Purpose

This lab was a review on material we already learned in CCNA but done in a CCNP format. The difference from this OSPF lab and previous labs done in CCNA is that we used to get detailed instruction in CCNA but CCNP is just a list of requirements and you get sent on your way to do the lab and fix bugs yourself. The other major difference is this lab writeup. Doing a lab we already know in a CCNP format allows us to get learn the CCNP format of labs and get ready to use it throughout the year.

Background information on lab concepts

The main lab concept was multiarea OSPF with at least 5 routers and 3 areas. Multiarea OSPF is different from single area OSPF due to being easier on the network when the network is large in scale. This is due to OSPF showing each router the entire OSPF routing domain by sending router information around the area. This is an issue however when a network becomes too large, single area OSPF becomes inefficient due to the high amount of OSPF routing information traveling across the network due to the large area size. Multiarea saves the day here by summarizing the routing information from other areas so there's less routing information on the network as a whole. This summarized routing information travels across the backbone area, also known as area 0. There are also 2 versions of OSPF outside of single and multiarea, these are IPv4 (legacy networking) and IPv6 (next gen networking). In this lab we need to use both, both having the requirement of being able to communicate throughout the network via pings. So regardless of whether you're using IPv4 or IPv6, you can communicate across our network.

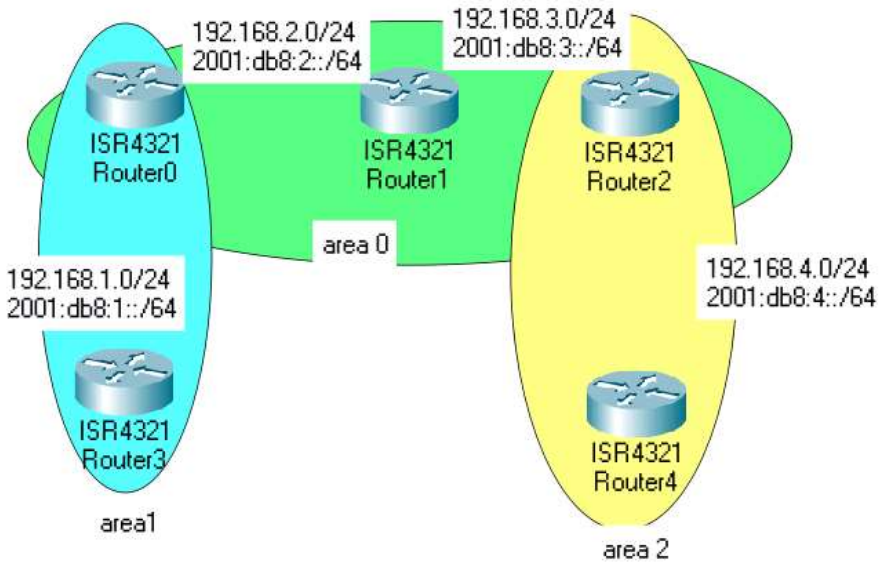
Lab summary

We created a digital environment using 3 areas and 5 routers. All routers were able to send messages between each other. Routing tables were filled by OSPF.

Lab commands

```
Commands used in this lab include:

Router(config): Interface g0/0/#

Router(config-if): Ip address 192.168.#.# 255.255.255.#

Router(config-if): Ipv6 address 2001:abc:#::#/64

Router(config): lo0

Router(config-if): Ipv add #.#.#.# 255.255.255.255

Router(config): router ospf 1

Router(config-router): network 192.168.#.0 255.255.255.0

Router(config-router): network 192.168.#.0 255.255.255.0
```

Network diagram with IP's



Note: Router names are inaccurate, true configuration should be:
Router 3 > R1
Router0 > R2
Router1 > R3
Router 2 > R4
Router4 > R5

