A white rectangular sign with black text

Description automatically generated

**Purpose**

This lab was designed to set up a network using multi-area OSPF comprised of 3 areas on a group of 5 routers to route traffic between the devices. Doing this required applying skills mastered in the CCNA course, such as: creating a topology from scratch, setting up a rack based on the topology with the appropriate cables, setting both IPv4 and IPv6 addresses on interfaces, setting router IDs, enabling OSPFv2 and OSPFv3 on interfaces, testing the network connectivity with pings through end devices, and debugging as necessary. Practicing these skills helps build the foundation needed to face upcoming CCNP labs and real-life scenarios.

**Background Information**

OSPF (Open Shortest Path First) is a link-state routing protocol, a set of instructions for routers to follow when sending out packets of data across a network. This routing protocol uses Dijkstra’s algorithm, router cost and priority, to determine the shortest distance to send the data packets to a particular network destination. It’s also valuable to have in larger, complex networks, as it enables scalability and helps ease redundancy when creating routes. The OSPF protocol allows the routes between devices to be recalculated quicker when changes are made to the topology as well. It’s also beneficial to use since it requires only a simple sequence of commands. OSPF has two versions, v2, and v3, that support IPv4 and IPv6 respectively.

This lab specifically explores multi-area OSPF, which is a way of utilizing the protocol to route packets through devices located in different OSPF areas. An area is a section of an OSPF network containing a smaller set of devices and networks apart of the topology of the full network. A single-area OSPF network places all of the devices in the network inside only one area, which is easier to plan for and configure when working with less devices. However, a single-area OSPF configuration is not efficient anymore when used to route through a higher number of devices. In a larger topology, more data is expected to be routed through the network and doing so on one area would overwhelm the network and cause various issues to arise. One common issue on a single-area OSPF network is route flapping, which occurs when a router is unnecessarily updating their routes too frequently, constantly connecting and disconnecting links, which causes instability in the traffic flow of the entire network and can even shut it down.

Multi-area OSPF networks are useful for isolating different groups of routers in the network to avoid problems like flapping. In a multi-area OSPF network, devices are logically separated into multiple areas that are connected through the backbone area, area 0. The backbone area is central to an OSPF network, as it connects all the other areas and distributes routing information among each area and helps prevent routing loops. Multi-area OSPF can improve the overall efficiency of the network by reducing the number of link-state updates between routers, creating smaller routing tables, and making shortest path calculations quicker for routers.

**Lab Summary**

1. Designed a topology with 3 areas and 4 networks assigned to 5 routers
2. Used the topology to physically wire a router network accordingly
3. Configured IPv4 and IPv6 addresses on router’s gigabit ethernet interfaces based on the planned topology and IP scheme
4. Configured OSPFv2 and OSPFv3 on interfaces, assigning them to their respective areas
5. Entered the no shut command to get interfaces up and waited for OSPF adjacencies to be established among the routers
6. Configured the router ID for all routers
7. Tested connectivity and troubleshooted issues that arose

**Lab Commands**

**router ospf [process ID]**   
**ipv6 router ospf [process ID]**Creates OSPFv2 and OSPFv3 routing processes, respectively.

**ipv6 unicast-routing**Enables ipv6 routing on a device.

**ip ospf 1 area [number]  
ipv6 ospf 1 area [number]**  
Enables OSPFv2/OSPFv3 and assigns an area number on the interface of a router.  
This command is issued after entering the router interface.

**clear ip ospf process  
clear ipv6 ospf process**Resets and restarts OSPF processes. Updates the router ID when the configuration changes. Often used for troubleshooting purposes.

**show ip ospf neighbor**  
**show ipv6 ospf neighbor**Displays information about OSPF neighbors and adjacencies.   
Often useful when troubleshooting.

**show ip route**  
**show ipv6 route**Displays the routing table of a router and helps confirm whether   
OSPF routes exist and routed correctly.

