

Interior Border Gateway Protocol

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# Purpose

The purpose behind this lab was to discover how BGP routes work while in the same autonomous system.

# Background Information

External Border Gateway Protocol (eBGP) is an exterior routing protocol designed to exchange routing information between autonomous systems. However, BGP may be used for routing within a domain. In this application, it is referred to as Interior BGP (iBGP). iBGP is primarily used for forwarding eBGP routes throughout a network where an interior gateway protocol would crash due to the large number of BGP routes on the internet.

# Lab Summary

In this lab we had to configure 7 Cisco CSR 1000v routers into 3 different autonomous systems, 2 for EIGRP and 1 for OSPF then link them with BGP.

# Lab Commands

This lab only needed a few new commands that we have not used before. All the commands needed are listed below.

Router(config)# ipv6 unicast-routing

* This command globally enables IPV6 packet forwarding on our router

R3(config)# router ospf 1

* This command starts OSPF on router 3

R3(config-router)# network 192.168.1.0 0.0.0.255

* This command adds the 192.168.1.0/24 network to router 3’s OSPF process

R3(config-router)# router-id 3.3.3.3

* This command sets a router id on router 3

R3(config)#router bgp 2

* This command starts BGP on router 3 with the autonomous system id of 2

R3(config-router)#neighbor 10.0.1.1 remote-as 1

* This command adds a neighbor with the IPv4 address of 10.0.1.1 to BGP on router 3

R3(config-router)#address-family ipv4

* This command will put us into more advanced IPv4 configuration for BGP

R3(config-router-af)#network 10.0.0.0 0.0.0.255

* Like OSPF BGP needs at least 1 network added to it in order to work properly

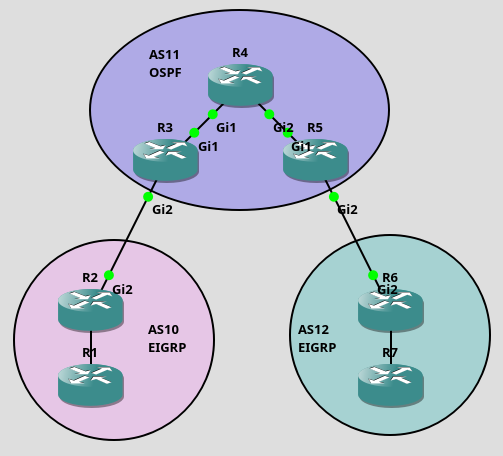
R3(config-router-af)#neighbor 10.0.0.2 activate

* This command activates the neighbor that we set earlier

R3(config-router-af)#redistribute ospf 1

* This command will redistribute all OSPF learned routes into BGP

# Lab Diagram



# Router Configurations

## R1

R1#show run

Building configuration...

Current configuration : 3847 bytes

!

! Last configuration change at 16:11:55 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R1

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

license udi pid CSR1000V sn 9GZ1GHZN9DG

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

redundancy

!

interface Loopback0

ip address 192.168.1.1 255.255.255.0

ipv6 address 100:1::1/64

ipv6 eigrp 10

!

interface GigabitEthernet1

ip address 10.0.0.1 255.255.255.252

negotiation auto

ipv6 address 10:1::1/64

ipv6 eigrp 10

no mop enabled

no mop sysid

!

interface GigabitEthernet2

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router eigrp 1

network 10.0.0.0 0.0.0.3

network 192.168.1.0

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

ipv6 router eigrp 10

eigrp router-id 1.1.1.1

!

ipv6 router eigrp 1

eigrp router-id 1.1.1.1

redistribute connected

!

control-plane

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R1#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

10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks

C 10.0.0.0/30 is directly connected, GigabitEthernet1

L 10.0.0.1/32 is directly connected, GigabitEthernet1

D EX 10.0.0.4/30 [170/281856] via 10.0.0.2, 00:50:36, GigabitEthernet1

D 10.0.2.0/30 [90/3072] via 10.0.0.2, 00:51:51, GigabitEthernet1

D EX 10.0.2.4/30 [170/281856] via 10.0.0.2, 00:50:36, GigabitEthernet1

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

C 192.168.1.0/24 is directly connected, Loopback0

L 192.168.1.1/32 is directly connected, Loopback0

D 192.168.2.0/24 [90/130816] via 10.0.0.2, 00:51:51, GigabitEthernet1

D EX 192.168.3.0/24 [170/281856] via 10.0.0.2, 00:50:36, GigabitEthernet1

D EX 192.168.5.0/24 [170/281856] via 10.0.0.2, 00:50:36, GigabitEthernet1

D EX 192.168.6.0/24 [170/281856] via 10.0.0.2, 00:50:36, GigabitEthernet1

D EX 192.168.7.0/24 [170/281856] via 10.0.0.2, 00:50:36, GigabitEthernet1

R1#show ipv6 route

IPv6 Routing Table - default - 7 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

