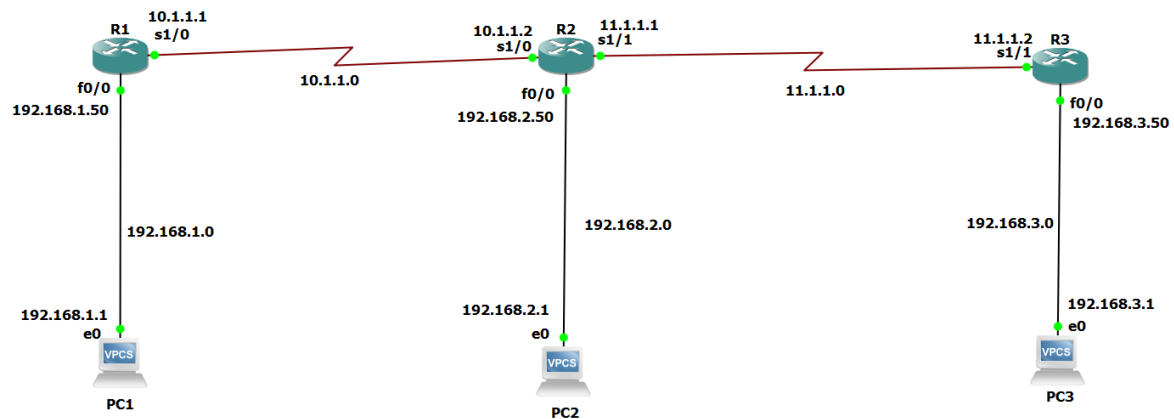


Practical 8

AIM: OSPF Implementation

1. Implement Single-Area OSPFv2

Step 1: To create a network take 3 routers and 3 PC's



Step 2: Configure PC:

PC1:

```

PC1> ip 192.168.1.1 255.255.255.0 gateway 192.168.1.50
Checking for duplicate address...
PC1 : 192.168.1.1 255.255.255.0 gateway 192.168.1.50

PC1> sh ip

NAME       : PC1[1]
IP/MASK    : 192.168.1.1/24
GATEWAY    : 192.168.1.50
DNS        :
MAC        : 00:50:79:66:68:00
LPORT      : 10024
RHOST:PORT : 127.0.0.1:10025
MTU        : 1500
  
```

PC2:

```

PC2> ip 192.168.2.1 255.255.255.0 gateway 192.168.2.50
Checking for duplicate address...
PC1 : 192.168.2.1 255.255.255.0 gateway 192.168.2.50

PC2> sh ip

NAME       : PC2[1]
IP/MASK    : 192.168.2.1/24
GATEWAY    : 192.168.2.50
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 10028
RHOST:PORT : 127.0.0.1:10029
MTU        : 1500
  
```

PC3:

```

PC3> ip 192.168.3.1 255.255.255.0 gateway 192.168.3.50
Checking for duplicate address...
PC1 : 192.168.3.1 255.255.255.0 gateway 192.168.3.50

PC3> sh ip

NAME       : PC3[1]
IP/MASK     : 192.168.3.1/24
GATEWAY     : 192.168.3.50
DNS         :
MAC         : 00:50:79:66:68:02
LPORT      : 10026
RHOST:PORT  : 127.0.0.1:10027
MTU         : 1500

```

Step 3: Configure IP Address in Router:**R1:**

```

R1#en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#int f0/0
R1(config-if)#ip add 192.168.1.50 255.255.255.0
R1(config-if)#no shut
R1(config-if)#ex
R1(config)#
*Mar 1 00:17:50.155: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:17:51.155: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config)#int s1/0
R1(config-if)#ip add 10.1.1.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#ex

```

R2:

```

R2#en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#int f0/0
R2(config-if)#ip add 192.168.2.50 255.255.255.0
R2(config-if)#no shut
R2(config-if)#ex
R2(config)#int
*Mar 1 00:19:43.007: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:19:44.007: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R2(config)#int s1/0
R2(config-if)#ip add 10.1.1.2
% Incomplete command.

R2(config-if)#ip add 10.1.1.2 255.255.255.0
R2(config-if)#no shut
R2(config-if)#ex
R2(config)#
*Mar 1 00:20:22.599: %LINK-3-UPDOWN: Interface Serial1/0, changed state to up
*Mar 1 00:20:23.599: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0, changed state to up
R2(config)#int s1/1
R2(config-if)#ip add 11.1.1.1 255.255.255.0
R2(config-if)#no shut
R2(config-if)#ex
R2(config)#do wr
*Mar 1 00:20:55.243: %LINK-3-UPDOWN: Interface Serial1/1, changed state to up
*Mar 1 00:20:56.243: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/1, changed state to up
R2(config)#do wr
Building configuration...
[OK]
R2(config)#
*Mar 1 00:21:22.519: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/1, changed state to down
R2(config)#
*Mar 1 00:22:22.519: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/1, changed state to up

```

R3:

```

R3#en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#int f0/0
R3(config-if)#ip add 192.168.3.50 255.255.255.0
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#int
*Mar 1 00:21:43.415: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:21:44.415: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R3(config)#int s1/1
R3(config-if)#ip add 11.1.1.2 255.255.255.0
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#do wr
Building configuration...
[OK]
R3(config)#
*Mar 1 00:22:04.587: %LINK-3-UPDOWN: Interface Serial1/1, changed state to up
*Mar 1 00:22:05.655: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/1, changed state to up

```

Step 4: Check whether the IP Address assigned is correct or not by using ‘do sh ip int br’

