Multi-Area OSPFv2 and OSPFv3 Lab

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P0-2 Cisco CCNP

Mr. Mason

A close-up of a logo

Description automatically generated

**Purpose:**

The major purpose of this lab was to refresh CCNP students with the important concept of configuring OSPF. The concepts Mr. Mason was trying to teach by having us complete this lab was configuring multi-area ipv4 and ipc6 OSPF on 5 routers with 3 different areas.

**Background Information:**

OSPF (aka Open Shortest Path First) is a common link-state router protocol used to determine feasible routes to distinct network destinations. When routers speak to each other using OSPF, they exchange information about the known routes and looks at the route cost. The route with the lowest cost value is chosen as the best route.

Imagine you have a thousand routers. When using single-area OSPF in such a massive network, you will run into problems such as having LSDs (link-state databases) filled with information about every single router and link. The routing table will also be too filled, making it harder for the router to find the right route. These two factors will fill up disk space and affect the processing power. We used multi-area OSPF instead because it is easier to manage all devices and more scalable than single-area OSPF.

Multi-area OSPF divides the network into multiple areas. These areas are connected via the backbone area which is area 0. Backbone areas are strategically placed in between the edge routers to connect all other areas in the network, acting like a transit area. A designated router and backup designated router will be elected within each specific area, thus limiting the number of routers participating in OSPF routing updates.

