BGP Lab

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# Purpose

The purpose of this lab was to be able to set up eBGP as a middleman for different IGPs for the different protocols to be able to communicate with each other without loss of information.

# Background Information

When different routing protocols need to communicate with one another, there needs to be a standard protocol that allows them to properly relay information from one network to another. There are several problems with just redistributing through these IGPs (Interior Gateway Protocol – routing protocols), such as lack of customizability, difficulty maintaining on a large scale, and as mentioned earlier, lack of standardization of the communication between protocols which makes routing through different IGPs difficult.

BGP, or Border Gateway Protocol, solves this issue, as it is the standard and is made for communicating between two IGPs (Interior Gateway Protocol). BGP is a path vector protocol (and the only one), meaning that unlike distance vector protocols such as OSPF, EIGRP, or RIP, that only share distance (metric) and direction to a route, path vector protocols sends the entire path, so loops will not occur, and changes in the path can be made to go through a particular path. BGP can have unique configurations for different types of routing, such as IPv4 and IPv6 and unicast, multicast, and broadcast. BGP has excellent ability to determine the best path to a destination, able to add attributes that change how it determines the best path to take, which is particularly useful in larger scale networks to maintain performance and implement security, which can be a big issue when communicating between different protocols. There are 4 types of attributes: well-known mandatory, well-known discretionary, optional transitive, and optional non-transitive.

* Well-known attributes are attributes that routers must have support for
  + Well-known mandatory attributes are attributes that must be in every BGP update packet, or else an error will be thrown
  + Well-known discretionary attributes are attributes that are not required but must be responded to
* Optional attributes are attributes that routers can ignore if they do not support them
  + Optional transitive attributes are attributes that must be passed on even if the device does not recognize the attribute
  + Optional non-transitive attributes are attributes that may be dropped if the device does not recognize the attribute

We used three different attributes to affect how BGP behaved on configured routes. However, since our BGP network only had one connection from the router which led to a switch that connected the routers together, the path determination was done by the switch and the BGP did not do any routing decisions. We used the next\_hop\_self, weight, and metric configurations for attributes in our configuration.

* next\_hop\_self is a parameter in the BGP neighbor command that configures the well-known mandatory NEXT\_HOP attribute by setting itself as the next hop from the configured neighbor for the neighbor’s BGP path calculations, as the name suggests.
* weight is a parameter in the BGP neighbor command that configures Cisco-proprietary attribute WEIGHT that is the top priority for Cisco BGP routing in making best path calculations – it does not fall under any of the attribute categories since it is local to the router – and is generally used to modify inbound routes from another AS into BGP
* metric was configured through the set metric command in a route map and configures the optional non-transitive MULTI\_EXIT\_DISC (MED) attribute, which is used to make best path calculations and is generally used to modify outbound routes into another AS from BGP

# Lab Summary

In this lab, we started by researching what BGP was and how to set it up. We created our topology in Packet Tracer first to visualize and solidify what we were creating. During this, we created configurations for the routers which we saved in text file. During configuration, we left out the 3 attributes in BGP that were required to include for later, and left out IPv6 routing because we were initially unaware that we had to do it. We migrated to the rack, were we experienced some issues with BGP, as the Packet Tracer’s BGP was different from the rack’s BGP, not having address families or attributes to name a few. When we had everything working, we researched attributes and what they did, then implemented them into our configurations. Finally we configured IPv6 which in concept, was almost identical to IPv4 other than the different addressing and slightly different commands.

# Lab Commands

router bgp <AS #>: creates a BGP process with a configured AS number

neighbor <Host IPv4: #.#.#.# | IPv6: #:#::#> remote-as <AS #>: Configure an eBGP neighbor to advertise routes

address-family {ipv4 | ipv6} unicast: enters address family that allows unique configuration of different IP protocols

neighbor <Host IPv4: #.#.#.# | v6: #:#::#> <Attributes>: Configure BGP neighbor with attributes to affect routing

