BGP Lab

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**Purpose**

BGP is an example of an EGP or exterior gateway protocol. Unlike routing protocols like OSPF or EIGRP, BGP is primarily used to route between various networks. Learning BGP is a key skill in any Network technician’s arsenal. It’s very powerful and is the routing protocol of choice on the internet. In this lab we’re practicing setting up BGP routes between various autonomous systems, learning about the ways to implement BGP, as well as how to modify its functionality.

**Background**

The internet as we know it consists of various “Autonomous Systems”. In practice, it’s useful to think of them as various isolated cities. They are self-contained, with a few roads leading out. From city to city, factors like the number of houses, layout of roads may differ. But when we zoom out, they all function similarly.

Our city analogy translates quite accurately to the internet. Often, different internet providers such as Comcast or AT&T set up their own “cities”. Other times, a company may set up its own network, creating their own city specific for their own needs.

Our cities are great and all, but you might be wondering how they can talk to each other. After all, not everything we use the internet for is found on our own network. That’s where BGP comes in. BGP is like the highway between these various cities. It establishes a way for people in any city to reach any other remote neighbor in a different city.

BGP doesn’t care how your city is set up internally, it doesn’t care what internal gateway protocol (IGP) you use. Rather BGP focuses on building roads between those cities. Simply put, BGP allows network administrators to connect with each other.

In this lab, we practiced setting up these “roads” between various networks, and configuring it in a way such that they can communicate.

**Lab Summary**

First, we created a general topology for the entire setup including 3 different autonomous systems, one BGP network, corresponding IPv4 and IPv6 addresses, and the associated wiring.

After wiring up the diagram, on each of the routers we preformed the following rough steps.

1. Set up basic device configuration including hostname, enabled ipv6 routing and general device security.
2. Turned on interfaces and loopbacks and set associated IPv4 and IPv6 addresses on said interfaces.
3. Configured OSPFv2 and OSPFv3, Eigrp and Eigrpv6, RIPv2 and IPv6 RIP in their respective networks.
4. Configured BGP Border Routers with the AS number/IP addresses of their neighbors.
5. Set up redistribute commands on border routers to allow routes to be shared between BGP and the various IGPs.

**Lab Commands**

**Hostname JacobAaronRX**: Sets a unique hostname to identify the various routers

**IPv6 Unicast-Routing**: Allows the routing of IPv6 packets across the network

**Interface g0/0/X**: Access the interfaces

**No shut**: Turns on the interfaces

**Ip add 192.168.x.x 255.255.255.0**: sets an ipv4 address on an interface

**Ipv6 add 2001:db8:acad:x::x/64**: sets an ipv6 address on an interface

**Ip ospf 1 area x**: Sets an OSPF process id of 1 and an associated area on an interface

**Ipv6 ospf 1 area x**: sets up OSPFv3 with process id of 1 and an associated area

**Router ospf 1**: access ospfv2 configuration on the router

**Ipv6 router ospf 1**: access ospfv3 configuration settings for the router

**Router-id x.x.x.x**: sets a specific router id for that router to use for OSPF

**Redistribute x:** Informs the routing protocol to inject certain types of routes routes into the routing protocol. Examples include Redistribute connected, Redistribute OSPF etc.

**Router BGP**: Access BGP configuration

**Neighbor x.x.x.x remote-as x**: Informs a device of its BGP neighbors.

**Neighbor 2001::x activate:** Activates BGP neighbor peering with IPv6

**No auto-summary:** prevents the auto summarization of subnets into classful networks. This is important because BGP needs the exact subnet to match in order to redistribute the routes.