Configurations:
R1:

```
Current configuration : 1494 bytes

! Last configuration change at 16:28:21 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
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

ipv6 unicast-routing

subscriber templating
multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO214421CF

spanning-tree extend system-id

redundancy
mode none

vlan internal allocation policy ascending

interface Loopback0
ip address 1.1.1.1 255.255.255.255

interface GigabitEthernet0/0/0
no ip address
negotiation auto

interface GigabitEthernet0/0/1
ip address 192.168.1.1 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:1::1/64
ipv6 ospf 1 area 1

interface Serial0/1/0
no ip address

interface Serial0/1/1
no ip address

interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
negotiation auto

interface Vlan1
no ip address

router ospf 1
network 1.1.1.1 0.0.0.0 area 1
network 192.168.1.0 0.0.0.255 area 1
```

```
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login

end
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
      3.0.0.0/32 is subnetted, 1 subnets
O IA     3.3.3.3 [110/5] via 192.168.1.2, 01:16:28,
GigabitEthernet0/0/1
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected,
GigabitEthernet0/0/1
L        192.168.1.1/32 is directly connected,
GigabitEthernet0/0/1
O IA  192.168.2.0/24 [110/2] via 192.168.1.2, 01:17:03,
GigabitEthernet0/0/1
O IA  192.168.3.0/24 [110/3] via 192.168.1.2, 01:16:28,
GigabitEthernet0/0/1
O IA  192.168.4.0/24 [110/4] via 192.168.1.2, 01:16:28,
GigabitEthernet0/0/1


C   2001:ABC:1::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:ABC:1::1/128 [0/0]
     via GigabitEthernet0/0/1, receive
OI  2001:ABC:2::/64 [110/2]
     via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1
OI  2001:ABC:3::/64 [110/3]
     via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1
OI  2001:ABC:4::/64 [110/4]
     via FE80::2F8:2CFF:FE7F:7191, GigabitEthernet0/0/1
L   FF00::/8 [0/0]
     via Null0, receive
```

R2:

```
Current configuration : 1483 bytes
```

```
! Last configuration change at 16:14:35 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no 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

ipv6 unicast-routing

subscriber templating
multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO211216BL

spanning-tree extend system-id

redundancy
mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0
ip address 192.168.2.1 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:2::1/64
ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1
ip address 192.168.1.2 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:1::2/64
ipv6 ospf 1 area 1

interface Serial0/1/0
no ip address

interface Serial0/1/1
```

```
no ip address

interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
negotiation auto

interface Vlan1
no ip address

router ospf 1
network 192.168.1.0 0.0.0.255 area 1
network 192.168.2.0 0.0.0.255 area 0

ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login

end
Gateway of last resort is not set

      1.0.0.0/32 is subnetted, 1 subnets
O        1.1.1.1 [110/2] via 192.168.1.1, 01:18:54,
GigabitEthernet0/0/1
      3.0.0.0/32 is subnetted, 1 subnets
O IA     3.3.3.3 [110/4] via 192.168.2.2, 01:18:09,
GigabitEthernet0/0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected,
GigabitEthernet0/0/1
L        192.168.1.2/32 is directly connected,
GigabitEthernet0/0/1
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected,
GigabitEthernet0/0/0
L        192.168.2.1/32 is directly connected,
GigabitEthernet0/0/0
O     192.168.3.0/24 [110/2] via 192.168.2.2, 01:18:09,
GigabitEthernet0/0/0
O IA  192.168.4.0/24 [110/3] via 192.168.2.2, 01:18:09,
```

```
GigabitEthernet0/0/0


C   2001:ABC:1::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:ABC:1::2/128 [0/0]
     via GigabitEthernet0/0/1, receive
C   2001:ABC:2::/64 [0/0]
     via GigabitEthernet0/0/0, directly connected
L   2001:ABC:2::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
O   2001:ABC:3::/64 [110/2]
     via FE80::1, GigabitEthernet0/0/0
OI  2001:ABC:4::/64 [110/3]
     via FE80::1, GigabitEthernet0/0/0
L   FF00::/8 [0/0]
     via Null0, receive
```