**Topology & IP Scheme**

A diagram of a circular object with a circular object and arrows

Description automatically generated



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | g0/0/0 | g0/0/1 | lo0 | Router ID |
| R1 | 10.0.1.1/24  2001:db8:acad:a::1/64 | N/A | 1.1.1.1/32 | 1.1.1.1 |
| R2 | 10.0.1.2/24  2001:db8:acad:a::2/64 | 10.0.0.1/24  2001:db8:acad:b::1/64 | N/A | 2.2.2.2 |
| R3 | 10.0.10.1/24  2001:db8:acad:c::1/64 | 10.0.0.2/24  2001:db8:acad:b::2/64 | N/A | 3.3.3.3 |
| R4 | 10.0.10.2/24  2001:db8:acad:c::2/64 | 10.0.2.1/24  2001:db8:acad:d::1/64 | N/A | 4.4.4.4 |
| R5 | N/A | 10.0.2.2/24  2001:db8:acad:d::2/64 | 2.2.2.2/32 | 5.5.5.5 |

**Configurations –** show run and show ip route, show ipv6 route

**R1**

Show run:

Current configuration : 1794 bytes

! Last configuration change at 16:58:27 UTC Mon Sep 11 2023

version 16.7

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

subscriber templating

vtp domain cisco

vtp mode transparent

ipv6 unicast-routing

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO220523GF

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 1.1.1.1 255.255.255.255

ip ospf 1 area 1

interface GigabitEthernet0/0/0

ip address 10.0.1.1 255.255.255.0

ip ospf 1 area 1

negotiation auto

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

ipv6 ospf 1 area 1

interface GigabitEthernet0/0/1

no ip address

ip ospf 1 area 1

shutdown

negotiation auto

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0/2/0

negotiation auto

interface GigabitEthernet0/2/1

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 1.1.1.1

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

wsma agent exec

wsma agent config

wsma agent filesys

wsma agent notify

end

IPv4 Route:

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

2.0.0.0/32 is subnetted, 1 subnets

O IA 2.2.2.2 [110/5] via 10.0.1.2, 00:00:51, GigabitEthernet0/0/0

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

O IA 10.0.0.0/24 [110/2] via 10.0.1.2, 00:12:38, GigabitEthernet0/0/0

C 10.0.1.0/24 is directly connected, GigabitEthernet0/0/0

L 10.0.1.1/32 is directly connected, GigabitEthernet0/0/0

O IA 10.0.2.0/24 [110/4] via 10.0.1.2, 00:12:38, GigabitEthernet0/0/0

O IA 10.0.10.0/24 [110/3] via 10.0.1.2, 00:12:38, GigabitEthernet0/0/0

IPv6 Route:

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

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

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

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

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

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

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

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

L FF00::/8 [0/0]

via Null0, receive

**R2**

Show run:

Current configuration : 3928 bytes

! Last configuration change at 16:30:25 UTC Mon Sep 11 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-2189345785

enrollment selfsigned

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

revocation-check none

rsakeypair TP-self-signed-2189345785

crypto pki certificate chain TP-self-signed-2189345785

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

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

69666963 6174652D 32313839 33343537 3835301E 170D3233 30393131 31353436

34325A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 31383933

34353738 35308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 0100C81C 3DA5371C 0B49CCB9 C2B8F5DB 72216D11 F4778BB2 C6D7C815

57C20050 960325A6 66192A18 C9C70482 5F5F7439 58A453C0 BC400651 2956DFCD

4BC2D24B 782F470D 46903A0E 0842B4B1 F0A131AF 1130E4A5 6ACD4BCF 39CAD154

B4466E5A FF2751FF D8025F91 A198ED25 A1A940AE 621C4B0C EF9B2A53 5D37EFFE

DFEB4CF8 0501E8FE 7A6DC83E 2E738F73 F2CE5031 46B6B3AC E962ADFF 6C0F77AF

7387FCD3 AD7F4221 1882C153 7CFF72AF D07595A4 19C13E4B 87A38AB0 87798790

E616A2B4 2E3235EC 7571E07D C7028991 6AB6A891 1E73F723 53EB8B62 8AFF8D03

F4FA097B 9FAE4210 41452898 11889581 4DE51FC4 05F25DF4 6E93DFAF 02BE59BA

8FC49007 04B30203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 14FC975E DC661564 7EC070A1 27185FB6 7B718F2E