**Router Rip:** Enables configuration of the RIP routing protocol

**Version 2:** Specifies to use RIP version 2 (a requirement to properly interact with BGP)

**Network x.x.x.x:** (specifies the rip network)

**Neighbor x.x.x.x:** (Configures the RIP neighbors)

**Ipv6 rip x enable:** Enables Ipv6 Rip Routing on an interface

**Router eigrp x:** Enables EIGRP configuration

**Ipv6 router eigrp 1:** Enables Ipv6 EIGRP configuration

**Eigrp router-id x.x.x.x**: Configures a router-id for EIGRP functionality

**Network x.x.x.x x.x.x.x:** Configures the within EIGRP is running

**access-list 1 permit any:** Creates an access list that permits any ip address

**route-map map permit 10**: Creates a routemap that is used to define which routes are permitted

**match ip address 1:** matches ip addresses based on an access list

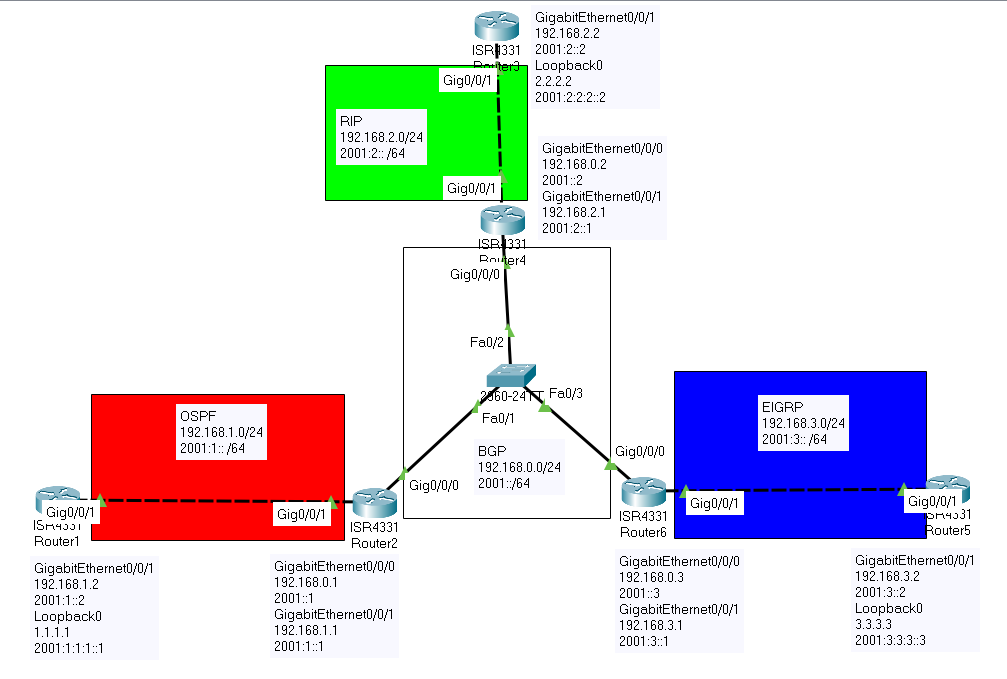
**set metric 500**: Sets a universal metric upon which the router will use to determine forwarding costs

**neighbor x.x.x.x next-hop-self:** is to allow this router to assign itself as the next hop for another bgp router

**neighbor x.x.x.x weight 200:** assigns a weight associated with a bgp route to influence BGP forwarding decisions

**neighbor x.x.x.x route-map map out:** Associates a [previously created route map with an instance of BGP to affect forwarding decisions and the ip addresses allowed.

