipv6

redistribute ospf 1

network 2001:DB8:1::/48

network 2001:DB8:3::/48

neighbor 2001:DB8:1::1 activate

neighbor 2001:DB8:1::3 activate

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 http client source-interface GigabitEthernet0/0/0

control-plane

banner motd ^Cno unauthorized access^C

line con 0

exec-timeout 0 0

password 7 060506324F41

logging synchronous

login

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

password 7 121A0C0411044C

login

line vty 5 15

password 7 121A0C0411044C

login

end

**R4 Ip routes:**

Gateway of last resort is not set

B 1.0.0.0/8 [200/1] via 200.100.53.2, 00:51:30

2.0.0.0/24 is subnetted, 1 subnets

B 2.2.2.0 [200/0] via 200.100.53.2, 00:51:30

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

B 3.3.3.0/24 [200/0] via 3.3.3.3, 01:22:25

O 3.3.3.3/32 [110/2] via 192.168.3.1, 01:23:15, GigabitEthernet0/0/1

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

C 4.4.4.0/24 is directly connected, Loopback0

L 4.4.4.4/32 is directly connected, Loopback0

5.0.0.0/24 is subnetted, 1 subnets

B 5.5.5.0 [200/0] via 200.100.53.5, 01:22:22

6.0.0.0/24 is subnetted, 1 subnets

B 6.6.6.0 [200/130816] via 200.100.53.5, 01:22:22

B 192.168.1.0/24 [200/0] via 200.100.53.2, 00:51:30

B 192.168.2.0/24 [200/0] via 200.100.53.5, 01:22:22

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

200.100.53.0/29 is subnetted, 1 subnets

B 200.100.53.0 [200/0] via 3.3.3.3, 01:22:25

**IPV6:**

B 2001:DB8:1::/48 [200/0]

via 2001:DB8:3::1

B 2001:DB8:2::/48 [200/0]

via 2001:DB8:1::1

C 2001:DB8:3::/48 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

B 2001:DB8:4::/48 [200/0]

via 2001:DB8:1::3

L FF00::/8 [0/0]

via Null0, receive

**R4 running config:**

Current configuration : 4595 bytes

Last configuration change at 17:48:35 UTC Fri Oct 27 2023

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

service password-encryption

platform qfp utilization monitor load 80

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

enable secret 5 $1$Mi1c$EYNG2LF5ruaow3/YQ6CzN/

no aaa new-model

no ip domain lookup

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-1457377718

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-1457377718

revocation-check none

rsakeypair TP-self-signed-1457377718

crypto pki certificate chain TP-self-signed-1457377718

certificate self-signed 01

quit

license udi pid ISR4321/K9 sn FDO21441WDF

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 4.4.4.4 255.255.255.0

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/0/1

ip address 192.168.3.2 255.255.255.0

negotiation auto

ipv6 address 2001:DB8:3::2/48

ipv6 ospf 1 area 1

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

router ospfv3 1

router-id 4.4.4.4

address-family ipv6 unicast

exit-address-family

router ospf 1

network 4.4.4.0 0.0.0.255 area 1

network 192.168.3.0 0.0.0.255 area 1

router bgp 1

bgp log-neighbor-changes

neighbor 3.3.3.3 remote-as 1

neighbor 3.3.3.3 update-source Loopback0

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

address-family ipv4

network 4.4.4.0 mask 255.255.255.0

redistribute ospf 1

neighbor 3.3.3.3 activate

no neighbor 2001:DB8:3::1 activate

exit-address-family

address-family ipv6

redistribute ospf 1

network 2001:DB8:3::/48

neighbor 2001:DB8:3::1 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

banner motd ^Cno unauthorized access^C

line con 0

password 7 0822455D0A16

logging synchronous

login

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

password 7 13061E01080344

login

line vty 5 15

password 7 13061E01080344

login

end

**R5 Ip routes:**

Gateway of last resort is not set

B 1.0.0.0/8 [20/1] via 200.100.53.2, 00:54:28

2.0.0.0/24 is subnetted, 1 subnets

B 2.2.2.0 [20/0] via 200.100.53.2, 00:54:28

3.0.0.0/24 is subnetted, 1 subnets

B 3.3.3.0 [20/0] via 200.100.53.3, 01:25:21

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

B 4.4.4.0/24 [20/0] via 200.100.53.3, 01:24:52

B 4.4.4.4/32 [20/2] via 200.100.53.3, 01:25:21

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

C 5.5.5.0/24 is directly connected, Loopback0

L 5.5.5.5/32 is directly connected, Loopback0

6.0.0.0/24 is subnetted, 1 subnets

D 6.6.6.0 [90/130816] via 192.168.2.2, 01:32:59, GigabitEthernet0/0/1

B 192.168.1.0/24 [20/0] via 200.100.53.2, 00:54:28

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 192.168.2.1/32 is directly connected, GigabitEthernet0/0/1