C 10:1::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:1::1/128 [0/0]

via GigabitEthernet1, receive

C 100:1::/64 [0/0]

via Loopback0, directly connected

L 100:1::1/128 [0/0]

via Loopback0, receive

D 100:2::/64 [90/130816]

via FE80::E2B:4FFF:FEF8:0, GigabitEthernet1

EX 100:3::/64 [170/258816]

via FE80::E2B:4FFF:FEF8:0, GigabitEthernet1

L FF00::/8 [0/0]

via Null0, receive

## R2

R2#show run

Building configuration...

Current configuration : 4419 bytes

!

! Last configuration change at 16:11:51 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R2

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

license udi pid CSR1000V sn 9VBM617NKNE

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

redundancy

!

interface Loopback0

ip address 192.168.2.1 255.255.255.0

ipv6 address 100:2::1/64

ipv6 eigrp 10

!

interface GigabitEthernet1

ip address 10.0.0.2 255.255.255.252

negotiation auto

ipv6 address 10:1::2/64

ipv6 eigrp 10

no mop enabled

no mop sysid

!

interface GigabitEthernet2

ip address 10.0.2.1 255.255.255.252

negotiation auto

ipv6 address 10:2::1/64

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router eigrp 1

network 10.0.0.0 0.0.0.3

network 10.0.2.0 0.0.0.3

network 192.168.2.0

redistribute bgp 10 metric 10000 100 255 240 65535

!

router bgp 10

bgp log-neighbor-changes

neighbor 10:2::2 remote-as 11

neighbor 10.0.2.2 remote-as 11

!

address-family ipv4

redistribute eigrp 1

no neighbor 10:2::2 activate

neighbor 10.0.2.2 activate

exit-address-family

!

address-family ipv6

redistribute connected

redistribute eigrp 10

neighbor 10:2::2 activate

exit-address-family

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

ipv6 router eigrp 10

eigrp router-id 2.2.2.2

redistribute bgp 10 metric 10000 10 254 254 65535

!

ipv6 router eigrp 1

eigrp router-id 2.2.2.2

redistribute bgp 10 metric 10000 10 254 254 65535

redistribute connected

!

control-plane

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R2#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

10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C 10.0.0.0/30 is directly connected, GigabitEthernet1

L 10.0.0.2/32 is directly connected, GigabitEthernet1

B 10.0.0.4/30 [20/0] via 10.0.2.2, 00:51:12

C 10.0.2.0/30 is directly connected, GigabitEthernet2

L 10.0.2.1/32 is directly connected, GigabitEthernet2

B 10.0.2.4/30 [20/0] via 10.0.2.2, 00:51:12

D 192.168.1.0/24 [90/130816] via 10.0.0.1, 00:52:29, GigabitEthernet1

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

C 192.168.2.0/24 is directly connected, Loopback0

L 192.168.2.1/32 is directly connected, Loopback0

B 192.168.3.0/24 [20/0] via 10.0.2.2, 00:51:12

B 192.168.5.0/24 [20/0] via 10.0.2.2, 00:51:12

B 192.168.6.0/24 [20/0] via 10.0.2.2, 00:51:12

B 192.168.7.0/24 [20/0] via 10.0.2.2, 00:51:12

R2#show ipv6 route

IPv6 Routing Table - default - 9 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

C 10:1::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:1::2/128 [0/0]

via GigabitEthernet1, receive

C 10:2::/64 [0/0]

via GigabitEthernet2, directly connected

L 10:2::1/128 [0/0]

via GigabitEthernet2, receive

D 100:1::/64 [90/130816]

via FE80::E08:33FF:FE05:0, GigabitEthernet1

C 100:2::/64 [0/0]

via Loopback0, directly connected

L 100:2::1/128 [0/0]

via Loopback0, receive

B 100:3::/64 [20/0]

via FE80::E9C:63FF:FE83:1, GigabitEthernet2

L FF00::/8 [0/0]

via Null0, receive

## R3

R3#show run

Building configuration...