**Network Diagram**



**Configuration:**

hostname JacobAaronAidenR1

ipv6 unicast-routing

int g0/0/1

ip address 192.168.1.2 255.255.255.0

ipv6 address 2001:1::2/64

no shut

ip ospf 1 area 0

ipv6 ospf 1 area 0

int lo0

ip address 1.1.1.1 255.255.255.0

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

no shut

ip ospf 1 area 0

ipv6 ospf 1 area 0

router ospf 1

router-id 1.1.1.1

redistribute connected

ipv6 router ospf 1

router-id 1.1.1.1

redistribute connected

hostname JacobAaronAidenR2

ipv6 unicast-routing

int g0/0/1

no shut

ip address 192.168.1.1 255.255.255.0

ipv6 address 2001:1::1/64

ip ospf 1 area 0

ipv6 ospf 1 area 0

int g0/0/0

no shut

ip address 192.168.0.1 255.255.255.0

ipv6 address 2001::1/64

ipv6 ospf 1 area 0

router ospf 1

router-id 2.2.2.2

passive-interface g0/0/0

redistribute bgp 2

redistribute connected

ipv6 router ospf 1

router-id 2.2.2.2

passive-interface g0/0/0

redistribute bgp 2

redistribute connected

router bgp 2

neighbor 192.168.0.2 remote-as 4

neighbor 192.168.0.3 remote-as 6

neighbor 2001::2 remote-as 4

neighbor 2001::3 remote-as 6

address-family ipv4 unicast

redistribute ospf 1

no auto-summary

address-family ipv6

neighbor 2001::2 activate

neighbor 2001::3 activate

redistribute ospf 1 include-connected

no auto-summary

hostname JacobAaronAidenR3

ipv6 unicast-routing

int g0/0/1

no shut

ip address 192.168.2.2 255.255.255.0

ipv6 address 2001:2::2/64

ipv6 rip RIPforV6 enable

int lo0

ip address 2.2.2.2 255.255.255.0

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

no shut

ipv6 rip RIPforV6 enable

router rip

version 2

network 192.168.2.0

neighbor 192.168.2.1

redistribute connected metric transparent

no auto-summary

ipv6 router rip RIPforV6

redistribute connected metric 5

hostname JacobAaronAidenR4

ipv6 unicast-routing

int g0/0/1

no shut

ip address 192.168.2.1 255.255.255.0

ipv6 address 2001:2::1/64

ipv6 rip RIPforV6 enable

int g0/0/0

no shut

ip address 192.168.0.2 255.255.255.0

ipv6 address 2001::2/64

ipv6 rip RIPforV6 enable

router rip

version 2

network 192.168.2.0

neighbor 192.168.2.2

passive-interface g0/0/0

redistribute bgp 4 metric 5

redistribute connected

no auto-summary

ipv6 router rip RIPforV6

redistribute bgp 4 metric 5

redistribute connected

router bgp 4

neighbor 192.168.0.3 remote-as 6

neighbor 192.168.0.1 remote-as 2

neighbor 2001::1 remote-as 2

neighbor 2001::3 remote-as 6

address-family ipv4 unicast

redistribute rip

no auto-summary

address-family ipv6

neighbor 2001::1 activate

neighbor 2001::3 activate

redistribute rip RIPforV6 include-connected

no auto-summary

hostname JacobAaronAidenR5

ipv6 unicast-routing

int g0/0/1

ip address 192.168.3.2 255.255.255.0

ipv6 address 2001:3::2/64

no shut

ipv6 eigrp 1

int lo0

ip address 3.3.3.3 255.255.255.0

ipv6 address 2001:3:3:3::3/64

no shut

ipv6 eigrp 1

router eigrp 1

eigrp router-id 5.5.5.5

network 192.168.3.0 0.0.0.255

redistribute connected metric 10000 100 255 1 1500

ipv6 router eigrp 1

eigrp router-id 5.5.5.5

redistribute connected metric 10000 100 255 1 1500

hostname JacobAaronAidenR6

ipv6 unicast-routing

int g0/0/1

no shut

ip address 192.168.3.1 255.255.255.0

ipv6 address 2001:3::1/64

ipv6 eigrp 1

int g0/0/0

no shut

ip address 192.168.0.3 255.255.255.0

ipv6 address 2001::3/64

ipv6 eigrp 1

router eigrp 1

eigrp router-id 6.6.6.6

network 192.168.3.0 0.0.0.255

passive-interface g0/0/0

redistribute bgp 6 metric 10000 100 255 1 1500

redistribute connected

ipv6 router eigrp 1

eigrp router-id 6.6.6.6

passive-interface g0/0/0

redistribute bgp 6 metric 10000 100 255 1 1500

redistribute connected

router bgp 6

neighbor 192.168.0.2 remote-as 4

neighbor 192.168.0.1 remote-as 2

neighbor 2001::1 remote-as 2

neighbor 2001::2 remote-as 4

address-family ipv4 unicast

redistribute eigrp 1

neighbor 192.168.0.1 next-hop-self

neighbor 192.168.0.1 weight 200

neighbor 192.168.0.2 route-map map out

no auto-summary

address-family ipv6

neighbor 2001::1 activate

neighbor 2001::2 activate

redistribute eigrp 1 include-connected

no auto-summary

access-list 1 permit any

route-map map permit 10

match ip address 1

set metric 500

route-map map permit 20

**Show Run:**

**R1**

Last configuration change at 20:06:21 UTC Wed Nov 8 2023

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname JacobAaronAidenR1

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 FDO214421CF

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

interface Loopback0

ip address 1.1.1.1 255.255.255.0

ip ospf 1 area 0

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

ipv6 ospf 1 area 0

interface GigabitEthernet0/0/0

no ip address

negotiation auto

interface GigabitEthernet0/0/1

ip address 192.168.1.2 255.255.255.0

ip ospf 1 area 0

negotiation auto

ipv6 address 2001:1::2/64

ipv6 ospf 1 area 0

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

interface Vlan1

no ip address

router ospf 1

router-id 1.1.1.1

redistribute connected subnets

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 1.1.1.1

redistribute connected

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R2**

Last configuration change at 20:23:14 UTC Wed Nov 8 2023

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname JacobAaronAidenR2

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 FDO211216BL

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0

ip address 192.168.0.1 255.255.255.0

negotiation auto

ipv6 address 2001::1/64

ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1

ip address 192.168.1.1 255.255.255.0

ip ospf 1 area 0

negotiation auto

ipv6 address 2001:1::1/64

ipv6 ospf 1 area 0

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

interface Vlan1

no ip address

router ospf 1

router-id 2.2.2.2

redistribute connected subnets

redistribute bgp 2 subnets

passive-interface GigabitEthernet0/0/0

router bgp 2

bgp log-neighbor-changes

neighbor 2001::2 remote-as 4

neighbor 2001::3 remote-as 6

neighbor 192.168.0.2 remote-as 4

neighbor 192.168.0.3 remote-as 6

!

address-family ipv4

redistribute ospf 1

no neighbor 2001::2 activate

no neighbor 2001::3 activate

neighbor 192.168.0.2 activate

neighbor 192.168.0.3 activate

exit-address-family

!