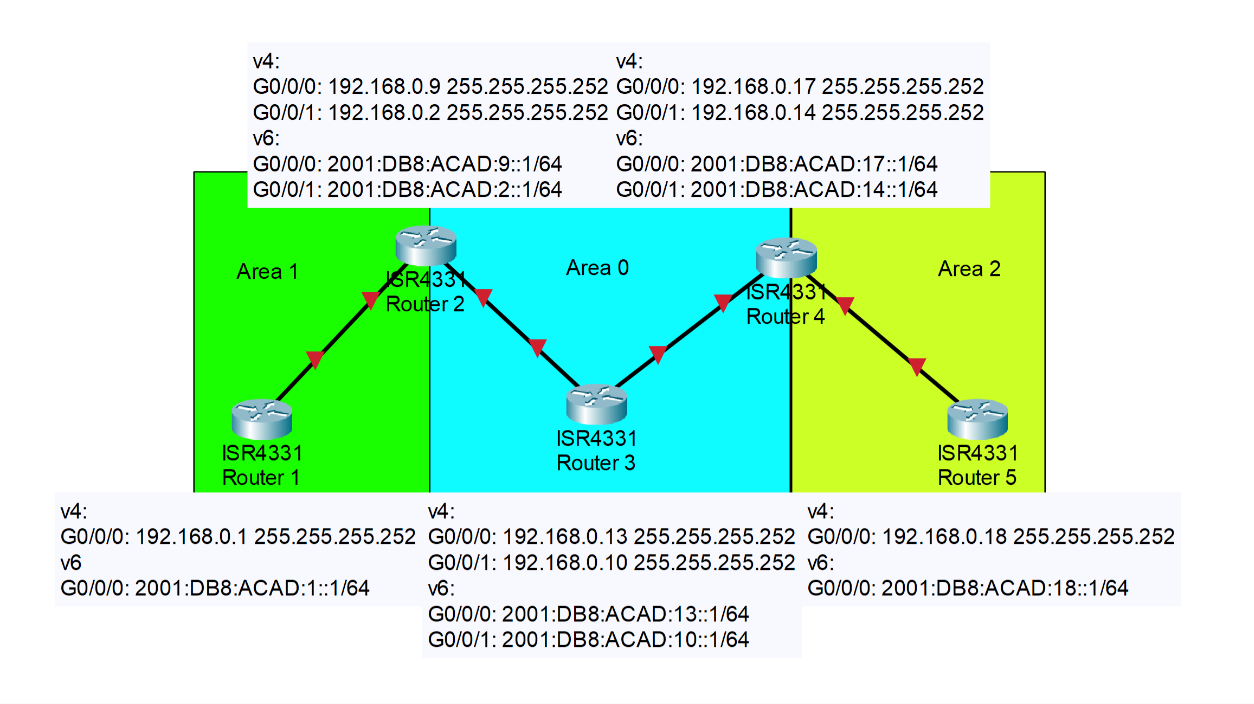
**Lab Summary:**

We first set up an IP scheme for each router’s interface (g0/0/0 and g0/0/1), setting up ipv4 and ipv6 addresses. We then created a topology based on our IP scheme to help us stay organized. Using the topology, we set up our cables to the matching connecting interfaces. Consoling into each router, we configured our preset ipv4 and ipv6 addresses on each interface we assigned the routers to. We then made sure that interfaces in the same area had the same OSPF area ID and those in different areas had a distinct OSPF area ID. Following that we assigned OSPF router IDs for ipv4 and ipv6. After this we defined OSPF areas through network commands, pairing interfaces with OSPF areas. To verify if we received OSPF adjacencies we used the “show ip ospf neighbor” command. We also pinged between different routers.

**Lab Commands:**

One of the most helpful commands that I used was “clear ip ospf process.” This command reset OSPF on the router and cleared running OSPF routing processes. This command in particular was helpful for troubleshooting because it reset OSPF entirely, getting us to start from scratch since we may have incorrectly configured OSPF. Another command that I learned was “ipv6 ospf *process-id* area *area#*”. In the past I wasn’t too accustomed in configuring ipv6 ospf. These commands allowed for the routers to participate in OSPF routing for specific areas in an IPv6 network.

**Network Diagram:**





**Configurations:**

**---R1---**

**R1#show run**

Building configuration...

Current configuration : 1659 bytes

Last configuration change at 16:12:46 UTC Tue Sep 19 2023

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

hostname R1

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21482HZX

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 1.1.1.1 255.255.255.255

interface GigabitEthernet0/0/0

ip address 192.168.0.1 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:1::1/64

ipv6 ospf 1 area 1

interface GigabitEthernet0/0/1

no ip address

negotiation auto

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 1.1.1.1

network 192.168.0.0 0.0.0.3 area 1

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

control-plane

line con 0

transport input none

stopbits 1

line aux 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

1.0.0.0/32 is subnetted, 1 subnets

C 1.1.1.1 is directly connected, Loopback0

192.168.0.0/24 is variably subnetted, 5 subnets, 2 masks

C 192.168.0.0/30 is directly connected, GigabitEthernet0/0/0

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

O IA 192.168.0.8/30

[110/2] via 192.168.0.2, 00:07:41, GigabitEthernet0/0/0

O IA 192.168.0.12/30

[110/3] via 192.168.0.2, 00:05:17, GigabitEthernet0/0/0

O IA 192.168.0.16/30

[110/4] via 192.168.0.2, 00:03:35, GigabitEthernet0/0/0

**R1#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, la - LISP alt

lr - LISP site-registrations, ld - LISP dyn-eid, lA - LISP away

le - LISP extranet-policy, a - Application

C 2001:DB8:ACAD:1::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

O 2001:DB8:ACAD:2::/64 [110/1]

via GigabitEthernet0/0/0, directly connected

OI 2001:DB8:ACAD:9::/64 [110/2]

via FE80::267E:12FF:FE4D:F771, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:10::/64 [110/2]

via FE80::267E:12FF:FE4D:F771, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:13::/64 [110/3]

via FE80::267E:12FF:FE4D:F771, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:14::/64 [110/3]

via FE80::267E:12FF:FE4D:F771, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:17::/64 [110/4]

via FE80::267E:12FF:FE4D:F771, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:18::/64 [110/4]

via FE80::267E:12FF:FE4D:F771, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**---R2---**

**R2#show run**

Building configuration...

Current configuration : 3941 bytes

Last configuration change at 16:18:49 UTC Tue Sep 19 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 R2

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2105456491

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2105456491

revocation-check none

rsakeypair TP-self-signed-2105456491

crypto pki certificate chain TP-self-signed-2105456491

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 32313035 34353634 3931301E 170D3233 30363036 31383232

32395A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 31303534

35363439 31308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 0100876A 184F35C6 0E929121 EE3811A8 28E1A40F FD6DDB23 539E0D71