Current configuration : 4592 bytes

!

! Last configuration change at 16:01:58 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R3

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

license udi pid CSR1000V sn 9MJCWK69HK6

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

redundancy

!

interface Loopback0

ip address 192.168.3.1 255.255.255.0

ipv6 address 100:3::1/64

ospfv3 11 ipv6 area 0

!

interface GigabitEthernet1

ip address 10.0.1.1 255.255.255.252

negotiation auto

ipv6 address 10:3::1/64

ospfv3 11 ipv6 area 0

no mop enabled

no mop sysid

!

interface GigabitEthernet2

ip address 10.0.2.2 255.255.255.252

negotiation auto

ipv6 address 10:2::2/64

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router ospfv3 11

!

address-family ipv6 unicast

redistribute bgp 11

router-id 3.3.3.3

exit-address-family

!

router ospf 1

router-id 3.3.3.3

redistribute bgp 11 subnets

network 10.0.1.0 0.0.0.3 area 0

network 10.0.2.0 0.0.0.3 area 0

network 192.168.3.0 0.0.0.255 area 0

!

router bgp 11

bgp log-neighbor-changes

neighbor 10:2::1 remote-as 10

neighbor 100:5::1 remote-as 11

neighbor 100:5::1 update-source Loopback0

neighbor 10.0.2.1 remote-as 10

neighbor 192.168.5.1 remote-as 11

neighbor 192.168.5.1 update-source Loopback0

!

address-family ipv4

network 192.168.3.1

no neighbor 10:2::1 activate

no neighbor 100:5::1 activate

neighbor 10.0.2.1 activate

neighbor 192.168.5.1 activate

exit-address-family

!

address-family ipv6

network 10:2::/64

network 100:3::/64

neighbor 10:2::1 activate

neighbor 100:5::1 activate

exit-address-family

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

control-plane

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R3#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

B 10.0.0.0/30 [20/0] via 10.0.2.1, 00:51:51

O E2 10.0.0.4/30 [110/1] via 10.0.1.2, 00:51:52, GigabitEthernet1

C 10.0.1.0/30 is directly connected, GigabitEthernet1

L 10.0.1.1/32 is directly connected, GigabitEthernet1

O 10.0.1.4/30 [110/2] via 10.0.1.2, 00:52:34, GigabitEthernet1

C 10.0.2.0/30 is directly connected, GigabitEthernet2

L 10.0.2.2/32 is directly connected, GigabitEthernet2

O 10.0.2.4/30 [110/3] via 10.0.1.2, 00:52:34, GigabitEthernet1

B 192.168.1.0/24 [20/130816] via 10.0.2.1, 00:51:51

B 192.168.2.0/24 [20/0] via 10.0.2.1, 00:51:51

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

C 192.168.3.0/24 is directly connected, Loopback0

L 192.168.3.1/32 is directly connected, Loopback0

192.168.4.0/32 is subnetted, 1 subnets

O 192.168.4.1 [110/2] via 10.0.1.2, 00:52:36, GigabitEthernet1

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

B 192.168.5.0/24 [200/0] via 192.168.5.1, 00:51:51

O 192.168.5.1/32 [110/3] via 10.0.1.2, 00:52:34, GigabitEthernet1

O E2 192.168.6.0/24 [110/1] via 10.0.1.2, 00:51:52, GigabitEthernet1

O E2 192.168.7.0/24 [110/1] via 10.0.1.2, 00:51:52, GigabitEthernet1

R3#show ipv6 route

IPv6 Routing Table - default - 13 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

B 10:1::/64 [20/0]

via FE80::E2B:4FFF:FEF8:1, GigabitEthernet2

C 10:2::/64 [0/0]

via GigabitEthernet2, directly connected

L 10:2::2/128 [0/0]

via GigabitEthernet2, receive

C 10:3::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:3::1/128 [0/0]

via GigabitEthernet1, receive

O 10:4::/64 [110/2]

via FE80::E95:44FF:FEEE:0, GigabitEthernet1

B 100:1::/64 [20/130816]

via FE80::E2B:4FFF:FEF8:1, GigabitEthernet2

B 100:2::/64 [20/0]

via FE80::E2B:4FFF:FEF8:1, GigabitEthernet2

C 100:3::/64 [0/0]

via Loopback0, directly connected

L 100:3::1/128 [0/0]

via Loopback0, receive

O 100:4::1/128 [110/1]

via FE80::E95:44FF:FEEE:0, GigabitEthernet1

O 100:5::1/128 [110/2]

via FE80::E95:44FF:FEEE:0, GigabitEthernet1

L FF00::/8 [0/0]

via Null0, receive

## R4

R4#show run

Building configuration...