B 192.168.3.0/24 [20/0] via 200.100.53.3, 01:25:21

200.100.53.0/24 is variably subnetted, 2 subnets, 2 masks

C 200.100.53.0/29 is directly connected, GigabitEthernet0/0/0

L 200.100.53.5/32 is directly connected, GigabitEthernet0/0/0

**IPV6:**

C 2001:DB8:1::/48 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

B 2001:DB8:2::/48 [20/0]

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

B 2001:DB8:3::/48 [20/0]

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

C 2001:DB8:4::/48 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

**R5 running config:**

Current configuration : 4898 bytes

Last configuration change at 17:47:43 UTC Fri Oct 27 2023

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

service password-encryption

platform qfp utilization monitor load 80

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

enable secret 5 $1$nW3W$Y9aGkC1Xe2rgutqCwt/od/

no aaa new-model

no ip domain lookup

login on-success log

subscriber templating

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2054344109

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2054344109

revocation-check none

rsakeypair TP-self-signed-2054344109

crypto pki certificate chain TP-self-signed-2054344109

certificate self-signed 01

quit

license udi pid ISR4321/K9 sn FDO215009QY

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 5.5.5.5 255.255.255.0

interface GigabitEthernet0/0/0

ip address 200.100.53.5 255.255.255.248

negotiation auto

ipv6 address 2001:DB8:1::3/48

interface GigabitEthernet0/0/1

ip address 192.168.2.1 255.255.255.0

negotiation auto

ipv6 address 2001:DB8:4::1/48

interface Serial0/1/0

no ip address

interface Serial0/1/1

no ip address

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

negotiation auto

router eigrp 1

network 5.5.5.0 0.0.0.255

network 192.168.2.0

router bgp 3

bgp log-neighbor-changes

neighbor 6.6.6.6 remote-as 3

neighbor 6.6.6.6 update-source Loopback0

neighbor 2001:DB8:1::1 remote-as 2

neighbor 2001:DB8:1::2 remote-as 1

neighbor 2001:DB8:4::2 remote-as 3

neighbor 200.100.53.2 remote-as 2

neighbor 200.100.53.3 remote-as 1

address-family ipv4

network 5.5.5.0 mask 255.255.255.0

network 192.168.2.0

network 200.100.53.0 mask 255.255.255.248

redistribute eigrp 1

neighbor 6.6.6.6 activate

no neighbor 2001:DB8:1::1 activate

no neighbor 2001:DB8:1::2 activate

no neighbor 2001:DB8:4::2 activate

neighbor 200.100.53.2 activate

neighbor 200.100.53.3 activate

exit-address-family

address-family ipv6

redistribute eigrp 1

network 2001:DB8:1::/48

network 2001:DB8:4::/48

neighbor 2001:DB8:1::1 activate

neighbor 2001:DB8:1::2 activate

neighbor 2001:DB8:4::2 activate

exit-address-family

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip http client source-interface GigabitEthernet0/0/0

control-plane

banner motd ^Cno unauthorized access^C

line con 0

password 7 05080F1C2243

logging synchronous

login

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

password 7 13061E01080344

login

line vty 5 15

password 7 13061E01080344

login

end

**R6 ip routes:**

Gateway of last resort is not set

B 1.0.0.0/8 [200/1] via 200.100.53.2, 00:57:07

2.0.0.0/24 is subnetted, 1 subnets

B 2.2.2.0 [200/0] via 200.100.53.2, 00:57:07

3.0.0.0/24 is subnetted, 1 subnets

B 3.3.3.0 [200/0] via 200.100.53.3, 01:27:58

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

B 4.4.4.0/24 [200/0] via 200.100.53.3, 01:27:30

B 4.4.4.4/32 [200/2] via 200.100.53.3, 01:27:58

5.0.0.0/24 is subnetted, 1 subnets

D 5.5.5.0 [90/130816] via 192.168.2.1, 01:35:37, GigabitEthernet0/0/1

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

C 6.6.6.0/24 is directly connected, Loopback0

L 6.6.6.6/32 is directly connected, Loopback0

B 192.168.1.0/24 [200/0] via 200.100.53.2, 00:57:07

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

B 192.168.3.0/24 [200/0] via 200.100.53.3, 01:27:58

200.100.53.0/29 is subnetted, 1 subnets

B 200.100.53.0 [200/0] via 5.5.5.5, 01:27:58

**IPV6:**

B 2001:DB8:1::/48 [200/0]

via 2001:DB8:4::1

B 2001:DB8:2::/48 [200/0]

via 2001:DB8:1::1

B 2001:DB8:3::/48 [200/0]

via 2001:DB8:1::2

C 2001:DB8:4::/48 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

**R6 config:**

Current configuration : 4519 bytes

Last configuration change at 17:31:01 UTC Fri Oct 27 2023

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

service password-encryption

platform qfp utilization monitor load 80

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

enable secret 5 $1$RuqZ$yKXS0LhR.nyJoFBklAIOh/

no aaa new-model

no ip domain lookup

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-318861592

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-318861592

revocation-check none

rsakeypair TP-self-signed-318861592

crypto pki certificate chain TP-self-signed-318861592

certificate self-signed 01

quit

license udi pid ISR4321/K9 sn FDO214420HM

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 6.6.6.6 255.255.255.0

interface GigabitEthernet0/0/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/0/1