address-family ipv6

redistribute ospf 1 include-connected

neighbor 2001::2 activate

neighbor 2001::3 activate

exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 2.2.2.2

passive-interface GigabitEthernet0/0/0

redistribute connected

redistribute bgp 2

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R3**

Last configuration change at 20:23:32 UTC Wed Nov 8 2023

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname JacobAaronAidenR3

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 FDO214420G7

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

interface Loopback0

ip address 2.2.2.2 255.255.255.0

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

ipv6 rip RIPforV6 enable

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 2001:2::2/64

ipv6 rip RIPforV6 enable

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

interface Vlan1

no ip address

shutdown

router rip

version 2

redistribute connected metric transparent

network 192.168.2.0

neighbor 192.168.2.1

no auto-summary

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router rip RIPforV6

redistribute connected metric 5

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R4**

Last configuration change at 20:29:24 UTC Wed Nov 8 2023

version 15.5

service timestamps debug datetime msec

service timestamps log datetime msec

no platform punt-keepalive disable-kernel-core

hostname JacobAaronAidenR4

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 FDO21442B21

spanning-tree extend system-id

redundancy

mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0

ip address 192.168.0.2 255.255.255.0

negotiation auto

ipv6 address 2001::2/64

ipv6 rip RIPforV6 enable

interface GigabitEthernet0/0/1

ip address 192.168.2.1 255.255.255.0

negotiation auto

ipv6 address 2001:2::1/64

ipv6 rip RIPforV6 enable

interface Serial0/1/0

no ip address

interface Serial0/1/1

no ip address

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

interface Vlan1

no ip address

router rip

version 2

redistribute connected

redistribute bgp 4 metric 5

passive-interface GigabitEthernet0/0/0

network 192.168.2.0

neighbor 192.168.2.2

no auto-summary

router bgp 4

bgp log-neighbor-changes

neighbor 2001::1 remote-as 2

neighbor 2001::3 remote-as 6

neighbor 192.168.0.1 remote-as 2

neighbor 192.168.0.3 remote-as 6

!

address-family ipv4

redistribute rip

no neighbor 2001::1 activate

no neighbor 2001::3 activate

neighbor 192.168.0.1 activate

neighbor 192.168.0.3 activate

exit-address-family

!

address-family ipv6

redistribute rip RIPforV6 include-connected

neighbor 2001::1 activate

neighbor 2001::3 activate

exit-address-family

ip forward-protocol nd

no ip http server

no ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router rip RIPforV6

redistribute connected

redistribute bgp 4 metric 5

control-plane

line con 0

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R5**

Last configuration change at 20:17:44 UTC Wed Nov 8 2023

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

platform punt-keepalive disable-kernel-core

hostname JacobAaronAidenR5

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 FLM24060912

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

ipv6 address 2001:3:3:3::3/64

ipv6 eigrp 1

interface GigabitEthernet0/0/0

no ip address

negotiation auto

interface GigabitEthernet0/0/1

ip address 192.168.3.2 255.255.255.0

negotiation auto

ipv6 address 2001:3::2/64

ipv6 eigrp 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 eigrp 1

network 192.168.3.0

redistribute connected metric 10000 100 255 1 1500

eigrp router-id 5.5.5.5

ip forward-protocol nd

no ip http server

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router eigrp 1

eigrp router-id 5.5.5.5

redistribute connected metric 10000 100 255 1 1500

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R6**

Last configuration change at 20:22:41 UTC Wed Nov 8 2023

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

platform punt-keepalive disable-kernel-core

hostname JacobAaronAidenR6

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 FLM2408005M

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 192.168.0.3 255.255.255.0

negotiation auto

ipv6 address 2001::3/64

ipv6 eigrp 1

interface GigabitEthernet0/0/1

ip address 192.168.3.1 255.255.255.0

negotiation auto

ipv6 address 2001:3::1/64

ipv6 eigrp 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 eigrp 1

network 192.168.3.0

redistribute bgp 6 metric 10000 100 255 1 1500

redistribute connected

passive-interface GigabitEthernet0/0/0

eigrp router-id 6.6.6.6

router bgp 6

bgp log-neighbor-changes

neighbor 2001::1 remote-as 2

neighbor 2001::2 remote-as 4

neighbor 192.168.0.1 remote-as 2

neighbor 192.168.0.2 remote-as 4

!

address-family ipv4

redistribute eigrp 1

no neighbor 2001::1 activate

no neighbor 2001::2 activate

neighbor 192.168.0.1 activate

neighbor 192.168.0.1 next-hop-self

neighbor 192.168.0.1 weight 200

neighbor 192.168.0.2 activate

neighbor 192.168.0.2 route-map map out

exit-address-family

!

address-family ipv6

redistribute eigrp 1 include-connected

neighbor 2001::1 activate

neighbor 2001::2 activate

exit-address-family

ip forward-protocol nd

no ip http server

ip http secure-server

ip tftp source-interface GigabitEthernet0

access-list 1 permit any

ipv6 router eigrp 1

passive-interface GigabitEthernet0/0/0

eigrp router-id 6.6.6.6

redistribute bgp 6 metric 10000 100 255 1 1500

redistribute connected

route-map map permit 10

match ip address 1

set metric 500

route-map map permit 20

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**Show IP Route/Show IPv6 Route**