Current configuration : 3969 bytes

!

! Last configuration change at 15:35:41 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R4

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

license udi pid CSR1000V sn 9YWWWYO4ZO0

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

interface Loopback0

ip address 192.168.4.1 255.255.255.0

ipv6 address 100:4::1/64

ospfv3 11 ipv6 area 0

!

interface GigabitEthernet1

ip address 10.0.1.2 255.255.255.252

negotiation auto

ipv6 address 10:3::2/64

ospfv3 11 ipv6 area 0

no mop enabled

no mop sysid

!

interface GigabitEthernet2

ip address 10.0.1.5 255.255.255.252

negotiation auto

ipv6 address 10:4::1/64

ospfv3 11 ipv6 area 0

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router ospfv3 11

!

address-family ipv6 unicast

router-id 4.4.4.4

exit-address-family

!

router ospf 1

router-id 4.4.4.4

network 10.0.1.0 0.0.0.3 area 0

network 10.0.1.4 0.0.0.3 area 0

network 192.168.4.0 0.0.0.255 area 0

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

control-plane

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R4#show ip route

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

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

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

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

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

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

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

a - application route

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

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

O E2 10.0.0.0/30 [110/1] via 10.0.1.1, 00:52:31, GigabitEthernet1

O E2 10.0.0.4/30 [110/1] via 10.0.1.6, 00:52:32, GigabitEthernet2

C 10.0.1.0/30 is directly connected, GigabitEthernet1

L 10.0.1.2/32 is directly connected, GigabitEthernet1

C 10.0.1.4/30 is directly connected, GigabitEthernet2

L 10.0.1.5/32 is directly connected, GigabitEthernet2

O 10.0.2.0/30 [110/2] via 10.0.1.1, 00:53:17, GigabitEthernet1

O 10.0.2.4/30 [110/2] via 10.0.1.6, 00:53:15, GigabitEthernet2

O E2 192.168.1.0/24 [110/1] via 10.0.1.1, 00:52:31, GigabitEthernet1

O E2 192.168.2.0/24 [110/1] via 10.0.1.1, 00:52:31, GigabitEthernet1

192.168.3.0/32 is subnetted, 1 subnets

O 192.168.3.1 [110/2] via 10.0.1.1, 00:53:17, GigabitEthernet1

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

C 192.168.4.0/24 is directly connected, Loopback0

L 192.168.4.1/32 is directly connected, Loopback0

192.168.5.0/32 is subnetted, 1 subnets

O 192.168.5.1 [110/2] via 10.0.1.6, 00:53:15, GigabitEthernet2

O E2 192.168.6.0/24 [110/1] via 10.0.1.6, 00:52:32, GigabitEthernet2

O E2 192.168.7.0/24 [110/1] via 10.0.1.6, 00:52:32, GigabitEthernet2

R4#show ipv6 route

IPv6 Routing Table - default - 12 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

OE2 10:1::/64 [110/1]

via FE80::E9C:63FF:FE83:0, GigabitEthernet1

C 10:3::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:3::2/128 [0/0]

via GigabitEthernet1, receive

C 10:4::/64 [0/0]

via GigabitEthernet2, directly connected

L 10:4::1/128 [0/0]

via GigabitEthernet2, receive

OE2 100:1::/64 [110/1]

via FE80::E9C:63FF:FE83:0, GigabitEthernet1

OE2 100:2::/64 [110/1]

via FE80::E9C:63FF:FE83:0, GigabitEthernet1

O 100:3::1/128 [110/1]

via FE80::E9C:63FF:FE83:0, GigabitEthernet1

C 100:4::/64 [0/0]

via Loopback0, directly connected

L 100:4::1/128 [0/0]

via Loopback0, receive

O 100:5::1/128 [110/1]

via FE80::E1D:10FF:FE5D:0, GigabitEthernet2

L FF00::/8 [0/0]

via Null0, receive

## R5

R5#show run

Building configuration...