8E7E6090 3554D474 46DF5C06 8E68CDAC B1FF1F90 ACF8D30E 20CD2F18 A3D2A9D8

AC5627B9 D2163758 C17AEB01 07A8C0CF 3C9C8CF9 ED7074F9 02991FB8 1E7409DD

74AEB5A2 40DC020A 5DE53722 7FFD0381 BD09A39C 11C123E4 BE55D472 1607DBD8

987513C4 03E13D0D B539E73B 7DF22B0C 7C34FEC8 89133906 8F3BB98B 6D8AD20E

0A490E56 48B00F73 80D3F9E9 A8B16B4D 64A6C0B4 C5C65E75 8FEAF49C 2B49687F

B150A1EC 6873780E 1AADEF00 CE9F01A6 17C6382D 4D71B2E6 1E4C78DA 5A46E715

3EE04254 0DC6B096 180F1EF5 FC4BE073 C1B9221D 3A4C9F87 C15B7860 0EF18D3E

54B842D5 0ABD0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 1440DDFF E73B2EAD ED3921BA A11AEE2E 6D45A59B

59301D06 03551D0E 04160414 40DDFFE7 3B2EADED 3921BAA1 1AEE2E6D 45A59B59

300D0609 2A864886 F70D0101 05050003 82010100 5B8F2495 D377BC11 0B345122

96F7CB9A 8003892D F80D3933 C744DFE8 D0C85690 A020EF0C D378F115 D2DFFBD5

7A915909 82581749 596387CB B7E832DF CBD3E80B 9C03DB26 DA183114 57E74C7D

27386F78 F616A79F 984C1F31 CEEBFC5A A7899161 15D25D18 0E3E64C0 1451C28A

E591F4F3 121F95BC E482E801 2886D58F 4B704519 75E997BC 751FCFA9 8C0FD4B5

707B872B BAAE459F A94760DE 290E7468 C566D6E4 C2E9AB64 DCD64D7E E4C533E1

02C26C97 342238B1 985B5E18 A43B10B3 69E0A5ED 30796592 C66037AE DAFA667A

782B7257 3E033740 86EB13DD 6D60C50E C84D2F03 0CF888C6 D1356561 7DB99621

79DC8347 077D1D63 E20BC2A1 AF6EC6E2 81F3D397

quit

license udi pid ISR4321/K9 sn FDO21482DWJ

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 192.168.0.9 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:9::1/64

ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1

ip address 192.168.0.2 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:2::1/64

ipv6 ospf 1 area 1

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 2.2.2.2

network 192.168.0.0 0.0.0.3 area 1

network 192.168.0.8 0.0.0.3 area 0

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 2.2.2.2

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

logi

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

192.168.0.0/24 is variably subnetted, 6 subnets, 2 masks

C 192.168.0.0/30 is directly connected, GigabitEthernet0/0/1

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

C 192.168.0.8/30 is directly connected, GigabitEthernet0/0/0

L 192.168.0.9/32 is directly connected, GigabitEthernet0/0/0

O 192.168.0.12/30

[110/2] via 192.168.0.10, 00:24:24, GigabitEthernet0/0/0

O IA 192.168.0.16/30

[110/3] via 192.168.0.10, 00:24:20, GigabitEthernet0/0/0

**R2#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, 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, la - LISP alt

lr - LISP site-registrations, ld - LISP dyn-eid, lA - LISP away

le - LISP extranet-policy, a - Application

O 2001:DB8:ACAD:1::/64 [110/1]

via GigabitEthernet0/0/1, directly connected

C 2001:DB8:ACAD:2::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

C 2001:DB8:ACAD:9::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:ACAD:9::1/128 [0/0]

via GigabitEthernet0/0/0, receive

O 2001:DB8:ACAD:10::/64 [110/1]

via GigabitEthernet0/0/0, directly connected

O 2001:DB8:ACAD:13::/64 [110/2]

via FE80::227:90FF:FED5:FAD1, GigabitEthernet0/0/0

O 2001:DB8:ACAD:14::/64 [110/2]

via FE80::227:90FF:FED5:FAD1, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:17::/64 [110/3]

via FE80::227:90FF:FED5:FAD1, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:18::/64 [110/3]

via FE80::227:90FF:FED5:FAD1, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**---R3---**

**R3#show run**

Building configuration...