JacobAaronAidenR1#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

1.0.0.0/8 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

2.0.0.0/24 is subnetted, 1 subnets

O E2 2.2.2.0 [110/1] via 192.168.1.1, 00:42:00, GigabitEthernet0/0/1

3.0.0.0/24 is subnetted, 1 subnets

O E2 3.3.3.0 [110/1] via 192.168.1.1, 00:43:32, GigabitEthernet0/0/1

O E2 192.168.0.0/24 [110/20] via 192.168.1.1, 00:45:54, 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

O E2 192.168.2.0/24 [110/1] via 192.168.1.1, 00:42:00, GigabitEthernet0/0/1

O E2 192.168.3.0/24 [110/1] via 192.168.1.1, 00:43:32, GigabitEthernet0/0/1

JacobAaronAidenR1#show ipv6 route

IPv6 Routing Table - default - 10 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

O 2001::/64 [110/2]

via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

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

via Loopback0, directly connected

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

via Loopback0, receive

OE2 2001:2::/64 [110/1]

via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1

OE2 2001:2:2:2::/64 [110/1]

via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1

OE2 2001:3::/64 [110/1]

via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1

OE2 2001:3:3:3::/64 [110/1]

via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

JacobAaronAidenR2#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

O 1.1.1.1 [110/2] via 192.168.1.2, 00:45:16, GigabitEthernet0/0/1

2.0.0.0/24 is subnetted, 1 subnets

B 2.2.2.0 [20/1] via 192.168.0.2, 00:41:22

3.0.0.0/24 is subnetted, 1 subnets

B 3.3.3.0 [20/281856] via 192.168.0.3, 00:42:54

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

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 192.168.0.2, 00:41:22

B 192.168.3.0/24 [20/0] via 192.168.0.3, 00:42:54

JacobAaronAidenR2#show ipv6 route

IPv6 Routing Table - default - 10 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

C 2001::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

O 2001:1:1:1::1/128 [110/1]

via FE80::B6A8:B9FF:FE47:8E41, GigabitEthernet0/0/1

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

via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/0

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

via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/0

B 2001:3::/64 [20/0]

via FE80::CE7F:76FF:FED1:ADC0, GigabitEthernet0/0/0

B 2001:3:3:3::/64 [20/130816]

via FE80::CE7F:76FF:FED1:ADC0, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

JacobAaronAidenR3#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

R 1.1.1.1 [120/5] via 192.168.2.1, 00:00:17, 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

R 3.3.3.0 [120/5] via 192.168.2.1, 00:00:17, GigabitEthernet0/0/1

R 192.168.0.0/24 [120/1] via 192.168.2.1, 00:00:17, GigabitEthernet0/0/1

R 192.168.1.0/24 [120/5] via 192.168.2.1, 00:00:17, 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

R 192.168.3.0/24 [120/5] via 192.168.2.1, 00:00:17, GigabitEthernet0/0/1

JacobAaronAidenR3#show ipv6 route

IPv6 Routing Table - default - 10 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

R 2001::/64 [120/2]

via FE80::B6A8:B9FF:FEA0:2E21, GigabitEthernet0/0/1

R 2001:1::/64 [120/6]

via FE80::B6A8:B9FF:FEA0:2E21, GigabitEthernet0/0/1

R 2001:1:1:1::1/128 [120/6]

via FE80::B6A8:B9FF:FEA0:2E21, GigabitEthernet0/0/1

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

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

via Loopback0, directly connected

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

via Loopback0, receive

R 2001:3::/64 [120/6]

via FE80::B6A8:B9FF:FEA0:2E21, GigabitEthernet0/0/1

R 2001:3:3:3::/64 [120/6]

via FE80::B6A8:B9FF:FEA0:2E21, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

JacobAaronAidenR4#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

B 1.1.1.1 [20/2] via 192.168.0.1, 00:38:49

2.0.0.0/24 is subnetted, 1 subnets

R 2.2.2.0 [120/1] via 192.168.2.2, 00:00:04, GigabitEthernet0/0/1

3.0.0.0/24 is subnetted, 1 subnets

B 3.3.3.0 [20/500] via 192.168.0.3, 00:38:49

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

B 192.168.1.0/24 [20/0] via 192.168.0.1, 00:38:49

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 [20/500] via 192.168.0.3, 00:38:49

JacobAaronAidenR4#show ipv6 route

IPv6 Routing Table - default - 10 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