Current configuration : 4529 bytes

!

! Last configuration change at 16:02:33 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R5

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

license udi pid CSR1000V sn 90LGOYKMJ18

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

interface Loopback0

ip address 192.168.5.1 255.255.255.0

ipv6 address 100:5::1/64

ospfv3 11 ipv6 area 0

!

interface GigabitEthernet1

ip address 10.0.1.6 255.255.255.252

negotiation auto

ipv6 address 10:4::2/64

ospfv3 11 ipv6 area 0

no mop enabled

no mop sysid

!

interface GigabitEthernet2

ip address 10.0.2.5 255.255.255.252

negotiation auto

ipv6 address 10:5::1/64

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router ospfv3 11

!

address-family ipv6 unicast

router-id 5.5.5.5

exit-address-family

!

router ospf 1

router-id 5.5.5.5

redistribute bgp 11 subnets

network 10.0.1.4 0.0.0.3 area 0

network 10.0.2.4 0.0.0.3 area 0

network 192.168.5.0 0.0.0.255 area 0

!

router bgp 11

bgp log-neighbor-changes

neighbor 10:5::2 remote-as 12

neighbor 100:3::1 remote-as 11

neighbor 100:3::1 update-source Loopback0

neighbor 10.0.2.6 remote-as 12

neighbor 192.168.3.1 remote-as 11

neighbor 192.168.3.1 update-source Loopback0

!

address-family ipv4

network 192.168.5.0

no neighbor 10:5::2 activate

no neighbor 100:3::1 activate

neighbor 10.0.2.6 activate

neighbor 192.168.3.1 activate

exit-address-family

!

address-family ipv6

neighbor 10:5::2 activate

neighbor 100:3::1 activate

exit-address-family

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R5#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

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

O E2 10.0.0.0/30 [110/1] via 10.0.1.5, 00:53:09, GigabitEthernet1

B 10.0.0.4/30 [20/0] via 10.0.2.6, 00:53:11

O 10.0.1.0/30 [110/2] via 10.0.1.5, 00:53:53, GigabitEthernet1

C 10.0.1.4/30 is directly connected, GigabitEthernet1

L 10.0.1.6/32 is directly connected, GigabitEthernet1

O 10.0.2.0/30 [110/3] via 10.0.1.5, 00:53:53, GigabitEthernet1

C 10.0.2.4/30 is directly connected, GigabitEthernet2

L 10.0.2.5/32 is directly connected, GigabitEthernet2

O E2 192.168.1.0/24 [110/1] via 10.0.1.5, 00:53:09, GigabitEthernet1

O E2 192.168.2.0/24 [110/1] via 10.0.1.5, 00:53:09, GigabitEthernet1

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

B 192.168.3.0/24 [200/0] via 192.168.3.1, 00:53:09

O 192.168.3.1/32 [110/3] via 10.0.1.5, 00:53:53, GigabitEthernet1

192.168.4.0/32 is subnetted, 1 subnets

O 192.168.4.1 [110/2] via 10.0.1.5, 00:53:53, GigabitEthernet1

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

C 192.168.5.0/24 is directly connected, Loopback0

L 192.168.5.1/32 is directly connected, Loopback0

B 192.168.6.0/24 [20/0] via 10.0.2.6, 00:53:11

B 192.168.7.0/24 [20/130816] via 10.0.2.6, 00:53:11

R5#show ipv6 route

IPv6 Routing Table - default - 15 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

OE2 10:1::/64 [110/1]

via FE80::E95:44FF:FEEE:1, GigabitEthernet1

B 10:2::/64 [200/0]

via 100:3::1

O 10:3::/64 [110/2]

via FE80::E95:44FF:FEEE:1, GigabitEthernet1

C 10:4::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:4::2/128 [0/0]

via GigabitEthernet1, receive

C 10:5::/64 [0/0]

via GigabitEthernet2, directly connected

L 10:5::1/128 [0/0]

via GigabitEthernet2, receive

OE2 100:1::/64 [110/1]

via FE80::E95:44FF:FEEE:1, GigabitEthernet1

OE2 100:2::/64 [110/1]

via FE80::E95:44FF:FEEE:1, GigabitEthernet1

B 100:3::/64 [200/0]

via 100:3::1

O 100:3::1/128 [110/2]

via FE80::E95:44FF:FEEE:1, GigabitEthernet1

O 100:4::1/128 [110/1]

via FE80::E95:44FF:FEEE:1, GigabitEthernet1

C 100:5::/64 [0/0]

via Loopback0, directly connected

L 100:5::1/128 [0/0]

via Loopback0, receive

L FF00::/8 [0/0]

via Null0, receive

## R6

R6#show run

Building configuration...