Current configuration : 3946 bytes

Last configuration change at 16:10:58 UTC Tue Sep 19 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 R3

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-2949602955

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-2949602955

revocation-check none

rsakeypair TP-self-signed-2949602955

crypto pki certificate chain TP-self-signed-2949602955

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 32393439 36303239 3535301E 170D3233 30363036 31383138

33395A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 39343936

30323935 35308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 0100C6B5 B6C310C4 166068B7 15C74E3E 53F7C254 939DBD5B E2434EC9

4FCA1119 86013DAA 104B9104 7AE81A7D 62DDA0AE 836E3586 DFDD1E84 5C287973

3328DD4D F48BF6D2 52662405 1841E05F B2FF3EC1 CC6A3955 064D5490 C240DEEF

3948256A 5BC47454 92A048CD DA5FCAD8 1D745E89 870637FB C36CFC5E 45760A8D

0E1BD89A 7EE17E9E 5EAE4702 46DDBF57 6C4D7E5F 2CA008E7 E7E6F775 74DAF7EF

D04D09A2 5B427C52 4AB66E61 38508337 E3BCF313 0A40F195 F368478D A335A20B

BB701646 D317E6D4 AE6A859F 5AE791B7 8EFC6926 0C73BA7D 7CB96288 7ECF7E1B

4B41CCBE 0F56B91F ACBCED21 A0B621ED 5D64DC14 60E2A166 C0245203 A43E7CF8

CDB7AE05 368D0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 149E38E7 4A07C2C4 CBC2185B 51B7256D F324FDDC

99301D06 03551D0E 04160414 9E38E74A 07C2C4CB C2185B51 B7256DF3 24FDDC99

300D0609 2A864886 F70D0101 05050003 82010100 221DD907 7E6116E7 361E4334

65D7ED95 6D1BB560 18432F68 9A4E4892 8BF9CD6F 2F1913AE 9B714EDA 2F37A0F0

531230DE 107289B1 628BB27F 3DC2CB84 D5E98C24 AB0D0D96 C8AEE293 3DEA769F

6DCA8267 1E50F272 EDDADF26 AC33371C B79A996A 83B6F7F7 DBF7FAEA D1B71FA3

07A5319B C545D7E5 7BC1C54F 1AC38B70 1AE6A10A 94A6F479 913EDB2C 971832C2

624DE6A7 3539E597 89CFAAAB 8B91A963 8B7A37FD 64EABCE8 C9A9AE43 92C3C0FF

86C8894E 21B2743D 07522338 EE69AE4A FD968EE7 A8FB88BF 42858824 86583368

C267EDAE 753390AB 5EFD923F 925102BF 9CCA72C1 2BA44FE4 8918CB12 B9D8A1FC

F2B9E102 5E585CE2 F980BAC1 D9C5AD01 338D1CB9

quit

license udi pid ISR4321/K9 sn FDO214420HW

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 192.168.0.13 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:13::1/64

ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1

ip address 192.168.0.10 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:10::1/64

ipv6 ospf 1 area 0

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 3.3.3.3

network 192.168.0.8 0.0.0.3 area 0

network 192.168.0.12 0.0.0.3 area 0

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 3.3.3.3

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

**R3#show 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

192.168.0.0/24 is variably subnetted, 6 subnets, 2 masks

O IA 192.168.0.0/30

[110/2] via 192.168.0.9, 00:35:39, GigabitEthernet0/0/1

C 192.168.0.8/30 is directly connected, GigabitEthernet0/0/1

L 192.168.0.10/32 is directly connected, GigabitEthernet0/0/1

C 192.168.0.12/30 is directly connected, GigabitEthernet0/0/0

L 192.168.0.13/32 is directly connected, GigabitEthernet0/0/0

O IA 192.168.0.16/30

[110/2] via 192.168.0.14, 00:31:35, GigabitEthernet0/0/0

**R3#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, 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, la - LISP alt

lr - LISP site-registrations, ld - LISP dyn-eid, lA - LISP away

le - LISP extranet-policy, a - Application

OI 2001:DB8:ACAD:1::/64 [110/2]

via FE80::267E:12FF:FE4D:F770, GigabitEthernet0/0/1

OI 2001:DB8:ACAD:2::/64 [110/2]

via FE80::267E:12FF:FE4D:F770, GigabitEthernet0/0/1

O 2001:DB8:ACAD:9::/64 [110/1]

via GigabitEthernet0/0/1, directly connected

C 2001:DB8:ACAD:10::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:ACAD:10::1/128 [0/0]

via GigabitEthernet0/0/1, receive

C 2001:DB8:ACAD:13::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:ACAD:13::1/128 [0/0]

via GigabitEthernet0/0/0, receive

O 2001:DB8:ACAD:14::/64 [110/1]

via GigabitEthernet0/0/0, directly connected

OI 2001:DB8:ACAD:17::/64 [110/2]

via FE80::B6A8:B9FF:FE01:B991, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:18::/64 [110/2]

via FE80::B6A8:B9FF:FE01:B991, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**---R4---**

**r4#show run**

Building configuration...