R1:

```

R1(config)#do sh ip int br

```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.1.50	YES	manual	up	up
Serial0/0	unassigned	YES	unset	administratively down	down
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	unassigned	YES	unset	administratively down	down
Serial0/2	unassigned	YES	unset	administratively down	down
Serial0/3	unassigned	YES	unset	administratively down	down
Serial0/4	unassigned	YES	unset	administratively down	down
Serial0/5	unassigned	YES	unset	administratively down	down
Serial1/0	10.1.1.1	YES	manual	up	up
Serial1/1	unassigned	YES	unset	administratively down	down
Serial1/2	unassigned	YES	unset	administratively down	down
Serial1/3	unassigned	YES	unset	administratively down	down
Serial2/0	unassigned	YES	unset	administratively down	down
Serial2/1	unassigned	YES	unset	administratively down	down
Serial2/2	unassigned	YES	unset	administratively down	down
Serial2/3	unassigned	YES	unset	administratively down	down

```

R1(config)#

```

R2:

```

R2(config)#do sh ip int br

```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.2.50	YES	manual	up	up
Serial0/0	unassigned	YES	unset	administratively down	down
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	unassigned	YES	unset	administratively down	down
Serial0/2	unassigned	YES	unset	administratively down	down
Serial0/3	unassigned	YES	unset	administratively down	down
Serial0/4	unassigned	YES	unset	administratively down	down
Serial0/5	unassigned	YES	unset	administratively down	down
Serial1/0	10.1.1.2	YES	manual	up	up
Serial1/1	11.1.1.1	YES	manual	up	up
Serial1/2	unassigned	YES	unset	administratively down	down
Serial1/3	unassigned	YES	unset	administratively down	down
Serial2/0	unassigned	YES	unset	administratively down	down
Serial2/1	unassigned	YES	unset	administratively down	down
Serial2/2	unassigned	YES	unset	administratively down	down
Serial2/3	unassigned	YES	unset	administratively down	down

```

R2(config)#do wr
Building configuration...
[OK]

```


R3:

```

R3(config)#do sh ip int br
Interface                IP-Address      OK? Method Status        Protocol
FastEthernet0/0          192.168.3.50    YES manual up            up
Serial0/0                 unassigned      YES unset  administratively down down
FastEthernet0/1          unassigned      YES unset  administratively down down
Serial0/1                 unassigned      YES unset  administratively down down
Serial0/2                 unassigned      YES unset  administratively down down
Serial0/3                 unassigned      YES unset  administratively down down
Serial0/4                 unassigned      YES unset  administratively down down
Serial0/5                 unassigned      YES unset  administratively down down
Serial1/0                 unassigned      YES unset  administratively down down
Serial1/1                 11.1.1.2        YES manual up            up
Serial1/2                 unassigned      YES unset  administratively down down
Serial1/3                 unassigned      YES unset  administratively down down
Serial2/0                 unassigned      YES unset  administratively down down
Serial2/1                 unassigned      YES unset  administratively down down
Serial2/2                 unassigned      YES unset  administratively down down
Serial2/3                 unassigned      YES unset  administratively down down
R3(config)#do wr
Building configuration...
[OK]

```

Step 5: Check whether direct connection ping is working in all the routers and PCs:

PC1:

```

PC1> ping 192.168.1.50
84 bytes from 192.168.1.50 icmp_seq=1 ttl=255 time=20.196 ms
84 bytes from 192.168.1.50 icmp_seq=2 ttl=255 time=8.162 ms
84 bytes from 192.168.1.50 icmp_seq=3 ttl=255 time=9.827 ms
84 bytes from 192.168.1.50 icmp_seq=4 ttl=255 time=12.356 ms
84 bytes from 192.168.1.50 icmp_seq=5 ttl=255 time=11.325 ms

```

PC2:

```

PC2> ping 192.168.2.50
84 bytes from 192.168.2.50 icmp_seq=1 ttl=255 time=9.116 ms
84 bytes from 192.168.2.50 icmp_seq=2 ttl=255 time=10.361 ms
84 bytes from 192.168.2.50 icmp_seq=3 ttl=255 time=4.947 ms
84 bytes from 192.168.2.50 icmp_seq=4 ttl=255 time=9.592 ms
84 bytes from 192.168.2.50 icmp_seq=5 ttl=255 time=6.315 ms

```

PC3:

```

PC3> ping 192.168.3.50
84 bytes from 192.168.3.50 icmp_seq=1 ttl=255 time=9.662 ms
84 bytes from 192.168.3.50 icmp_seq=2 ttl=255 time=10.858 ms
84 bytes from 192.168.3.50 icmp_seq=3 ttl=255 time=5.080 ms
84 bytes from 192.168.3.50 icmp_seq=4 ttl=255 time=14.192 ms
84 bytes from 192.168.3.50 icmp_seq=5 ttl=255 time=7.879 ms

```

R1:

```

R1(config)#do ping 10.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/23/32 ms

```

R2:

```
[OK]
R2(config)#do ping 10.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/21/24 ms
R2(config)#do ping 11.1.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 11.1.1.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/21/24 ms
R2(config)#exit
```

R3:

```
R3(config)#do ping 11.1.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 11.1.1.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/44 ms
R3(config)#exit
```

Direct Connection ping is working successfully. But indirect won't work because we haven't done any protocol.

So, we will do OSPF in single area.

Step 6: Configure OSPF protocol in all the routers.

R1:

```
R1(config)#no router ospf 1
R1(config)#router ospf 1
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#network 10.1.1.0 0.0.0.255 area 0
R1(config-router)#x
*Mar 1 00:50:44.003: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.50 on Serial1/0 from LOADING to FULL, Loading Done
R1(config-router)#ex
R1(config)#do wr
Building configuration...
[OK]
```

R2:

```
[OK]
R2#en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#router ospf 1
R2(config-router)#network 192.168.2.0 0.0.0.255 area 0
R2(config-router)#network 10.1.1.0 0.0.0.255 area 0
R2(config-router)#network 11.1.1.0 0.0.0.255 area 0
R2(config-router)#ex
R2(config)#do wr
Building configuration...
[OK]
R2(config)#
```

R3:

```

R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#router ospf 1
R3(config-router)#network 192.168.3.0 0.0.0.255 area 0
R3(config-router)#network 11.1.1.0 0.0.0.255 area 0
R3(config-router)#
*Mar 1 00:49:32.483: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.50 on Serial1/1 from LOADING to FULL, Loading Done
R3(config-router)#ex
R3(config)#do wr
Building configuration...
[OK]
R3(config)#

```

Step 7: Once OSPF is done enter command ‘sh ip route’ in all router to check whether OSPF is done properly.