C 2001::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

B 2001:1::/64 [20/0]

via FE80::2F8:2CFF:FE7F:7190, GigabitEthernet0/0/0

B 2001:1:1:1::1/128 [20/1]

via FE80::2F8:2CFF:FE7F:7190, GigabitEthernet0/0/0

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

R 2001:2:2:2::/64 [120/2]

via FE80::B6A8:B9FF:FE01:B751, GigabitEthernet0/0/1

B 2001:3::/64 [20/0]

via FE80::CE7F:76FF:FED1:ADC0, GigabitEthernet0/0/0

B 2001:3:3:3::/64 [20/130816]

via FE80::CE7F:76FF:FED1:ADC0, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

JacobAaronAidenR5#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

D EX 1.1.1.1 [170/281856] via 192.168.3.1, 00:38:47, GigabitEthernet0/0/1

2.0.0.0/24 is subnetted, 1 subnets

D EX 2.2.2.0 [170/281856] via 192.168.3.1, 00:37:14, GigabitEthernet0/0/1

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

D EX 192.168.0.0/24

[170/28416] via 192.168.3.1, 00:40:06, GigabitEthernet0/0/1

D EX 192.168.1.0/24

[170/281856] via 192.168.3.1, 00:38:47, GigabitEthernet0/0/1

D EX 192.168.2.0/24

[170/281856] via 192.168.3.1, 00:37:14, 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

JacobAaronAidenR5#show ipv6 route

IPv6 Routing Table - default - 10 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

D 2001::/64 [90/28416]

via FE80::CE7F:76FF:FED1:ADC1, GigabitEthernet0/0/1

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

via FE80::CE7F:76FF:FED1:ADC1, GigabitEthernet0/0/1

EX 2001:1:1:1::1/128 [170/281856]

via FE80::CE7F:76FF:FED1:ADC1, GigabitEthernet0/0/1

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

via FE80::CE7F:76FF:FED1:ADC1, GigabitEthernet0/0/1

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

via FE80::CE7F:76FF:FED1:ADC1, GigabitEthernet0/0/1

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

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

via Loopback0, directly connected

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

via Loopback0, receive

L FF00::/8 [0/0]

via Null0, receive

JacobAaronAidenR6#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

B 1.1.1.1 [20/2] via 192.168.0.1, 00:35:07

2.0.0.0/24 is subnetted, 1 subnets

B 2.2.2.0 [20/0] via 192.168.0.2, 00:33:35

3.0.0.0/24 is subnetted, 1 subnets

D EX 3.3.3.0 [170/281856] via 192.168.3.2, 00:36:23, GigabitEthernet0/0/1

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 192.168.0.3/32 is directly connected, GigabitEthernet0/0/0

B 192.168.1.0/24 [20/0] via 192.168.0.1, 00:35:07

B 192.168.2.0/24 [20/0] via 192.168.0.2, 00:33:35

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

JacobAaronAidenR6#show ipv6 route

IPv6 Routing Table - default - 10 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

C 2001::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

B 2001:1::/64 [20/0]

via FE80::2F8:2CFF:FE7F:7190, GigabitEthernet0/0/0

B 2001:1:1:1::1/128 [20/1]

via FE80::2F8:2CFF:FE7F:7190, GigabitEthernet0/0/0

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

via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/0

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

via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/0

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

D 2001:3:3:3::/64 [90/130816]

via FE80::CE7F:76FF:FE6A:B5E1, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

**Traceroutes**

JacobAaronAidenR1#traceroute 1.1.1.1

Type escape sequence to abort.

Tracing the route to 1.1.1.1

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

1 1.1.1.1 1 msec \* 1 msec

JacobAaronAidenR1#traceroute 2.2.2.2

Type escape sequence to abort.

Tracing the route to 2.2.2.2

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

1 192.168.1.1 0 msec 1 msec 0 msec

2 192.168.0.2 1 msec 1 msec 1 msec

3 192.168.2.2 1 msec 2 msec \*

JacobAaronAidenR1#traceroute 3.3.3.3

Type escape sequence to abort.

Tracing the route to 3.3.3.3

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

1 192.168.1.1 1 msec 0 msec 1 msec

2 192.168.0.3 1 msec 1 msec 1 msec

3 192.168.3.2 1 msec 1 msec \*

JacobAaronAidenR1#traceroute 2001:1:1:1::1

Type escape sequence to abort.

Tracing the route to 2001:1:1:1::1

1 2001:1:1:1::1 1 msec 0 msec 1 msec

JacobAaronAidenR1#traceroute 2001:2:2:2::2

Type escape sequence to abort.

Tracing the route to 2001:2:2:2::2

1 2001:1::1 6 msec 1 msec 1 msec

2 2001::2 1 msec 1 msec 1 msec

3 2001:2::2 1 msec 1 msec 0 msec

JacobAaronAidenR1#traceroute 2001:3:3:3::3

Type escape sequence to abort.

Tracing the route to 2001:3:3:3::3

1 2001:1::1 1 msec 1 msec 1 msec

2 2001::3 1 msec 1 msec 1 msec

3 2001:3::2 1 msec 2 msec 1 msec

JacobAaronAidenR2#traceroute 1.1.1.1

Type escape sequence to abort.