Current configuration : 3879 bytes

Last configuration change at 15:59:58 UTC Tue Sep 19 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 r4

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-262078645

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-262078645

revocation-check none

rsakeypair TP-self-signed-262078645

crypto pki certificate chain TP-self-signed-262078645

certificate self-signed 01

3082032E 30820216 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 32363230 37383634 35301E17 0D323330 39313931 35343930

315A170D 33303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F

532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3236 32303738

36343530 82012230 0D06092A 864886F7 0D010101 05000382 010F0030 82010A02

82010100 B3745D5F 1B925CD5 DAC63FCE FE0B90A8 CD02C7CE 2954D614 E8662794

07E245EE 227CBC07 09F88213 4B80BEFB 7561CFC8 98A6DD14 0A815B18 D2663FB6

45DF2FB4 BFB1F099 ABAC32B0 8DED45F0 BF1319F1 47E995A4 D0332823 459F1CFD

AEDDD7C2 0229084A E780A11B DA42367E 4138AD7B 4E179930 DFECB3A4 7F2CEC4B

F1BC7B94 17E8D434 395ADF54 A7AC3D64 D8C760AE 27F1B1E3 F46F494E C7C98D92

14651416 C1DCE158 9A92CBF6 2C173495 5F3B6777 C715E4DF 50D06D45 8B78039E

EDCCBFF5 78FF5E87 3CEFAC58 0568582E DFB45356 508102EC 771A0F71 1B3808ED

370E8B94 FAF34BD9 F1764FCE 1EB20973 7BA1DA5C D83D647A F7E1EC6E 220C7EDB

AF08E987 02030100 01A35330 51300F06 03551D13 0101FF04 05300301 01FF301F

0603551D 23041830 168014A2 E328621F FE355D7C 7C64B58E F31675A7 40EEF630

1D060355 1D0E0416 0414A2E3 28621FFE 355D7C7C 64B58EF3 1675A740 EEF6300D

06092A86 4886F70D 01010505 00038201 0100B082 936A4078 10EB7091 B670EA94

49118FF0 A9DBFA1A 6338A1BA CD9CBC38 B4AF5AEF 75A7F7FB D0BBC462 05C89006

10DCF8FA E1CE4A95 18278BF6 67A19B96 32FF5A5C 891E6AA4 00FB4F94 5C64158C

B53291C3 126C636E 657DB8D1 506413B3 BE8EC2C3 394F94F6 A0871142 6BAA1234

289EC3F5 916F5898 5E8BD6F8 2D84DD57 93C0F84C 51FFDA18 0A63250D 87E04E35

1186BD89 2F41715B 76529693 23B96118 929E3C29 013D6971 1800039D C68950B2

F899FA6C B1732A69 89D869FC 5F63DC29 5617F53F 7953AB60 6A472B38 56054B53

2CAC4485 BA1A3CF5 BED6FBE3 6835194A 39810726 6CF34347 39DD3BAB A72B4731

228D6BD3 3854C56B 6D4F91CF B9D52D5E F70B

quit

license udi pid ISR4321/K9 sn FDO214421D1

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 192.168.0.17 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:17::1/64

ipv6 ospf 1 area 2

interface GigabitEthernet0/0/1

ip address 192.168.0.14 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:14::1/64

ipv6 ospf 1 area 0

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 4.4.4.4

network 192.168.0.12 0.0.0.3 area 0

network 192.168.0.16 0.0.0.3 area 2

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 4.4.4.4

control-plane

line con 0

transport input none

stopbits 1

line aux 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

192.168.0.0/24 is variably subnetted, 6 subnets, 2 masks

O IA 192.168.0.0/30

[110/3] via 192.168.0.13, 00:11:10, GigabitEthernet0/0/1

O 192.168.0.8/30

[110/2] via 192.168.0.13, 00:11:10, GigabitEthernet0/0/1

C 192.168.0.12/30 is directly connected, GigabitEthernet0/0/1

L 192.168.0.14/32 is directly connected, GigabitEthernet0/0/1

C 192.168.0.16/30 is directly connected, GigabitEthernet0/0/0

L 192.168.0.17/32 is directly connected, GigabitEthernet0/0/0

**r4#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, 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

OI 2001:DB8:ACAD:1::/64 [110/3]