ip address 192.168.2.2 255.255.255.0

negotiation auto

ipv6 address 2001:DB8:4::2/48

ipv6 eigrp 1

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

router eigrp 1

network 6.6.6.0 0.0.0.255

network 192.168.2.0

router bgp 3

bgp log-neighbor-changes

neighbor 5.5.5.5 remote-as 3

neighbor 5.5.5.5 update-source Loopback0

neighbor 2001:DB8:4::1 remote-as 3

address-family ipv4

network 6.6.6.0 mask 255.255.255.0

redistribute eigrp 1

neighbor 5.5.5.5 activate

no neighbor 2001:DB8:4::1 activate

exit-address-family

address-family ipv6

redistribute eigrp 1

network 2001:DB8:4::/48

neighbor 2001:DB8:4::1 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 1

eigrp router-id 6.6.6.6

control-plane

banner motd ^Cno unauthorized access^C

line con 0

password 7 13061E010803

logging synchronous

login

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

password 7 05080F1C22430E

login

line vty 5 15

password 7 05080F1C22430E

login

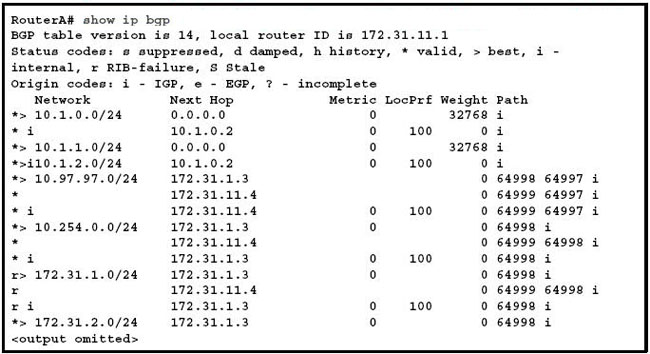
End

**Problems:**

* Use of internal BGP which was not in the scope of this lab
  + Caused issues with rip specifically but worked with EIGRP and OSPF
    - Removed iBGP from router 1 and 2 which were connected by RIP
* Issues with pasted configurations resulting in faulty configs
  + Sometimes ipv6 unicast routing would not activate causing all following ipv6 commands to be errors. After a few periods of constant fixing the issues one by one, we realized it was this problem.
    - Solved by typing ipv6 unicast-routing in before pasting config.
* Router 1 not receiving bgp routes
  + The router only received the one rip route to router 2 and could not ping out of its subnet.
    - Fixed by adding the “redistribute bgp 2 metric transparent” to both the rip routers
* Ipv4 routes removed after adding ipv6 to bgp
  + Happened the first time we tried using the address-family ipv6 commands to all routers
    - Realized we had to use address-family ipv4 commands too if we wanted both ipv6 and ipv4. Worked after we use both address families together.
* No BGP connection
  + Checked our show runs and realized the connections were made on interfaces with different networks
    - Changed the IP addresses to be in the same subnets and the connections established.
* Packet Tracer did not support all BGP commands
  + Used physical routers instead and reloaded or used no \_\_\_ when we messed up commands.

**Evidence of Modifiers:**

**IP BGP Table Format**

****

1. changed weight of neighbor 200.100.53.3 to 500 has greater priority over weight of 0 (changed weight)

R2:

\*> 3.3.3.0/24 200.100.53.3 500 3 1 i

\* 200.100.53.3 0 0 1 i

The > tells us that is the chosen best route for that network (3.3.3.0/24). This is because weight has the highest priority in bgp routing decisions so if there was more than one route to a 3.3.3.0 address, the router would choose to use the route using 200.100.53.3.

1. internal route less preferred because weight is higher priority than local preference (use of iBGP). Router chooses to use the external route of 192.168.1.2.

\*>i 1.1.1.0/24 1.1.1.1 0 100 0 i

\*> 1.1.1.1/32 192.168.1.2 2 32768 ?

Tracing the route to 1.1.1.1

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

1. 192.168.1.2 10 msec \* 2 msec
2. 0.0.0.0 route is chosen because this network originates on this router and is given the highest weight (use of network command).

\* 200.100.53.0/29 200.100.53.5 0 500 3 i

\*> 0.0.0.0 0 32768 i

\* 200.100.53.3 0 0 1 i

**Conclusion:**

We had to research many of the concepts in this lab due to BGP being a new Routing protocol to us. Now we know how to set up BGP and iBGP (even though not in the scope of this lab) and their use in the real world with ISP use of it. Another important lesson we learned is that research takes time to find accurate sources and to cross check everything you view. We watched videos and read documents of the commands to enable BGP and explanation of its concepts or use. We were misled by most of the sources but figured it out after cross checking with cisco verified sources. My most crucial takeaway from this lab is to make sure your research is accurate so you can fix your problem and accomplish your tasks more efficiently.