Current configuration : 4372 bytes

!

! Last configuration change at 16:04:18 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R6

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

license udi pid CSR1000V sn 98GB0MFTGTD

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

redundancy

!

interface Loopback0

ip address 192.168.6.1 255.255.255.0

ipv6 address 100:6::1/64

ipv6 eigrp 12

!

interface GigabitEthernet1

ip address 10.0.0.6 255.255.255.252

negotiation auto

ipv6 address 10:6::1/64

ipv6 eigrp 12

no mop enabled

no mop sysid

!

interface GigabitEthernet2

ip address 10.0.2.6 255.255.255.252

negotiation auto

ipv6 address 10:5::2/64

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router eigrp 2

network 10.0.0.4 0.0.0.3

network 10.0.2.4 0.0.0.3

network 192.168.6.0

redistribute bgp 12 metric 10000 100 255 240 65535

!

router bgp 12

bgp log-neighbor-changes

neighbor 10:5::1 remote-as 11

neighbor 10.0.2.5 remote-as 11

!

address-family ipv4

redistribute eigrp 2

no neighbor 10:5::1 activate

neighbor 10.0.2.5 activate

exit-address-family

!

address-family ipv6

neighbor 10:5::1 activate

exit-address-family

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

ipv6 router eigrp 12

eigrp router-id 6.6.6.6

redistribute bgp 12 metric 10000 100 254 254 65535

!

ipv6 router eigrp 2

eigrp router-id 6.6.6.6

redistribute bgp 12 metric 10000 100 254 254 65535

redistribute connected

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R6#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

10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

B 10.0.0.0/30 [20/0] via 10.0.2.5, 00:53:10

C 10.0.0.4/30 is directly connected, GigabitEthernet1

L 10.0.0.6/32 is directly connected, GigabitEthernet1

B 10.0.2.0/30 [20/0] via 10.0.2.5, 00:53:10

C 10.0.2.4/30 is directly connected, GigabitEthernet2

L 10.0.2.6/32 is directly connected, GigabitEthernet2

B 192.168.1.0/24 [20/0] via 10.0.2.5, 00:53:10

B 192.168.2.0/24 [20/0] via 10.0.2.5, 00:53:10

B 192.168.3.0/24 [20/0] via 10.0.2.5, 00:53:10

B 192.168.5.0/24 [20/0] via 10.0.2.5, 00:53:41

192.168.6.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.6.0/24 is directly connected, Loopback0

L 192.168.6.1/32 is directly connected, Loopback0

D 192.168.7.0/24 [90/130816] via 10.0.0.5, 00:54:58, GigabitEthernet1

R6#show ipv6 route

IPv6 Routing Table - default - 13 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

B 10:1::/64 [20/0]

via FE80::E1D:10FF:FE5D:1, GigabitEthernet2

B 10:2::/64 [20/0]

via FE80::E1D:10FF:FE5D:1, GigabitEthernet2

C 10:5::/64 [0/0]

via GigabitEthernet2, directly connected

L 10:5::2/128 [0/0]

via GigabitEthernet2, receive

C 10:6::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:6::1/128 [0/0]

via GigabitEthernet1, receive

B 100:1::/64 [20/0]

via FE80::E1D:10FF:FE5D:1, GigabitEthernet2

B 100:2::/64 [20/0]

via FE80::E1D:10FF:FE5D:1, GigabitEthernet2

B 100:3::/64 [20/0]

via FE80::E1D:10FF:FE5D:1, GigabitEthernet2

C 100:6::/64 [0/0]

via Loopback0, directly connected

L 100:6::1/128 [0/0]

via Loopback0, receive

D 100:7::/64 [90/130816]

via FE80::EAB:E1FF:FE01:0, GigabitEthernet1

L FF00::/8 [0/0]

via Null0, receive

## R7

R7#show run

Building configuration...

Current configuration : 3839 bytes

!