via FE80::227:90FF:FED5:FAD0, GigabitEthernet0/0/1

OI 2001:DB8:ACAD:2::/64 [110/3]

via FE80::227:90FF:FED5:FAD0, GigabitEthernet0/0/1

O 2001:DB8:ACAD:9::/64 [110/2]

via FE80::227:90FF:FED5:FAD0, GigabitEthernet0/0/1

O 2001:DB8:ACAD:10::/64 [110/2]

via FE80::227:90FF:FED5:FAD0, GigabitEthernet0/0/1

O 2001:DB8:ACAD:13::/64 [110/1]

via GigabitEthernet0/0/1, directly connected

C 2001:DB8:ACAD:14::/64 [0/0]

via GigabitEthernet0/0/1, directly connected

L 2001:DB8:ACAD:14::1/128 [0/0]

via GigabitEthernet0/0/1, receive

C 2001:DB8:ACAD:17::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:ACAD:17::1/128 [0/0]

via GigabitEthernet0/0/0, receive

O 2001:DB8:ACAD:18::/64 [110/1]

via GigabitEthernet0/0/0, directly connected

L FF00::/8 [0/0]

via Null0, receive

**---R5---**

**R5#show run**

Building configuration...

Current configuration : 3884 bytes

Last configuration change at 16:16:03 UTC Tue Sep 19 2023

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

hostname R5

boot-start-marker

boot-end-marker

vrf definition Mgmt-intf

address-family ipv4

exit-address-family

address-family ipv6

exit-address-family

no aaa new-model

login on-success log

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

crypto pki trustpoint TP-self-signed-859896477

enrollment selfsigned

subject-name cn=IOS-Self-Signed-Certificate-859896477

revocation-check none

rsakeypair TP-self-signed-859896477

crypto pki certificate chain TP-self-signed-859896477

certificate self-signed 01

3082032E 30820216 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274

69666963 6174652D 38353938 39363437 37301E17 0D323231 30313731 38323635

385A170D 33303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F

532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3835 39383936

34373730 82012230 0D06092A 864886F7 0D010101 05000382 010F0030 82010A02

82010100 CA31EE51 C97FF58C 76C72B4E 2B6CD51B 98CBA177 7EEF8D11 DAAB7CA8

47B3AA97 3B815AD1 09F637AE B1D98BB8 A2CAA1A9 0AFAF87A 3AFBFF9E 34875D72

0BD5EE8D E40F4D4A 3B4A38A7 09F1940D 013C18AE F29F2BEA 07085EB5 982E9BC8

F99C8CA7 1C7DD58E 67B89FCB 951C3C4C 6D11B8C7 8D24BF5C 973A32BF E16A3094

99E8DB22 7FEA5A30 6E9457F6 90485336 E953F3D2 942824E3 87D8DE52 E00336AC

09CA85F0 0BD105FA B4078F96 9A2EA846 C147AD42 B08CD3D2 16A06EB1 CC54E167

8F4677E9 2663D37D 7B1C3891 9ABF4B5B 83ECE428 AD426108 357B992E 792C850D

84C67187 BF0E10B5 B1D23A97 F2F1372F 7D0FA8C8 80E947DE 5E0FA234 7FA6A487

24A0DB83 02030100 01A35330 51300F06 03551D13 0101FF04 05300301 01FF301F

0603551D 23041830 168014E7 C71AF39E FCC743E7 C7395603 DBBCA771 4C734E30

1D060355 1D0E0416 0414E7C7 1AF39EFC C743E7C7 395603DB BCA7714C 734E300D