6D301D06 03551D0E 04160414 FC975EDC 6615647E C070A127 185FB67B 718F2E6D

300D0609 2A864886 F70D0101 05050003 82010100 93C94FEB 88345158 8262B54B

E22C8AA4 D455E87F 7DD10B1F 31BE2EC0 06FFDA4E 60CCF9BD 13C1843A BAFA4CF6

2CB2CEEB FC8DE107 7141C7F3 790F095D F18F76AC 799DE55D 288359DB 3CB7D4C3

7A72E795 85DFF6AA B99ADDFC 611FC229 C71F0DAB 98104A90 69B960DA CA733E2D

064A9E12 87B56337 A635CB9D 10FDE965 1926DAD5 52168866 E8F70E27 7A045921

F3B9C9A7 24FE6B00 D6942532 6D1E958A C526DC49 AC31BF03 25A5C63A BEB24719

A4B31C44 8FDC845F DEF5A3D4 47C64E56 9DBFC91D 1FC90FE2 1F0A9AD1 84A945BD

7EE30312 6C04D722 46BE46CE C8D083CB 4EEDB2DB C067B63F A42B8681 00574ACB

4366B905 1A702ABC 4E50683B CF77928A F3E099F7

quit

license udi pid ISR4321/K9 sn FDO21482DXE

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 10.0.1.2 255.255.255.0

ip ospf 1 area 1

negotiation auto

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

ipv6 ospf 1 area 1

interface GigabitEthernet0/0/1

ip address 10.0.0.1 255.255.255.0

ip ospf 1 area 0

negotiation auto

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

ipv6 ospf 1 area 0

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0/2/0

negotiation auto

interface GigabitEthernet0/2/1

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 2.2.2.2

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

IPv4 Route:

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

O 1.1.1.1 [110/2] via 10.0.1.1, 00:56:02, GigabitEthernet0/0/0

2.0.0.0/32 is subnetted, 1 subnets

O IA 2.2.2.2 [110/4] via 10.0.0.2, 00:49:30, GigabitEthernet0/0/1

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

C 10.0.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.0.0.1/32 is directly connected, GigabitEthernet0/0/1

C 10.0.1.0/24 is directly connected, GigabitEthernet0/0/0

L 10.0.1.2/32 is directly connected, GigabitEthernet0/0/0

O IA 10.0.2.0/24 [110/3] via 10.0.0.2, 00:54:12, GigabitEthernet0/0/1

O 10.0.10.0/24 [110/2] via 10.0.0.2, 00:54:12, GigabitEthernet0/0/1

IPv6 Route:

C 2001:DB8:ACAD:A::/64 [0/0] via GigabitEthernet0/0/0, directly connected

L 2001:DB8:ACAD:A::2/128 [0/0] via GigabitEthernet0/0/0, receive

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

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

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/1

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

via FE80::521C:B0FF:FE63:3831, GigabitEthernet0/0/1

L FF00::/8 [0/0]

via Null0, receive

**R3**

Show run:

Current configuration : 4029 bytes

! Last configuration change at 16:56:21 UTC Mon Sep 11 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-2557841031

enrollment selfsigned

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

revocation-check none

rsakeypair TP-self-signed-2557841031

crypto pki certificate chain TP-self-signed-2557841031

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

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

69666963 6174652D 32353537 38343130 3331301E 170D3233 30393131 31353432

30365A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 35353738

34313033 31308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 0100ADC2 EECB2353 4307E2D4 DF621BCB 40C4A4F3 FEBCD0A8 1A3DD3CA