Tracing the route to 1.1.1.1

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

1 192.168.1.2 1 msec 2 msec \*

JacobAaronAidenR2#traceroute 2.2.2.2

Type escape sequence to abort.

Tracing the route to 2.2.2.2

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

1 192.168.0.2 1 msec 0 msec 1 msec

2 192.168.2.2 [AS 4] 1 msec 1 msec \*

JacobAaronAidenR2#traceroute 3.3.3.3

Type escape sequence to abort.

Tracing the route to 3.3.3.3

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

1 192.168.0.3 1 msec 1 msec 1 msec

2 192.168.3.2 [AS 6] 1 msec 1 msec \*

JacobAaronAidenR2#traceroute 2001:1:1:1::1

Type escape sequence to abort.

Tracing the route to 2001:1:1:1::1

1 2001:1::2 14 msec 1 msec 1 msec

JacobAaronAidenR2#traceroute 2001:2:2:2::2

Type escape sequence to abort.

Tracing the route to 2001:2:2:2::2

1 2001::2 3 msec 3 msec 3 msec

2 2001:2::2 [AS 4] 1 msec 2 msec 1 msec

JacobAaronAidenR2#traceroute 2001:3:3:3::3

Type escape sequence to abort.

Tracing the route to 2001:3:3:3::3

1 2001::3 1 msec 1 msec 1 msec

2 2001:3::2 [AS 6] 1 msec 1 msec 1 msec

JacobAaronAidenR3#traceroute 1.1.1.1

Type escape sequence to abort.

Tracing the route to 1.1.1.1

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

1 192.168.2.1 1 msec 1 msec 0 msec

2 192.168.0.1 1 msec 1 msec 0 msec

3 192.168.1.2 1 msec 1 msec \*

JacobAaronAidenR3#traceroute 2.2.2.2

Type escape sequence to abort.

Tracing the route to 2.2.2.2

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

1 2.2.2.2 0 msec \* 1 msec

JacobAaronAidenR3#traceroute 3.3.3.3

Type escape sequence to abort.

Tracing the route to 3.3.3.3

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

1 192.168.2.1 0 msec 1 msec 0 msec

2 192.168.0.3 1 msec 1 msec 1 msec

3 192.168.3.2 2 msec 1 msec \*

JacobAaronAidenR3#traceroute 2001:1:1:1::1

Type escape sequence to abort.

Tracing the route to 2001:1:1:1::1

1 2001:2::1 5 msec 1 msec 1 msec

2 2001::1 1 msec 1 msec 1 msec

3 2001:1::2 1 msec 1 msec 1 msec

JacobAaronAidenR3#traceroute 2001:2:2:2::2

Type escape sequence to abort.

Tracing the route to 2001:2:2:2::2

1 2001:2:2:2::2 0 msec 1 msec 0 msec

JacobAaronAidenR3#traceroute 2001:3:3:3::3

Type escape sequence to abort.

Tracing the route to 2001:3:3:3::3

1 2001:2::1 1 msec 1 msec 1 msec

2 2001::3 1 msec 2 msec 1 msec

3 2001:3::2 1 msec 1 msec 1 msec

JacobAaronAidenR4#traceroute 1.1.1.1

Type escape sequence to abort.

Tracing the route to 1.1.1.1

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

1 192.168.0.1 0 msec 1 msec 0 msec

2 192.168.1.2 [AS 2] 1 msec 1 msec \*

JacobAaronAidenR4#traceroute 2.2.2.2

Type escape sequence to abort.

Tracing the route to 2.2.2.2

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

1 192.168.2.2 2 msec 1 msec \*

JacobAaronAidenR4#traceroute 3.3.3.3

Type escape sequence to abort.

Tracing the route to 3.3.3.3

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

1 192.168.0.3 1 msec 1 msec 1 msec

2 192.168.3.2 [AS 6] 1 msec 2 msec \*

JacobAaronAidenR4#traceroute 2001:1:1:1::1

Type escape sequence to abort.

Tracing the route to 2001:1:1:1::1

1 2001::1 2 msec 1 msec 1 msec

2 2001:1::2 [AS 2] 1 msec 1 msec 1 msec

JacobAaronAidenR4#traceroute 2001:2:2:2::2

Type escape sequence to abort.

Tracing the route to 2001:2:2:2::2

1 2001:2::2 8 msec 1 msec 1 msec

JacobAaronAidenR4#traceroute 2001:3:3:3::3

Type escape sequence to abort.

Tracing the route to 2001:3:3:3::3

1 2001::3 1 msec 2 msec 1 msec

2 2001:3::2 [AS 6] 1 msec 1 msec 1 msec

JacobAaronAidenR5#traceroute 1.1.1.1

Type escape sequence to abort.