06092A86 4886F70D 01010505 00038201 010029B2 769B6033 C71585B8 DD1EE596

BDB3F81C 5C58921E AF7FBE2F A95F447D 7B870BCD B9AE5E5D 46FCE0E1 667295B7

4668DACB F848F91A 207FC6CD 203E64BF 6747B9E7 6FF304F1 491442EA 56EEBEE6

DE79EC87 F5BE7B9C B2482264 A58FAC1B 827F66C7 F16C0292 815AD1ED 86F2E167

9568FC20 9E2ADCB6 311B34E4 E93EC128 2DD25078 4F27E1F1 4DD309BA B2A0248A

C41F66C8 4A81C2B8 9D0E8A62 4E0443F6 F28B3203 28A14D43 0E06A98B 06DAB16D

66E0616A DB63132A 8FB53D9B 88A28660 F84CD05D EC8653F6 C3FC6446 94977DAC

0ED87E1C 9C0B372A 6E25729B FAD2B249 6FDF7BC6 3218B110 D167D3D5 AEACB17D

6E8CB48E ED168D18 8D9104DE BA9F3515 5662

Quit

license udi pid ISR4321/K9 sn FLM240608PJ

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 5.5.5.5 255.255.255.255

interface GigabitEthernet0/0/0

ip address 192.168.0.18 255.255.255.252

negotiation auto

ipv6 address 2001:DB8:ACAD:18::1/64

ipv6 ospf 1 area 2

interface GigabitEthernet0/0/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/1/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/1/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 5.5.5.5

network 192.168.0.16 0.0.0.3 area 2

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

router-id 5.5.5.5

control-plane

line con 0

transport input none

stopbits 1

line aux 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

5.0.0.0/32 is subnetted, 1 subnets

C 5.5.5.5 is directly connected, Loopback0

192.168.0.0/24 is variably subnetted, 5 subnets, 2 masks

O IA 192.168.0.0/30

[110/4] via 192.168.0.17, 00:16:03, GigabitEthernet0/0/0

O IA 192.168.0.8/30

[110/3] via 192.168.0.17, 00:16:03, GigabitEthernet0/0/0

O IA 192.168.0.12/30

[110/2] via 192.168.0.17, 00:16:03, GigabitEthernet0/0/0

C 192.168.0.16/30 is directly connected, GigabitEthernet0/0/0

L 192.168.0.18/32 is directly connected, GigabitEthernet0/0/0

**R5#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

OI 2001:DB8:ACAD:1::/64 [110/4]

via FE80::B6A8:B9FF:FE01:B990, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:2::/64 [110/4]

via FE80::B6A8:B9FF:FE01:B990, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:9::/64 [110/3]

via FE80::B6A8:B9FF:FE01:B990, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:10::/64 [110/3]

via FE80::B6A8:B9FF:FE01:B990, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:13::/64 [110/2]

via FE80::B6A8:B9FF:FE01:B990, GigabitEthernet0/0/0

OI 2001:DB8:ACAD:14::/64 [110/2]

via FE80::B6A8:B9FF:FE01:B990, GigabitEthernet0/0/0

O 2001:DB8:ACAD:17::/64 [110/1]

via GigabitEthernet0/0/0, directly connected

C 2001:DB8:ACAD:18::/64 [0/0]

via GigabitEthernet0/0/0, directly connected

L 2001:DB8:ACAD:18::1/128 [0/0]

via GigabitEthernet0/0/0, receive

L FF00::/8 [0/0]