R1:

```

R1#sh ip route
Codes: 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

Gateway of last resort is not set

    10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Serial1/0
    11.0.0.0/24 is subnetted, 1 subnets
O       11.1.1.0 [110/128] via 10.1.1.2, 00:35:34, Serial1/0
C       192.168.1.0/24 is directly connected, FastEthernet0/0
O       192.168.2.0/24 [110/74] via 10.1.1.2, 00:35:34, Serial1/0
O       192.168.3.0/24 [110/138] via 10.1.1.2, 00:35:34, Serial1/0
R1#

```

R2:

```

changed state to up
R2#sh ip route
Codes: 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

Gateway of last resort is not set

    10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Serial1/0
    11.0.0.0/24 is subnetted, 1 subnets
C       11.1.1.0 is directly connected, Serial1/1
O       192.168.1.0/24 [110/74] via 10.1.1.1, 00:36:18, Serial1/0
C       192.168.2.0/24 is directly connected, FastEthernet0/0
O       192.168.3.0/24 [110/74] via 11.1.1.2, 00:36:18, Serial1/1
R2#

```

R3:

```

R3#sh ip route
Codes: 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

Gateway of last resort is not set

    10.0.0.0/24 is subnetted, 1 subnets
O       10.1.1.0 [110/128] via 11.1.1.1, 00:37:43, Serial1/1
    11.0.0.0/24 is subnetted, 1 subnets
C       11.1.1.0 is directly connected, Serial1/1
O       192.168.1.0/24 [110/138] via 11.1.1.1, 00:37:43, Serial1/1
O       192.168.2.0/24 [110/74] via 11.1.1.1, 00:37:43, Serial1/1
C       192.168.3.0/24 is directly connected, FastEthernet0/0
R3#

```

Step 8: Enter command ‘sh ip protocols’ to check which all protocols are applied in our network:

R1:

```

R1#sh ip protocols
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.1.50
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.1.1.0 0.0.0.255 area 0
    192.168.1.0 0.0.0.255 area 0
  Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.50          110          00:40:05
    192.168.3.50          110          00:40:05
  Distance: (default is 110)

```

R2:

```

R2#sh ip protocols
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.2.50
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.1.1.0 0.0.0.255 area 0
    11.1.1.0 0.0.0.255 area 0
    192.168.2.0 0.0.0.255 area 0
  Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.3.50          110          00:40:48
    192.168.1.50          110          00:40:48
  Distance: (default is 110)

```

R3:

```
C 192.168.3.0/24 is directly connected, FastEthernet0/0
R3#sh ip protocols
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.3.50
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    11.1.1.0 0.0.0.255 area 0
    192.168.3.0 0.0.0.255 area 0
  Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.50      110          00:41:43
    192.168.1.50      110          00:41:43
  Distance: (default is 110)

R3#
```

Step 9: Enter command 'sh ip ospf neighbor' to check OSPF Neighbor:

R1:

```
R1#sh ip ospf neighbor

Neighbor ID    Pri   State           Dead Time   Address      Interface
192.168.2.50    0     FULL/ -         00:00:30    10.1.1.2     Serial1/0
R1#
```

R2:

```
R2#sh ip ospf neighbor

Neighbor ID    Pri   State           Dead Time   Address      Interface
192.168.3.50    0     FULL/ -         00:00:33    11.1.1.2     Serial1/1
192.168.1.50    0     FULL/ -         00:00:33    10.1.1.1     Serial1/0
R2#
```

R3:

```
R3#sh ip ospf neighbor

Neighbor ID    Pri   State           Dead Time   Address      Interface
192.168.2.50    0     FULL/ -         00:00:37    11.1.1.1     Serial1/1
R3#
```


Step 10: Now you can ping any indirect connection because we have done OSPF on the router

PC1:

```
PC1> ping 192.168.2.1
84 bytes from 192.168.2.1 icmp_seq=1 ttl=62 time=76.150 ms
84 bytes from 192.168.2.1 icmp_seq=2 ttl=62 time=93.310 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=62 time=59.691 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=62 time=61.681 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=62 time=76.101 ms

PC1> ping 192.168.3.1
84 bytes from 192.168.3.1 icmp_seq=1 ttl=61 time=93.073 ms
84 bytes from 192.168.3.1 icmp_seq=2 ttl=61 time=138.210 ms
84 bytes from 192.168.3.1 icmp_seq=3 ttl=61 time=138.599 ms
84 bytes from 192.168.3.1 icmp_seq=4 ttl=61 time=123.391 ms
84 bytes from 192.168.3.1 icmp_seq=5 ttl=61 time=122.068 ms

PC1> █
```

PC2:

```
PC2> ping 192.168.1.1
84 bytes from 192.168.1.1 icmp_seq=1 ttl=62 time=75.501 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=62 time=60.606 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=62 time=77.407 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=62 time=60.903 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=62 time=92.025 ms

PC2> ping 192.168.3.1
84 bytes from 192.168.3.1 icmp_seq=1 ttl=62 time=60.012 ms
84 bytes from 192.168.3.1 icmp_seq=2 ttl=62 time=60.472 ms
84 bytes from 192.168.3.1 icmp_seq=3 ttl=62 time=59.969 ms
84 bytes from 192.168.3.1 icmp_seq=4 ttl=62 time=61.992 ms
84 bytes from 192.168.3.1 icmp_seq=5 ttl=62 time=60.688 ms

PC2> █
```

PC3:

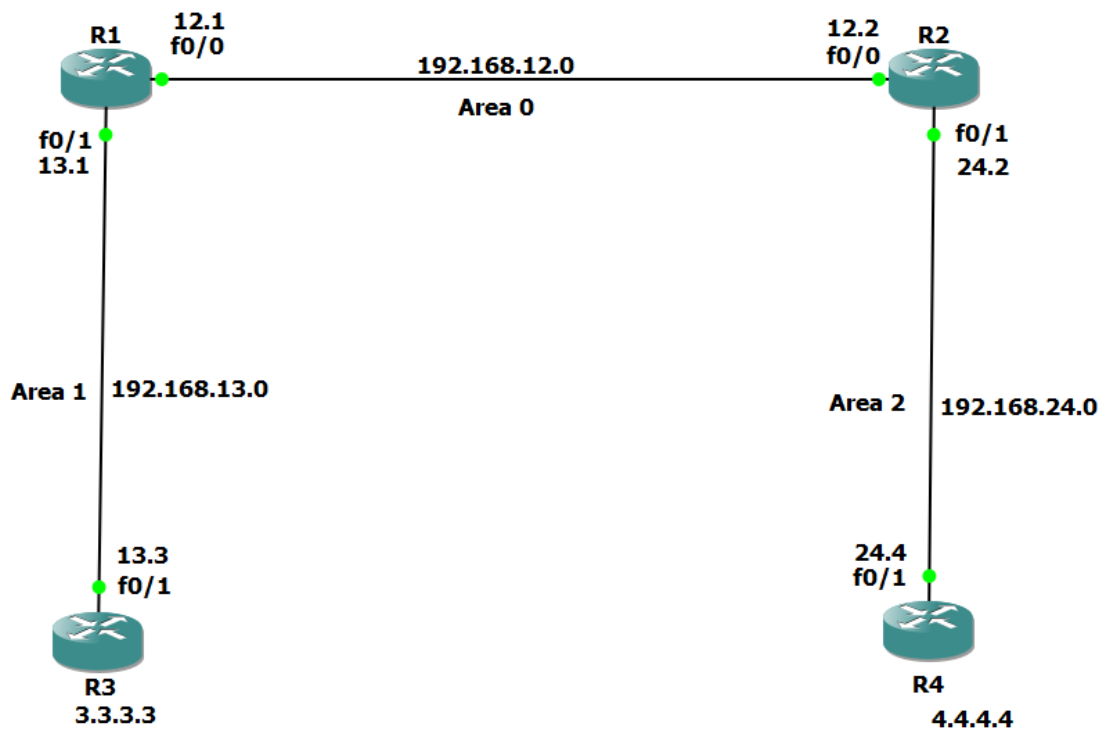
```
PC3> ping 192.168.1.1
84 bytes from 192.168.1.1 icmp_seq=1 ttl=61 time=92.556 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=61 time=91.819 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=61 time=99.931 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=61 time=108.801 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=61 time=92.443 ms

PC3> ping 192.168.2.1
84 bytes from 192.168.2.1 icmp_seq=1 ttl=62 time=77.452 ms
84 bytes from 192.168.2.1 icmp_seq=2 ttl=62 time=93.842 ms
84 bytes from 192.168.2.1 icmp_seq=3 ttl=62 time=78.707 ms
84 bytes from 192.168.2.1 icmp_seq=4 ttl=62 time=62.592 ms
84 bytes from 192.168.2.1 icmp_seq=5 ttl=62 time=74.394 ms

PC3> █
```

2. Implement Multi-Area OSPFv2

Step 1: Take 4 router and make a network as below.



Step 2: Configure all the network as below:

R1:

```

% Unknown command or computer name, or unable to find computer address
R1#en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#int f0/0
R1(config-if)#ip add 192.168.12.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#ex
R1(config)#
*Mar 1 00:05:12.091: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:05:13.091: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R1(config)#int f0/1
R1(config-if)#ip add 192.168.13.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#ex
R1(config)#
*Mar 1 00:05:48.379: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:05:49.379: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R1(config)#do wr
Building configuration...
[OK]
R1(config)#sh ip route

```

R2:

```

: ● R1 ● R2 × ● R3
changed state to down
R2#en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#int f0/0
R2(config-if)#ip add 192.168.12.2 255.255.255.0
R2(config-if)#no shut
R2(config-if)#ex
R2(config)#
*Mar 1 00:07:22.367: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar 1 00:07:23.367: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R2(config)#int f0/1
R2(config-if)#ip add 192.168.24.2 255.255.255.0
R2(config-if)#no shut
R2(config-if)#ex
R2(config)#
*Mar 1 00:07:58.427: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:07:59.427: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R2(config)#do wr
Building configuration...
[OK]
R2(config)#do sh ip route

```

R3:

```

: ● R1 ● R2 ● R3 ×
e to down
R3#en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#int f0/1
R3(config-if)#ip add 192.168.13.3 255.255.255.0
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#
*Mar 1 00:08:54.439: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:08:55.439: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
R3(config)#int loopback0
R3(config-if)#
*Mar 1 00:10:27.131: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R3(config-if)#ip add 3.3.3.3 255.255.255.255
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#do wr
Building configuration...
[OK]
R3(config)#do sh ip route

```

R4:

```

: ● R1 ● R2 ● R3 ● R4
o down
R4#en
R4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R4(config)#int f0/1
R4(config-if)#ip add 192.168.24.4 255.255.255.0
R4(config-if)#no shut
R4(config-if)#ex
R4(config)#do wr
Building configuration...

*Mar 1 00:11:58.387: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:11:59.387: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up[OK]
R4(config)#int loopback0
R4(config-if)#ip
*Mar 1 00:12:13.655: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R4(config-if)#ip add 4.4.4.4 255.255.255.255
R4(config-if)#no shut
R4(config-if)#ex
R4(config)#do wr
Building configuration...
[OK]
R4(config)#do sh ip route

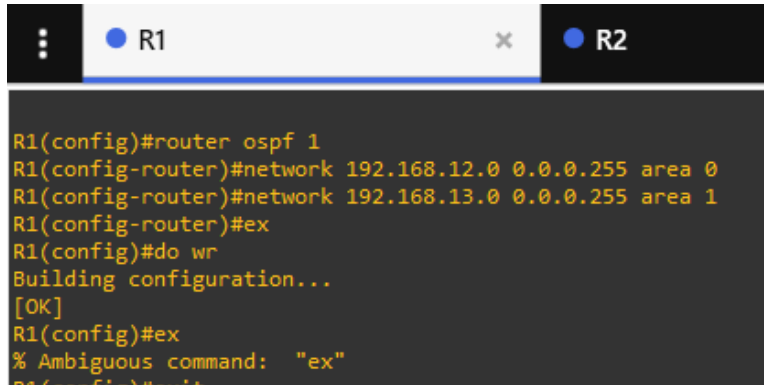
```

Step 3: Now try to ping any router. It won't work because there is no Protocol applied.