R3

```
Building configuration...


Current configuration : 1506 bytes

! Last configuration change at 14:48:25 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no 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

ipv6 unicast-routing

subscriber templating
multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO214420G7
```

```
spanning-tree extend system-id

redundancy
mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0
ip address 192.168.3.1 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:3::1/64
ipv6 ospf 1 area 0

interface GigabitEthernet0/0/1
ip address 192.168.2.2 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:2::2/64
ipv6 ospf 1 area 0

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto

interface Vlan1
no ip address
shutdown

router ospf 1
network 192.168.2.0 0.0.0.255 area 0
network 192.168.3.0 0.0.0.255 area 0

ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
```

```
login

end

R3(config-if)#do show run
Building configuration...


Current configuration : 1506 bytes

! Last configuration change at 14:48:25 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no 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

ipv6 unicast-routing

subscriber templating
multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO214420G7

spanning-tree extend system-id

redundancy
mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0
ip address 192.168.3.1 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:3::1/64
ipv6 ospf 1 area 0
interface GigabitEthernet0/0/1
```

```
ip address 192.168.2.2 255.255.255.0
negotiation auto
ipv6 address FE80::1 link-local
ipv6 address 2001:ABC:2::2/64
ipv6 ospf 1 area 0

interface Serial0/1/0

interface Serial0/1/1

interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
shutdown
negotiation auto

interface Vlan1
no ip address
shutdown

router ospf 1
network 192.168.2.0 0.0.0.255 area 0
network 192.168.3.0 0.0.0.255 area 0

ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1

control-plane

line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login

end

      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/3] via 192.168.2.1, 01:19:14,
GigabitEthernet0/0/1
      3.0.0.0/32 is subnetted, 1 subnets
O IA     3.3.3.3 [110/3] via 192.168.3.2, 01:19:25,
GigabitEthernet0/0/0
O IA  192.168.1.0/24 [110/2] via 192.168.2.1, 01:19:14,
GigabitEthernet0/0/1
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected,
```

```
GigabitEthernet0/0/1
L        192.168.2.2/32 is directly connected,
GigabitEthernet0/0/1
      192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected,
GigabitEthernet0/0/0
L        192.168.3.1/32 is directly connected,
GigabitEthernet0/0/0
O IA  192.168.4.0/24 [110/2] via 192.168.3.2, 01:19:25,
GigabitEthernet0/0/0


OI  2001:ABC:1::/64 [110/2]
     via FE80::2F8:2CFF:FE7F:7190, GigabitEthernet0/0/1
C   2001:ABC:2::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:ABC:2::2/128 [0/0]
     via GigabitEthernet0/0/1, receive
C   2001:ABC:3::/64 [0/0]
     via GigabitEthernet0/0/0, directly connected
L   2001:ABC:3::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
OI  2001:ABC:4::/64 [110/2]
     via FE80::B6A8:B9FF:FEA0:2E21, GigabitEthernet0/0/0
L   FF00::/8 [0/0]
     via Null0, receive
```

R4

```
Building configuration...


Current configuration : 1733 bytes

! Last configuration change at 16:03:00 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no 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
```

```
R4(config)#
R4(config)#do show run
Building configuration...

Current configuration : 1733 bytes

! Last configuration change at 16:03:00 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no 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

ipv6 unicast-routing

subscriber templating
multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21442B21

spanning-tree extend system-id

redundancy
mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0
ip address 192.168.4.1 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:4::1/64
ipv6 ospf 1 area 2

interface GigabitEthernet0/0/1
ip address 192.168.3.2 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:3::2/64
```

```
ipv6 ospf 1 area 0

interface Serial0/1/0
no ip address

interface Serial0/1/1
no ip address


R4(config)#do show ipv6 ospf int 0/0/1
                                 ^
% Invalid input detected at '^' marker.

R4(config)#do show ipv6 ospf int g0/0/1
GigabitEthernet0/0/1 is up, line protocol is up
  Link Local Address FE80::1, Interface ID 7
  Area 0, Process ID 1, Instance ID 0, Router ID 192.168.4.1
  Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DOWN, Priority 1
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40,
Retransmit 5
R4(config)#do show run
Building configuration...


Current configuration : 1733 bytes

! Last configuration change at 16:03:00 UTC Fri Sep 8 2023

version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no 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
ipv6 unicast-routing
```

```
subscriber templating
multilink bundle-name authenticated

license udi pid ISR4321/K9 sn FDO21442B21
spanning-tree extend system-id

redundancy
mode none

vlan internal allocation policy ascending

interface GigabitEthernet0/0/0
ip address 192.168.4.1 255.255.255.0
negotiation auto
ipv6 address FE80::1 link-local
ipv6 address 2001:ABC:4::1/64
ipv6 ospf 1 area 2

interface GigabitEthernet0/0/1
ip address 192.168.3.2 255.255.255.0
negotiation auto
ipv6 address FE80::1 link-local
ipv6 address 2001:ABC:3::2/64
ipv6 ospf 1 area 0

interface Serial0/1/0
no ip address

interface Serial0/1/1
no ip address

interface GigabitEthernet0/2/0
no ip address
negotiation auto

interface GigabitEthernet0/2/1
no ip address
negotiation auto

interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
negotiation auto

interface Vlan1
no ip address

router ospf 1
network 192.168.3.0 0.0.0.255 area 0
network 192.168.4.0 0.0.0.255 area 2
```

```
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0

ipv6 router ospf 1
default-information originate
redistribute static

control-plane

line con 0
stopbits 1
line aux 0
stopbits 1
line vty 0 4
login

end
      1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/4] via 192.168.3.1, 01:20:08,
GigabitEthernet0/0/1
      3.0.0.0/32 is subnetted, 1 subnets
O        3.3.3.3 [110/2] via 192.168.4.2, 01:21:14,
GigabitEthernet0/0/0
O IA  192.168.1.0/24 [110/3] via 192.168.3.1, 01:20:08,
GigabitEthernet0/0/1
O     192.168.2.0/24 [110/2] via 192.168.3.1, 01:20:18,
GigabitEthernet0/0/1
      192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected,
GigabitEthernet0/0/1
L        192.168.3.2/32 is directly connected,
GigabitEthernet0/0/1
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected,
GigabitEthernet0/0/0
L        192.168.4.1/32 is directly connected,
GigabitEthernet0/0/0



OI  2001:ABC:1::/64 [110/3]
     via FE80::B6A8:B9FF:FE01:B750, GigabitEthernet0/0/1
O   2001:ABC:2::/64 [110/2]
     via FE80::B6A8:B9FF:FE01:B750, GigabitEthernet0/0/1
C   2001:ABC:3::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:ABC:3::2/128 [0/0]
     via GigabitEthernet0/0/1, receive
C   2001:ABC:4::/64 [0/0]
```

```
     via GigabitEthernet0/0/0, directly connected
L   2001:ABC:4::1/128 [0/0]
     via GigabitEthernet0/0/0, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

R5