2F2E3422 B62F061D 726BBFEE 73A250AC 0D3C35F6 B545A86E 766F028B 68AD9EF8

107C3DB2 CA32CFA0 8FAC82CF 5A9A9213 75DB753C D4C7EBC2 1657ABC4 4CEC829D

B83157EE 0FF6842B 6B71E2C5 0A3A8327 AD1FEBE0 2FC1AE81 30A4ED51 02351D03

DDA7352F 19B0A84C 345304AD 1E5F88FF 4842A71F 8329DB0B DA77B9F9 31194546

F44C538D EAD96F16 C2F66E9F A508346B 6FCF2630 8C0C7014 CD27DC1D 125DD0CD

4E3FC848 9262F3F5 8906E7A2 65112F52 729ACEEB F5798C8C 32B01583 C48F2C3C

089CB197 8B3BEDD2 B8D9D07C 953F621D 7CAF890B BE747824 1A39C53E C659AFB4

F8676AB4 901D0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 14FB4C6A 9331D4AC 56EED5D6 28335C38 27475B8D

E1301D06 03551D0E 04160414 FB4C6A93 31D4AC56 EED5D628 335C3827 475B8DE1

300D0609 2A864886 F70D0101 05050003 82010100 1738E7FC BFE6646A 69FABAF1

1FC89E80 EF3FF7CD A181C920 4E9AD544 008AD7D4 4BE8B47D F5272309 1B2EE481

3308258D E17BC363 25238008 9D166FC8 09920C73 76429611 256AAF99 5E808D27

431EF45A E755AF1B BC21C09A 85CD6730 8C2A9FA2 7F477B9A A30416CC 42FA5B17

CEF5B00A 881ACFEE DA104C54 6C37EAC8 0E4BFF5B 0F051BF6 6651F996 9DC66996

2900A89D E3364F74 632B0118 675B23B2 BA5310C1 843B30CF FEC65B86 69AB7E30

E3FBBF09 A988B0BE 580C6394 0B65CCB5 57848E9D B55FF5AA 3BEEA936 14A5E4BD

5365098A 7D24B2BF EDFB3471 48E6668F 32FF6A93 EA342A05 C9485F8D AB3C31A5

6171F12F C8D65FCB F652589A 8D29B07D EB3149D2

quit

license udi pid ISR4321/K9 sn FDO21500G1N

license boot level appxk9

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 10.0.10.1 255.255.255.0

ip ospf 1 area 0

negotiation auto

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

ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1

ip address 10.0.0.2 255.255.255.0

ip ospf 1 area 0

negotiation auto

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

ipv6 ospf 1 area 0

interface Serial0/1/0

no ip address

shutdown

interface Serial0/1/1

no ip address

shutdown

interface GigabitEthernet0/2/0

no ip address

shutdown

negotiation auto

interface GigabitEthernet0/2/1

no ip address

shutdown

negotiation auto

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

shutdown

negotiation auto

router ospf 1

router-id 3.3.3.3

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

IPv4 Route:

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

O IA 1.1.1.1 [110/3] via 10.0.0.1, 00:58:47, GigabitEthernet0/0/1

2.0.0.0/32 is subnetted, 1 subnets

O IA 2.2.2.2 [110/3] via 10.0.10.2, 00:52:20, GigabitEthernet0/0/0

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

C 10.0.0.0/24 is directly connected, GigabitEthernet0/0/1

L 10.0.0.2/32 is directly connected, GigabitEthernet0/0/1

O IA 10.0.1.0/24 [110/2] via 10.0.0.1, 00:58:47, GigabitEthernet0/0/1

O IA 10.0.2.0/24 [110/2] via 10.0.10.2, 00:57:02, GigabitEthernet0/0/0

C 10.0.10.0/24 is directly connected, GigabitEthernet0/0/0

L 10.0.10.1/32 is directly connected, GigabitEthernet0/0/0

IPv6 Route:

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

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

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

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

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

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

via FE80::B6A8:B9FF:FE47:9230, GigabitEthernet0/0/0

L FF00::/8 [0/0]

via Null0, receive

**R4**

Show run:

Current configuration : 3817 bytes

! Last configuration change at 16:22:13 UTC Mon Sep 11 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-1457377718

enrollment selfsigned

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

revocation-check none

rsakeypair TP-self-signed-1457377718

crypto pki certificate chain TP-self-signed-1457377718

certificate self-signed 01

30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 05050030

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

69666963 6174652D 31343537 33373737 3138301E 170D3233 30393131 31363039

32345A17 0D333030 31303130 30303030 305A3031 312F302D 06035504 03132649

4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D31 34353733

37373731 38308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201

0A028201 0100BA88 84F6937A A2071AAF 49C141EF 8861C473 47E66D80 27530B73

06717179 7AE7D4AD 50B9B645 E4C28E22 B5C301E4 5548407E 1422A0DA 572A7A67

65A3F682 E97260B7 06BFFC25 394074B5 361EF71F CCBF3AAE F283DA38 ACF7E8A2

BC4FD9B3 ED0562A6 E0000ECC 2BAD82A9 10C38592 B45EEB18 AEC13D38 C41A9ED6

261734A9 42194AD7 B251EF09 5DC91801 5A6EC98C 43AA4E3E 8D74C760 0C1CB0C4

F0E7AE20 7EEDFFA2 1C5D9D3A 3D63DCCE 7041F482 3E71C993 19529238 F6DFA70B

B516C619 66C1266B EA8EFA98 5309A068 B78A4DF1 14831391 5257A17C 47E0403C

F7A0C44F 6FDD605C 600BB272 8D8C4F51 92623520 75FCF66D C81E3190 B532D533

CAE96EF2 F5EF0203 010001A3 53305130 0F060355 1D130101 FF040530 030101FF

301F0603 551D2304 18301680 14BB7A15 6B78456D D82574EF 375BD5B6 A4354924

12301D06 03551D0E 04160414 BB7A156B 78456DD8 2574EF37 5BD5B6A4 35492412

300D0609 2A864886 F70D0101 05050003 82010100 2A35D5D7 B640D2F9 5D18C105

382BF130 E88DE32E 1415A9B6 7BD52BEC 11D5083B DFF88677 3BEDE327 CF0C5C28

075E0969 4655310D E008DE81 2C3AC4DD 46F3E59D 2638E326 BCECC54F 4DCAEFDC

B5C049F6 9CF6A0A8 D5D01049 D711C46B 83AF6FA2 141B22D7 F6E1BDAA B915B9BD

E4CAE313 D8FE73EE 64E900E4 E2E6FE79 751A81FA E4673652 40ECB839 62536A02

F69159E2 C16E0713 E7F29610 57DE43A6 4F61DC0D E1EAAC41 26A73FB8 21FAA985

C74730CE 774FE0ED 2AD1EBC2 B3F94472 31064F09 2A3C1670 EC6BD720 4FC880C4

C95D438F BFE663B3 33A1D306 06607038 F70159F6 A769B7F2 CB45F114 B3269351

1B89AB5C D6650A5D 235D3F71 544D5EFD EDCDFA28

quit

license udi pid ISR4321/K9 sn FDO21441WDF

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface GigabitEthernet0/0/0

ip address 10.0.10.2 255.255.255.0

ip ospf 1 area 0

negotiation auto

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

ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1

ip address 10.0.2.1 255.255.255.0

ip ospf 1 area 2

negotiation auto

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

ipv6 ospf 1 area 2

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

ip forward-protocol nd

ip http server

ip http authentication local

ip http secure-server

ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

IPv4 Route:

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

O IA 1.1.1.1 [110/4] via 10.0.10.1, 00:59:15, GigabitEthernet0/0/0

2.0.0.0/32 is subnetted, 1 subnets

O 2.2.2.2 [110/2] via 10.0.2.2, 00:54:33, GigabitEthernet0/0/1

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

O 10.0.0.0/24 [110/2] via 10.0.10.1, 00:59:15, GigabitEthernet0/0/0

O IA 10.0.1.0/24 [110/3] via 10.0.10.1, 00:59:15, GigabitEthernet0/0/0

C 10.0.2.0/24 is directly connected, GigabitEthernet0/0/1

L 10.0.2.1/32 is directly connected, GigabitEthernet0/0/1

C 10.0.10.0/24 is directly connected, GigabitEthernet0/0/0

L 10.0.10.2/32 is directly connected, GigabitEthernet0/0/0

IPv6 Route:

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

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

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

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

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

via GigabitEthernet0/0/0, directly connected

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

via GigabitEthernet0/0/0, receive

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

**R5**

Show run:

Current configuration : 1459 bytes

! Last configuration change at 16:13:47 UTC Mon Sep 11 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 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

ipv6 unicast-routing

multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO215009QY

no license smart enable

diagnostic bootup level minimal

spanning-tree extend system-id

redundancy

mode none

interface Loopback0

ip address 2.2.2.2 255.255.255.255

ip ospf 1 area 2

interface GigabitEthernet0/0/0

no ip address

negotiation auto

interface GigabitEthernet0/0/1

ip address 10.0.2.2 255.255.255.0

ip ospf 1 area 2

negotiation auto

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

ipv6 ospf 1 area 2

interface Serial0/1/0

no ip address

interface Serial0/1/1

no ip address

interface GigabitEthernet0

vrf forwarding Mgmt-intf

no ip address

negotiation auto

router ospf 1

router-id 5.5.5.5

ip forward-protocol nd

no ip http server

ip http secure-server

ipv6 router ospf 1

control-plane

line con 0

transport input none

stopbits 1

line aux 0

stopbits 1

line vty 0 4

login

end

IPv4 Route:

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

O IA 1.1.1.1 [110/5] via 10.0.2.1, 00:54:38, GigabitEthernet0/0/1

2.0.0.0/32 is subnetted, 1 subnets

C 2.2.2.2 is directly connected, Loopback0

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

O IA 10.0.0.0/24 [110/3] via 10.0.2.1, 00:54:38, GigabitEthernet0/0/1

O IA 10.0.1.0/24 [110/4] via 10.0.2.1, 00:54:38, GigabitEthernet0/0/1

C 10.0.2.0/24 is directly connected, GigabitEthernet0/0/1

L 10.0.2.2/32 is directly connected, GigabitEthernet0/0/1

O IA 10.0.10.0/24 [110/2] via 10.0.2.1, 00:54:38, GigabitEthernet0/0/1

IPv6 Route:

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

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/1

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

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/1

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

via FE80::B6A8:B9FF:FE47:9231, GigabitEthernet0/0/1

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

via GigabitEthernet0/0/1, directly connected

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

via GigabitEthernet0/0/1, receive

L FF00::/8 [0/0]

via Null0, receive

Trace Routes:

A screenshot of a computer

Description automatically generated

A screen shot of a computer

Description automatically generated

A black screen with white text

Description automatically generated

A screen shot of a computer

Description automatically generated

**Problems**

While setting up this lab, OSPFv2 was able to be set on the routers through a simple command: ip ospf 1 area [#]. However, when the command was altered to support ipv6 and enable OSPFv3, the command did not go through on the router interfaces unless ipv6 unicast-routing was issued first.