So now we will apply Multi – Area OSPFv2(Area 0, 1, 2).

Configure the system for Multi – Area OSPFv2 as below:

R1:

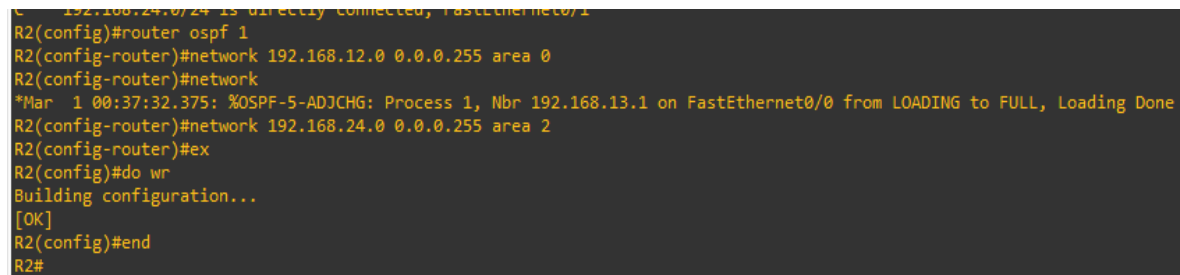


```

R1
R1(config)#router ospf 1
R1(config-router)#network 192.168.12.0 0.0.0.255 area 0
R1(config-router)#network 192.168.13.0 0.0.0.255 area 1
R1(config-router)#ex
R1(config)#do wr
Building configuration...
[OK]
R1(config)#ex
% Ambiguous command: "ex"
R1(config)#exit
R1#

```

R2:

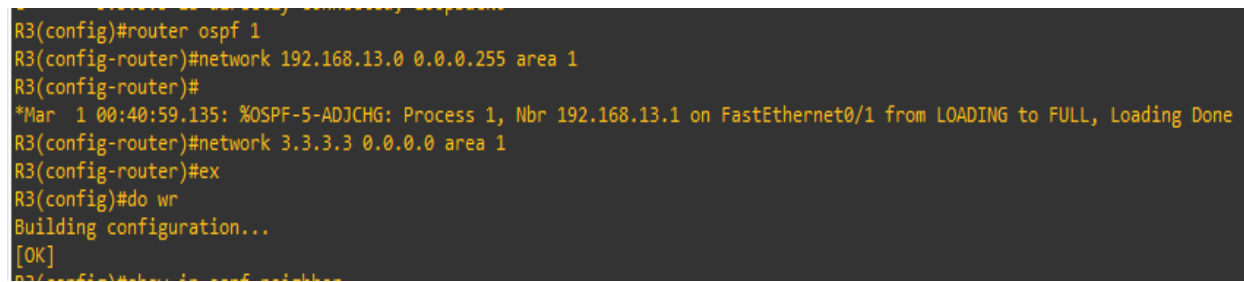


```

R2
R2(config)#router ospf 1
R2(config-router)#network 192.168.12.0 0.0.0.255 area 0
R2(config-router)#network
*Mar 1 00:37:32.375: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.13.1 on FastEthernet0/0 from LOADING to FULL, Loading Done
R2(config-router)#network 192.168.24.0 0.0.0.255 area 2
R2(config-router)#ex
R2(config)#do wr
Building configuration...
[OK]
R2(config)#end
R2#

```

R3:

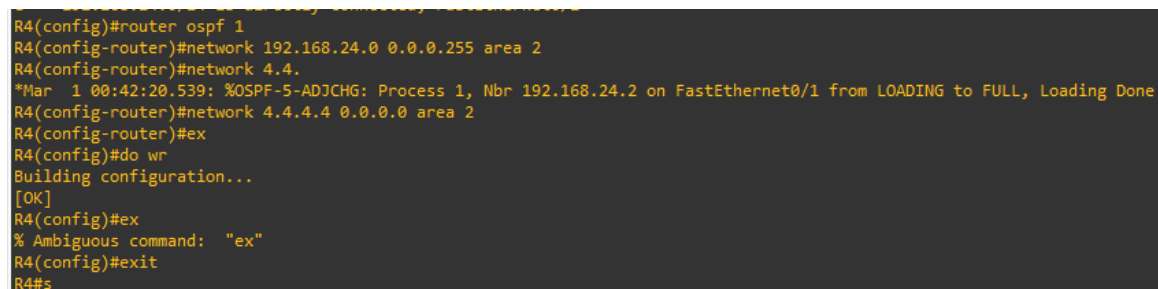


```

R3
R3(config)#router ospf 1
R3(config-router)#network 192.168.13.0 0.0.0.255 area 1
R3(config-router)#
*Mar 1 00:40:59.135: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.13.1 on FastEthernet0/1 from LOADING to FULL, Loading Done
R3(config-router)#network 3.3.3.3 0.0.0.0 area 1
R3(config-router)#ex
R3(config)#do wr
Building configuration...
[OK]
R3(config)#exit
R3#

```

R4:



```

R4
R4(config)#router ospf 1
R4(config-router)#network 192.168.24.0 0.0.0.255 area 2
R4(config-router)#network 4.4.
*Mar 1 00:42:20.539: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.24.2 on FastEthernet0/1 from LOADING to FULL, Loading Done
R4(config-router)#network 4.4.4.4 0.0.0.0 area 2
R4(config-router)#ex
R4(config)#do wr
Building configuration...
[OK]
R4(config)#ex
% Ambiguous command: "ex"
R4(config)#exit
R4#

```


Step 4: Enter the command ‘show ip route ospf’ to check whether OSPF is successfully configured.