Attributes:

next-hop-self: Configures this neighbor as the next hop router by modifying the NEXT\_HOP attribute

weight <Weight #>: Configures weight of route to neighbor by configuring the WEIGHT attribute

route-map <Name> {in | out}: applies specified route map to neighbor, on route to neighbor (in), or on route on neighbor to this router (out)

network {<IPv4 #.#.#.#> mask <Subnet Mask #.#.#.#> | <IPv6 #:#::#/#>}: Configures network to be redistributed by BGP, must have EXACT match in routing table – unused in our final configuration

redistribute {{ospf/eigrp} <Process ID #> | rip <Name>} [include-connected]: Redistributes all routes in specified routing protocol to BGP, only specify RIP name for IPv6 routing, include-connected is for IPv6 because IPv6 does not include connected routes by default when redistributing

no auto-summary: prevents summarization of routes into classful routes so they are properly redistributed by BGP

router {{ospf/eigrp} <Process ID #> | rip}: Creates specified process with process ID (excluding RIP) for IPv4 routing

ipv6 router {{ospf/eigrp} <Process ID #> | rip <Name>}: Creates specified process with process ID (process name for RIP) for IPv6 routing

redistribute {bgp <AS #> | connected} [metric <metric>]: Redistributes all routes from the BGP process with specified AS number/all routes directly connected to device to the routing protocol, specify metric since metrics differ between protocols (can also use default-metric command)

network <IP #.#.#.#> <Host #.#.#.#>: Configures a network inside of routing protocol – RIP does not have host bits

router-id <ID #.#.#.#>: Configure router ID in OSPF - A router ID is required in IPv6 routing to properly allow routers in the AS (Autonomous System) to route between one another, because the router ID is formatted in an IPv4 format (32 bit separated into 4 fields with periods), and IPv6 addresses do not follow the same format

eigrp router-id <ID #.#.#.#>: Configure router ID in EIGRP

interface <Interface>: Specify interface to configure

ipv6 ospf <Process ID #> area <Area #>: Include interface that this command is nestled within in specified OSPF process and area for IPv6

ipv6 rip <Name> enable: Include interface that this command is nestled within in specified RIP process for IPv6

ipv6 eigrp <Process ID #>: Include interface that this command is nestled within in specified EIGRP process for IPv6

access-list <ACL #> permit any: Creates an access list at that allows all IPs through

route-map <Name> {permit | deny} <Sequence #>: configures route map with specified name to permit or deny matching route, change information about the route, and set the order number (sequence number) the route map will filter in

match ip address <ACL #>: Specifies route map to match a configured ACL’s filtering

set metric <Metric #>: Changes metric of matched IP addresses and in BGP changes the MULTI\_EXIT\_DISC (MED) attribute

# Network Diagram

A diagram of a computer network

Description automatically generated

# Configurations

## 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

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(v6) route

### R1

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

### R2

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

### R3

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

### R4

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

### R5

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

### R6

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

## traceroute

### R1

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

### R2

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

### R3

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

### R4

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

### R5

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

### R6

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

## show ip bgp

NOTE: show ip bgp not included since Rack 06 is not working

### R1

### R2

### R3

### R4

### R5

### R6

# Problems

We ran into several difficult problems that took a while to solve. We originally configured our topology in Packet Tracer, and our commands that we copy pasted into Packet Tracer did not work on the physical rack or for our assignment, since Packet Tracer did not have support for different address families, and many features such as attributes and redistributing routes into certain IGPs was not supported by Packet Tracer, which took us a long time to figure out. Another problem we came across was the BGP network command requiring exact matches in the routing table. For example, if BGP called for 192.168.1.0/24 and the router had a route for 192.168.0.0/16, BGP would not take the route in the routing table. This was a problem because the IGPs we used redistributed routes differently, so we needed different network commands for each IGP, and sometimes the route the IGP redistributed was different and as a result the route was not redistributed. The last issue we encountered was being unaware of how IPv6 BGP routing differed from IPv4 BGP routing. IPv6 redistribution requires an include-connected parameter to redistribute routes directly connected to a router, unlike IPv4 which does this by default. Since we were clueless on what our problem was that made IPv6 BGP routing not work at all, we did not think it would be in the redistribute command, so we also took a few days to resolve this issue.

# Conclusion

In this lab we set up a topology that communicated between different IGPs using BGP in IPv4 and IPv6. We planned our topology, configured it physically, and applied attributes to change the behavior of BGP. We had some issues due to lack of knowledge and the limitations of certain commands, but they were resolved at the end and the topology functioned as expected. We learned how to set up BGP and why to use BGP in the real world, and refreshed our knowledge on the IGPs used; OSPF, RIP, EIGRP in both IPv4 and IPv6.