via Null0, receive

**Problems:**

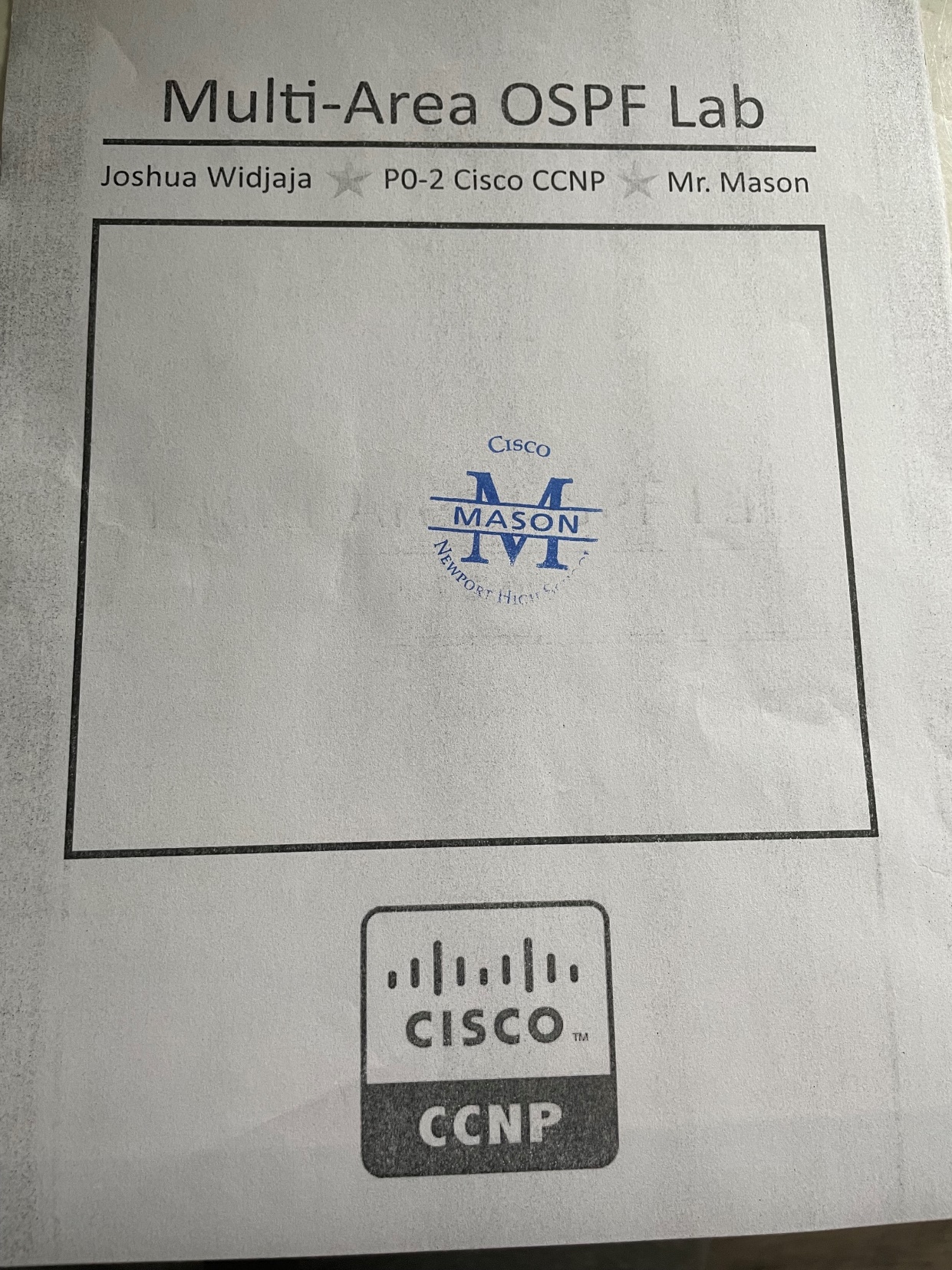
One of our first problems was that our router 5 wasn’t establishing OSPF routes. After checking all the configurations which seemed right, we were stumped and asked around. We were advised to check on our layer 1 configurations and we realized that one of the ethernet cables was connected to a 6th router which wasn’t supposed to exist. We then connected the ethernet cable back to the corresponding interface for R5 and got our OSPF routes to show up again.

A second problem we ran into was that we didn’t configure any ipv6. After setting up an ipv6 addressing scheme and configuring them, our ipv6 communications weren’t working. After asking another CCNP student for help, we realized that we placed the addresses from different routers into the same network, so we changed the ipv6 addresses to place them into different networks.

Another problem we had was that when entering in “show ip route” and “show ipv6 route,” we only received direct OSPF links in our routing tables. This meant that OSPF routes could only communicate to routers within the same area, and we wanted them to communicate between other areas. We then established the need for a backbone router (area 0). A backbone router is critical for a multi-area OSPF network because it connects non-backbone routers to the central backbone area, allowing for communication between different areas. After configuring area 0 on routers 2, 3, and 4, because they were in between the edge routers, we received Intra-Area (IA) OSPF routes when issuing show ip and ipv6 route.

**Conclusion:**

Overall, I found this lab to be quite enjoyable and was able to refresh my mind on critical concepts after summer break. When a problem arose, we felt quite stuck and troubleshooting wasn’t the most fun, but we learned that asking other CCNP students who have probably went through the same problem was most helpful in overcoming certain problems.

**Teacher Sign Off:**