R1:

```
R1#show ip route ospf
      3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/11] via 192.168.13.3, 00:52:34, FastEthernet0/1
      4.0.0.0/32 is subnetted, 1 subnets
O IA    4.4.4.4 [110/21] via 192.168.12.2, 00:51:12, FastEthernet0/0
O IA 192.168.24.0/24 [110/20] via 192.168.12.2, 00:52:34, FastEthernet0/0
R1#
```

R2:

```
R2#show ip route ospf
O IA 192.168.13.0/24 [110/20] via 192.168.12.1, 00:55:13, FastEthernet0/0
      3.0.0.0/32 is subnetted, 1 subnets
O IA    3.3.3.3 [110/21] via 192.168.12.1, 00:55:13, FastEthernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O       4.4.4.4 [110/11] via 192.168.24.4, 00:55:13, FastEthernet0/1
R2#
```

R3:

```
R3#show ip route ospf
O IA 192.168.12.0/24 [110/20] via 192.168.13.1, 00:57:06, FastEthernet0/1
      4.0.0.0/32 is subnetted, 1 subnets
O IA    4.4.4.4 [110/31] via 192.168.13.1, 00:55:47, FastEthernet0/1
O IA 192.168.24.0/24 [110/30] via 192.168.13.1, 00:57:06, FastEthernet0/1
R3#
```

R4:

```
R4#show ip route ospf
O IA 192.168.12.0/24 [110/20] via 192.168.24.2, 00:56:01, FastEthernet0/1
O IA 192.168.13.0/24 [110/30] via 192.168.24.2, 00:56:01, FastEthernet0/1
      3.0.0.0/32 is subnetted, 1 subnets
O IA    3.3.3.3 [110/31] via 192.168.24.2, 00:56:01, FastEthernet0/1
R4#
```

Step 5: To check the neighbor enter ‘show ip ospf neighbor’ and check the neighbor:

R1:

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.24.2	1	FULL/BDR	00:00:38	192.168.12.2	FastEthernet0/0
3.3.3.3	1	FULL/BDR	00:00:36	192.168.13.3	FastEthernet0/1

```
R1#
```

R2:

```

R2#show ip ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.13.1	1	FULL/DR	00:00:39	192.168.12.1	FastEthernet0/0
4.4.4.4	1	FULL/BDR	00:00:32	192.168.24.4	FastEthernet0/1

```

R2#

```

R3:

```

R3#show ip ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.13.1	1	FULL/DR	00:00:32	192.168.13.1	FastEthernet0/1

```

R3#

```

R4:

```

R4#show ip ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.24.2	1	FULL/DR	00:00:33	192.168.24.2	FastEthernet0/1

```

R4#

```

As now we have successfully configured and checked that OSPF multi-Area is there in our network. Try pinging any router or loopback from any router.

Step 6:**R1:**

```

Success rate is 100 percent (5/5), round-trip min/avg/max = 20/32/40 ms
R1#ping 192.168.13.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.13.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/36/48 ms
R1#ping 192.168.24.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.24.4, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms
R1#ping 3.3.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/36 ms
R1#ping 4.4.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/61/64 ms
R1#ping 4.4.4.4
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/61/72 ms

```

R2:

```
0 4.4.4.4 [110/11] via 192.168.24.4, 00:01:41, FastEthernet0/1
R2#ping 192.168.13.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.13.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/62/68 ms
R2#ping 3.3.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/61/68 ms
R2#ping 4.4.4.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
R2#show ip ospf neighbor
```

R3:

```
0 1A 192.168.24.0/24 [110/30] via 192.168.13.1, 00:03:49, FastEthernet0/1
R3#ping 192.168.12.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.12.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/60/64 ms
R3#ping 192.168.24.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.24.4, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 88/96/112 ms
R3#ping 3.3.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
R3#ping 4.4.4.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 4.4.4.4, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 88/92/96 ms
R3#show ip ospf neighbor
```

R4:

```
0 1A 3.3.3.3 [110/31] via 192.168.24.2, 00:02:56, FastEthernet0/1
R4#ping 192.168.13.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.13.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/63/68 ms
R4#ping 192.168.12.1

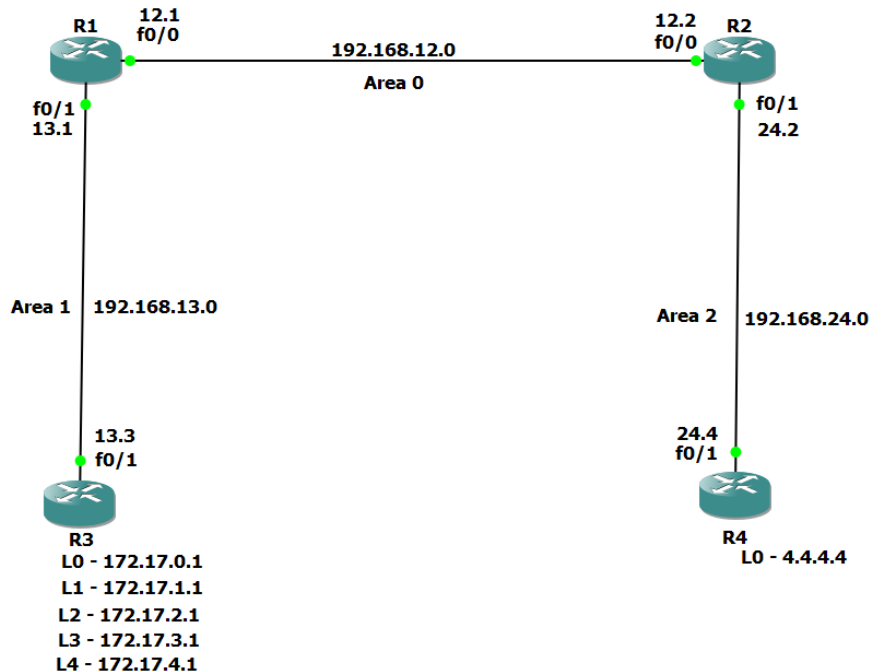
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.12.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/65/76 ms
R4#ping 192.168.13.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.13.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 92/92/96 ms
R4#ping 3.3.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 88/92/96 ms
R4#show ip ospf neighbor
```

3. OSPFv2 Route Summarization and Filtering

Step 1: Follow the same Topology as the Multi – Area OSPFv2.



Step 2: Add more loopbacks to Router 3 and configure the OSPF accordingly.