! Last configuration change at 15:55:56 UTC Fri Jan 28 2022

!

version 16.9

service timestamps debug datetime msec

service timestamps log datetime msec

platform qfp utilization monitor load 80

no platform punt-keepalive disable-kernel-core

platform console serial

!

hostname R7

!

boot-start-marker

boot-end-marker

!

ipv6 unicast-routing

multilink bundle-name authenticated

!

crypto pki trustpoint TP-self-signed-330298951

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-330298951

revocation-check none

rsakeypair TP-self-signed-330298951

!

license udi pid CSR1000V sn 9EWKOY7WCO0

no license smart enable

diagnostic bootup level minimal

!

spanning-tree extend system-id

!

redundancy

!

interface Loopback0

ip address 192.168.7.1 255.255.255.0

ipv6 address 100:7::1/64

ipv6 eigrp 12

!

interface GigabitEthernet1

ip address 10.0.0.5 255.255.255.252

negotiation auto

ipv6 address 10:6::2/64

ipv6 eigrp 12

no mop enabled

no mop sysid

!

interface GigabitEthernet2

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet3

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

interface GigabitEthernet4

no ip address

shutdown

negotiation auto

no mop enabled

no mop sysid

!

router eigrp 2

network 10.0.0.4 0.0.0.3

network 192.168.7.0

!

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

!

ipv6 router eigrp 12

eigrp router-id 7.7.7.7

!

ipv6 router eigrp 2

eigrp router-id 7.7.7.7

redistribute connected

!

line con 0

stopbits 1

line vty 0 4

login

!

end

R7#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

10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks

D EX 10.0.0.0/30 [170/281856] via 10.0.0.6, 00:53:53, GigabitEthernet1

C 10.0.0.4/30 is directly connected, GigabitEthernet1

L 10.0.0.5/32 is directly connected, GigabitEthernet1

D EX 10.0.2.0/30 [170/281856] via 10.0.0.6, 00:53:53, GigabitEthernet1

D 10.0.2.4/30 [90/3072] via 10.0.0.6, 00:55:40, GigabitEthernet1

D EX 192.168.1.0/24 [170/281856] via 10.0.0.6, 00:53:53, GigabitEthernet1

D EX 192.168.2.0/24 [170/281856] via 10.0.0.6, 00:53:53, GigabitEthernet1

D EX 192.168.3.0/24 [170/281856] via 10.0.0.6, 00:53:53, GigabitEthernet1

D EX 192.168.5.0/24 [170/281856] via 10.0.0.6, 00:54:24, GigabitEthernet1

D 192.168.6.0/24 [90/130816] via 10.0.0.6, 00:55:40, GigabitEthernet1

192.168.7.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.7.0/24 is directly connected, Loopback0

L 192.168.7.1/32 is directly connected, Loopback0

R7#show ipv6 route

IPv6 Routing Table - default - 11 entries

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

B - BGP, R - RIP, H - NHRP, 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, RL - RPL, O - OSPF Intra, OI - OSPF Inter

OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1

ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations

ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy

a - Application

EX 10:1::/64 [170/281856]

via FE80::E64:D0FF:FEDF:0, GigabitEthernet1

EX 10:2::/64 [170/281856]

via FE80::E64:D0FF:FEDF:0, GigabitEthernet1

C 10:6::/64 [0/0]

via GigabitEthernet1, directly connected

L 10:6::2/128 [0/0]

via GigabitEthernet1, receive

EX 100:1::/64 [170/281856]

via FE80::E64:D0FF:FEDF:0, GigabitEthernet1

EX 100:2::/64 [170/281856]

via FE80::E64:D0FF:FEDF:0, GigabitEthernet1

EX 100:3::/64 [170/281856]

via FE80::E64:D0FF:FEDF:0, GigabitEthernet1

D 100:6::/64 [90/130816]

via FE80::E64:D0FF:FEDF:0, GigabitEthernet1

C 100:7::/64 [0/0]

via Loopback0, directly connected

L 100:7::1/128 [0/0]

via Loopback0, receive

L FF00::/8 [0/0]

via Null0, receive

# Problems

We were unable to get IPv6 fully working in this lab. We think IPv6 failed to work due to a misconfiguration of BGP on a border router but we are not sure. We were also having some issues with router 4 not forwarding traffic to the EIGRP networks as it did not have routes to those networks. This was solved by redistributing BGP into OSPF.

# Conclusion

In summary we setup 7 cisco routers, designed an IP addressing scheme, and troubleshooted IP route distribution.