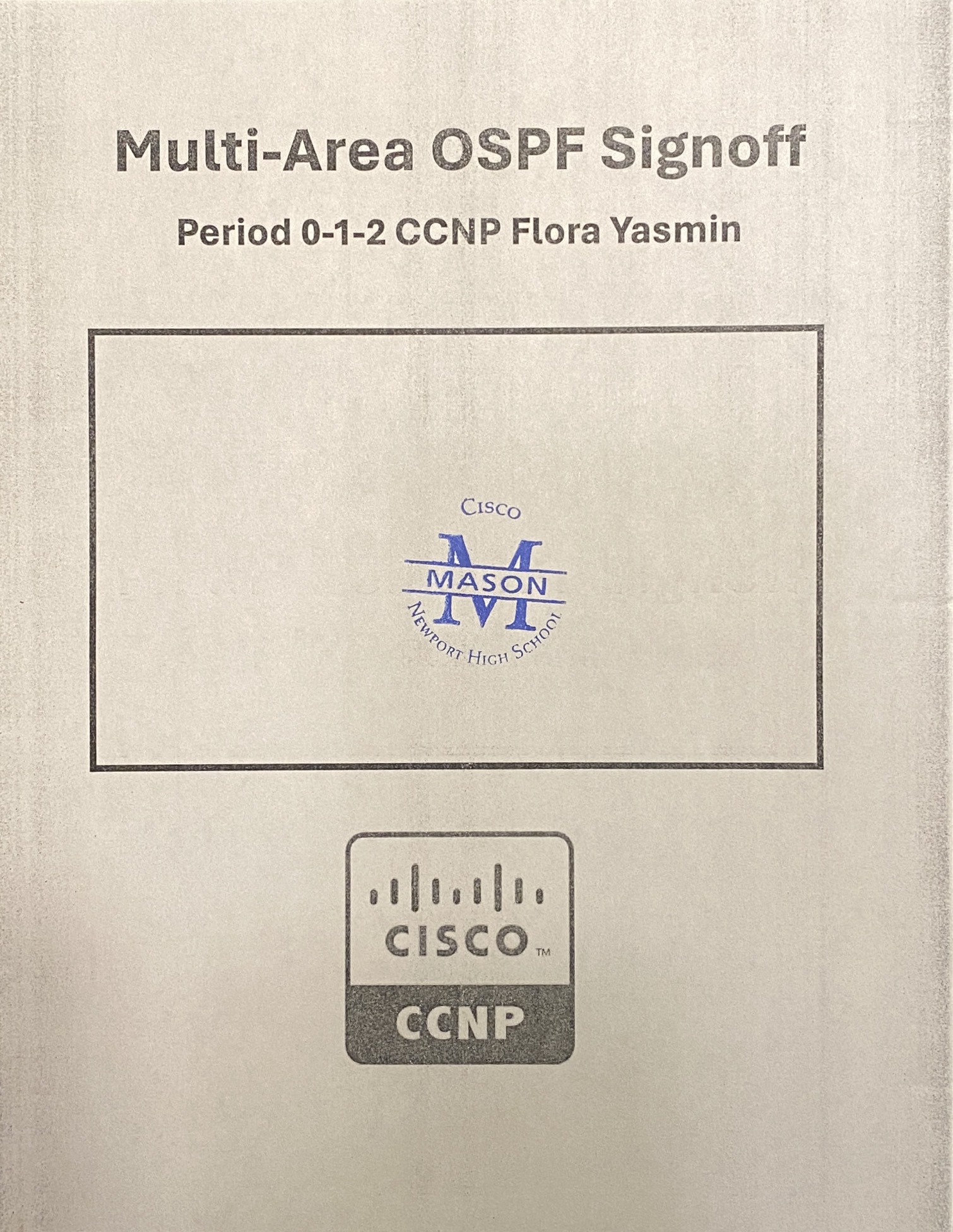
When testing the network, one router was able to ping to all the other router gigabit ethernet interfaces but not to any loopbacks. This occurred because while R1 had a loopback configured, the loopback interface on R5 was missing an address. After it was configured, loopbacks could be pinged across the network.

R5 was unable to ping outside of its own area and pinging R1 delivered a “host unreachable” message. R1 could ping every router except R5.

**Conclusion**

This lab demonstrates the benefits of utilizing multi-area OSPF to support a network of routers, as the protocol makes it easier to plan a topology by allowing separate areas communicating with each other to route information and can also be done in a series of simple commands, making both the engineer’s and router’s jobs more efficient. The lab introduced to us the process of planning, documenting, and configuring a network from scratch and how to effectively troubleshoot, setting us up for future CCNP labs and real life scenarios where such skill are required on a daily basis.

**Teacher Signoff**

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