Tracing the route to 1.1.1.1

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

1 192.168.3.1 1 msec 1 msec 1 msec

2 192.168.0.1 1 msec 1 msec 1 msec

3 192.168.1.2 1 msec 1 msec \*

JacobAaronAidenR5#traceroute 2.2.2.2

Type escape sequence to abort.

Tracing the route to 2.2.2.2

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

1 192.168.3.1 1 msec 1 msec 1 msec

2 192.168.0.2 0 msec 1 msec 0 msec

3 192.168.2.2 1 msec 1 msec \*

JacobAaronAidenR5#traceroute 3.3.3.3

Type escape sequence to abort.

Tracing the route to 3.3.3.3

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

1 3.3.3.3 1 msec \* 1 msec

JacobAaronAidenR5#traceroute 2001:1:1:1::1

Type escape sequence to abort.

Tracing the route to 2001:1:1:1::1

1 2001:3::1 6 msec 1 msec 1 msec

2 2001::1 1 msec 1 msec 1 msec

3 2001:1::2 1 msec 1 msec 1 msec

JacobAaronAidenR5#traceroute 2001:2:2:2::2

Type escape sequence to abort.

Tracing the route to 2001:2:2:2::2

1 2001:3::1 1 msec 1 msec 0 msec

2 2001::2 1 msec 1 msec 1 msec

3 2001:2::2 1 msec 1 msec 1 msec

JacobAaronAidenR5#traceroute 2001:3:3:3::3

Type escape sequence to abort.

Tracing the route to 2001:3:3:3::3

1 2001:3:3:3::3 0 msec 1 msec 0 msec

JacobAaronAidenR6#traceroute 1.1.1.1

Type escape sequence to abort.

Tracing the route to 1.1.1.1

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

1 192.168.0.1 0 msec 1 msec 0 msec

2 192.168.1.2 [AS 2] 1 msec 1 msec \*

JacobAaronAidenR6#traceroute 2.2.2.2

Type escape sequence to abort.

Tracing the route to 2.2.2.2

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

1 192.168.0.2 0 msec 1 msec 0 msec

2 192.168.2.2 [AS 4] 1 msec 1 msec \*

JacobAaronAidenR6#traceroute 3.3.3.3

Type escape sequence to abort.

Tracing the route to 3.3.3.3

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

1 192.168.3.2 1 msec 1 msec \*

JacobAaronAidenR6#traceroute 2001:1:1:1::1

Type escape sequence to abort.

Tracing the route to 2001:1:1:1::1

1 2001::1 1 msec 1 msec 0 msec

2 2001:1::2 [AS 2] 1 msec 1 msec 1 msec

JacobAaronAidenR6#traceroute 2001:2:2:2::2

Type escape sequence to abort.

Tracing the route to 2001:2:2:2::2

1 2001::2 1 msec 1 msec 0 msec

2 2001:2::2 [AS 4] 1 msec 1 msec 1 msec

JacobAaronAidenR6#traceroute 2001:3:3:3::3

Type escape sequence to abort.

Tracing the route to 2001:3:3:3::3

1 2001:3::2 7 msec 1 msec 1 msec

**Problems**

The first problem that we faced was with the RIP version. Due to the nature of subnet summarization with RIP, using default RIP wouldn’t work. BGP only spreads routes if the route exactly matches something found in the routing table. Auto summarization on RIP version 1 means the subnets won’t match. As a result, our RIP routes weren’t being spread throughout the BGP network. Through a bit of online research, we discovered that RIP version 2 was compatible with BGP. As such we switched to using RIP version 2, which ultimately ended up working.

The second issue that we ran into, wasn’t so much an issue, but rather a quirk in configuration. In previous labs, we’d do everything on packet tracer and use it to virtualize our network and then move to the actual rack after we debugged all our issues on packet tracer. For this lab, that strategy wouldn’t work. We discovered there were actually differences in commands between packet tracer and the actual Cisco CLI. In the future, we’ll be sure to just start on the actual rack.

The final issue that we faced was with regards to using network or redistribute commands. In BGP, there’s 2 ways to spread commands. One way is to use network statements, the other is to redistribute commands. As mentioned earlier, network commands can be finicky, especially with various subnet masks. After initially designing the lab using network commands, it wouldn’t work. We resolved this issue by swapping them out for redistribute commands which finally worked.

**Conclusion**

This Lab was the hardest lab I’ve done so far this year. Compared to other labs, figuring out the right commands to do wasn’t a straightforward process. We had to learn things like how to configure RIP, RIPv6, EIGRP, EIGRPv6, and encountered many problems relating to them. Throughout this process, I’ve gotten better at approaching and debugging problems.

Throughout this lab, the learning about BGP helped reinforce concepts I’d previously blipped over with IGPs. One of the key examples being redistribute commands. Transitioning from just doing OSPF to BGP was a good reminder of how much more I’ve yet to explore, and how nuanced the systems that we take for granted are.

A close up of a paper

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