```

R1 R2 R3 R4
up
R3#en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#int loopback0
R3(config-if)#ip add 172.17.0.1 255.255.255.255
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#int loopback1
R3(config-if)#ex
*Mar 1 00:08:17.319: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1, changed state to up
R3(config-if)#ip add 172.17.1.1 255.255.255.255
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#int loopback2
R3(config-if)#
*Mar 1 00:09:07.083: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback2, changed state to up
R3(config-if)#ip add 172.17.2.1 255.255.255.255
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#int loopback3
R3(config-if)#ip add 172.17.2.1 255.255.255.255
*Mar 1 00:09:32.439: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback3, changed state to up
R3(config-if)#ip add 172.17.3.1 255.255.255.255
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#int loopback4
R3(config-if)#ip add 172.17.3.1 255.255.255.255
*Mar 1 00:09:55.295: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback4, changed state to up
R3(config-if)#ip add 172.17.4.1 255.255.255.255
R3(config-if)#no shut
R3(config-if)#ex
R3(config)#exit

```


Step 3: Enter 'show ip route' on R2 and you will see all the loopback of R3. Because till now we haven't performed any summarization on R1.

```

R2#show ip route
Codes: 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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, FastEthernet0/0
O IA 192.168.13.0/24 [110/20] via 192.168.12.1, 00:13:28, FastEthernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O     4.4.4.4 [110/11] via 192.168.24.4, 00:13:28, FastEthernet0/1
C    192.168.24.0/24 is directly connected, FastEthernet0/1
      172.17.0.0/32 is subnetted, 5 subnets
O IA   172.17.4.1 [110/21] via 192.168.12.1, 00:02:26, FastEthernet0/0
O IA   172.17.0.1 [110/21] via 192.168.12.1, 00:02:46, FastEthernet0/0
O IA   172.17.1.1 [110/21] via 192.168.12.1, 00:02:38, FastEthernet0/0
O IA   172.17.2.1 [110/21] via 192.168.12.1, 00:02:38, FastEthernet0/0
O IA   172.17.3.1 [110/21] via 192.168.12.1, 00:02:28, FastEthernet0/0
R2#router ospf 1

```

Step 4: So now we will perform summarization on R1

```

R1(config)#router ospf 1
R1(config-router)#area 1 range 172.17.0.0 255.255.252.0
R1(config-router)#end
R1#
*Mar  1 00:16:09.683: %SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
Codes: 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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, FastEthernet0/0
C    192.168.13.0/24 is directly connected, FastEthernet0/1
      4.0.0.0/32 is subnetted, 1 subnets
O IA   4.4.4.4 [110/21] via 192.168.12.2, 00:00:09, FastEthernet0/0
O IA 192.168.24.0/24 [110/20] via 192.168.12.2, 00:00:09, FastEthernet0/0
      172.17.0.0/16 is variably subnetted, 6 subnets, 2 masks
O     172.17.4.1/32 [110/11] via 192.168.13.3, 00:00:09, FastEthernet0/1
O     172.17.0.1/32 [110/11] via 192.168.13.3, 00:00:09, FastEthernet0/1
O     172.17.1.1/32 [110/11] via 192.168.13.3, 00:00:11, FastEthernet0/1
O     172.17.0.0/22 is a summary, 00:00:11, Null0
O     172.17.2.1/32 [110/11] via 192.168.13.3, 00:00:11, FastEthernet0/1
O     172.17.3.1/32 [110/11] via 192.168.13.3, 00:00:11, FastEthernet0/1
R1#

```

Step 5: Once again we will go to R2 and enter the command ‘show ip route’. Now we have done summarization on R1 so we will see only 2 loopbacks of R3.

```

: R1 R2 R3
*Mar 1 00:16:36.143: %SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
Codes: 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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, FastEthernet0/0
O IA 192.168.13.0/24 [110/20] via 192.168.12.1, 00:15:46, FastEthernet0/0
      4.0.0.0/32 is subnetted, 1 subnets
O      4.4.4.4 [110/11] via 192.168.24.4, 00:15:46, FastEthernet0/1
C    192.168.24.0/24 is directly connected, FastEthernet0/1
      172.17.0.0/16 is variably subnetted, 2 subnets, 2 masks
O IA   172.17.4.1/32 [110/21] via 192.168.12.1, 00:04:43, FastEthernet0/0
O IA   172.17.0.0/22 [110/21] via 192.168.12.1, 00:00:32, FastEthernet0/0
R2#
R2#

```

That's how we do summarization.

Step 6: And now you can ping any loopback of R3 from any router.

Just to confirm I have pinged the loopback of R3 via R4.

```

R4#ping 172.17.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.3.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 84/92/96 ms
R4#ping 172.17.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.4.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 80/107/148 ms
R4#ping 172.17.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.0.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 88/120/156 ms
R4#

```

I have pinged the loopback of R3 via R1.

```
R1#ping 172.17.2.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.2.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/32 ms
R1#ping 172.17.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
R1#ping 172.17.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.4.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/28/32 ms
R1#
```

I have pinged the loopback of R3 via R2.