```
Current configuration : 1567 bytes

! Last configuration change at 16:05:44 UTC Fri Sep 8 2023

version 16.9
service timestamps debug datetime msec
service timestamps log datetime msec
platform qfp utilization monitor load 80
platform punt-keepalive disable-kernel-core

hostname 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 FLM24060912
no license smart enable
diagnostic bootup level minimal

spanning-tree extend system-id

redundancy
mode none

interface Loopback0
ip address 3.3.3.3 255.255.255.255

interface GigabitEthernet0/0/0
no ip address
negotiation auto
```

```
interface GigabitEthernet0/0/1
ip address 192.168.4.2 255.255.255.0
negotiation auto
ipv6 address 2001:ABC:4::2/64
ipv6 ospf 1 area 2

interface GigabitEthernet0/2/0
no ip address
negotiation auto

interface GigabitEthernet0/2/1
no ip address
negotiation auto

interface GigabitEthernet0
vrf forwarding Mgmt-intf
no ip address
negotiation auto

router ospf 1
network 3.3.3.3 0.0.0.0 area 2
network 192.168.4.0 0.0.0.255 area 2

ip forward-protocol nd
no ip http server
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
1.0.0.0/32 is subnetted, 1 subnets
O IA     1.1.1.1 [110/5] via 192.168.4.1, 01:21:10,
GigabitEthernet0/0/1
      3.0.0.0/32 is subnetted, 1 subnets
C        3.3.3.3 is directly connected, Loopback0
O IA  192.168.1.0/24 [110/4] via 192.168.4.1, 01:21:10,
GigabitEthernet0/0/1
O IA  192.168.2.0/24 [110/3] via 192.168.4.1, 01:21:31,
GigabitEthernet0/0/1
O IA  192.168.3.0/24 [110/2] via 192.168.4.1, 01:22:06,
```

```
GigabitEthernet0/0/1
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected,
GigabitEthernet0/0/1


OI  2001:ABC:1::/64 [110/4]
     via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/1
OI  2001:ABC:2::/64 [110/3]
     via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/1
OI  2001:ABC:3::/64 [110/2]
     via FE80::B6A8:B9FF:FEA0:2E20, GigabitEthernet0/0/1
C   2001:ABC:4::/64 [0/0]
     via GigabitEthernet0/0/1, directly connected
L   2001:ABC:4::2/128 [0/0]
     via GigabitEthernet0/0/1, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Problems

The first problem we ran into was areas not talking to each other in IPv4. That was because we didn't understand area 0 was the backbone, so we made the current area 1 as area 0 instead of the area in the center between router 2 and router 4. This issue was an easy fix however once we understood what the backbone area was.

The major issue we faced was router 5 not having routes to anything other than router 4. This was due to an ipv6 OSPF neighbor adjacency issues between router 3 and 4 caused by the use of link local addresses. Link local addresses are not necessary for this setup, instead it will cause issues.

Conclusions

This lab was a multiarea OSPF lab with 5 routers and 3 areas routed using OSPF. We faced issues in both IPv4 and IPv6 due to our lack of understanding of multiarea. Though with the use of resources on the interwebs we were able to fix these issues we faced and learn more about multiarea OSPF.