```
R2#ping 172.17.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.3.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/63/80 ms
R2#ping 172.17.4.1

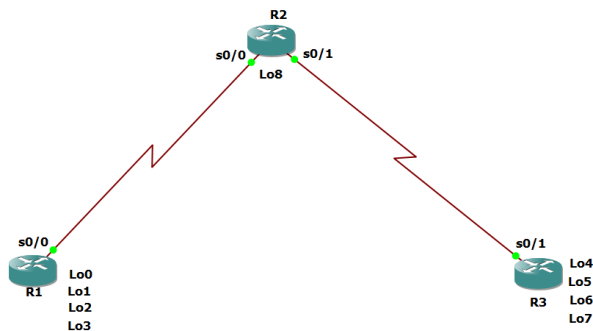
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.4.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/61/64 ms
R2#ping 172.17.2.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.2.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/61/68 ms
R2#ping 172.17.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.17.0.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/65/76 ms
R2#
```

4. Implement Multiarea OSPFv3

Step 1: Build the topology



Step 2: Configure IP's address and Loopback in all the router according to the topology

We will use IPv6 for OSPF version 3

There's a different command for IPv6 configuration. Follow as below.

R1:

```

R1#en
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#int s0/0
R1(config-if)#no shut
R1(config-if)#
*Mar 1 00:57:45.083: %LINK-3-UPDOWN: Interface Serial0/0, changed state to up
*Mar 1 00:57:46.083: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up
R1(config-if)#ipv6 address
*Mar 1 00:58:12.463: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to down
R1(config-if)#ipv6 address 2001:DB8:ACAD:12::1/64
R1(config-if)#no shut
R1(config-if)#int L0
R1(config-if)#
*Mar 1 01:00:31.079: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
R1(config-if)#no shut
R1(config-if)#ipv6 address 2001:DB8:ACAD::1/64
R1(config-if)#no shut
R1(config-if)#L1
R1(config-if)#
^
% Invalid input detected at '^' marker.

R1(config-if)#int L1
R1(config-if)#
*Mar 1 01:01:13.931: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1, changed state to up
R1(config-if)#ipv6 address 2001:DB8:ACAD:1::1/64
R1(config-if)#no shut
R1(config-if)#int L2
R1(config-if)#no
*Mar 1 01:01:55.539: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback2, changed state to up
R1(config-if)#no shut
R1(config-if)#ipv6 address 2001:DB8:ACAD:2::1/64
R1(config-if)#no shut
R1(config-if)#int L3
R1(config-if)#no
*Mar 1 01:04:43.443: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback3, changed state to up
R1(config-if)#no shut
R1(config-if)#ipv6 address 2001:DB8:ACAD:3::1/64
R1(config-if)#no shut
R1(config-if)#do wr
Building configuration...
[OK]
R1(config-if)#ex
R1(config)#exit
  
```


R2:

```

R2#en
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#int s0/0
R2(config-if)#no shut
R2(config-if)#ipv6
*Mar 1 01:08:37.147: %LINK-3-UPDOWN: Interface Serial0/0, changed state to up
*Mar 1 01:08:38.147: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up
R2(config-if)#ipv6 address 2001:DB8:ACAD:12::2/64
R2(config-if)#no shut
R2(config-if)#int s0/1
R2(config-if)#no shut
R2(config-if)#ip
*Mar 1 01:09:20.663: %LINK-3-UPDOWN: Interface Serial0/1, changed state to up
*Mar 1 01:09:21.663: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed state to up
R2(config-if)#ipv6 address 2001:DB8:ACAD:23::2/64
R2(config-if)#no shut
R2(config-if)#
*Mar 1 01:09:42.515: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed state to down
R2(config-if)#int L8
R2(config-if)#
*Mar 1 01:09:49.435: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback8, changed state to up
R2(config-if)#ipv6 address 2001:DB8:ACAD:8::1/64
R2(config-if)#no shut
R2(config-if)#do wr
Building configuration...
[OK]
R2(config-if)#ex

```

R3:

```

R3#en
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#int s0/1
R3(config-if)#no shut
R3(config-if)#ipv6 add
*Mar 1 01:11:29.955: %LINK-3-UPDOWN: Interface Serial0/1, changed state to up
*Mar 1 01:11:30.955: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed state to up
R3(config-if)#ipv6 address 2001:DB8:ACAD:23::3/64
R3(config-if)#no shut
R3(config-if)#int L4
R3(config-if)#no shut
*Mar 1 01:11:59.163: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback4, changed state to up
R3(config-if)#no shut
R3(config-if)#ipv6 add
R3(config-if)#ipv6 address 2001:DB8:ACAD:4::1/64
R3(config-if)#no shut
R3(config-if)#int L5
R3(config-if)#no shut
R3(config-if)#
*Mar 1 01:12:26.911: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback5, changed state to up
R3(config-if)#ipv6 add
R3(config-if)#ipv6 address 2001:DB8:ACAD:5::1/64
R3(config-if)#no shut
R3(config-if)#int L6
R3(config-if)#no shut
*Mar 1 01:12:57.535: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback6, changed state to up
R3(config-if)#no shut
R3(config-if)#ipv6 ad
R3(config-if)#ipv6 address 2001:DB8:ACAD:6::1/64
R3(config-if)#no shut
R3(config-if)#int L7
R3(config-if)#no
*Mar 1 01:13:26.687: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback7, changed state to up
R3(config-if)#no shut
R3(config-if)#ipv6 add
R3(config-if)#ipv6 address 2001:DB8:ACAD:7::1/64
R3(config-if)#no shut
R3(config-if)#do wr
Building configuration...
[OK]
R3(config-if)#ex

```

Step 3: Once IP is assigned to all. We have to do IPv6 unicast. And we have to assign router ID to the routers.

R1:

```

Mar  1 01:03:38.003: %SYS-5-CONFIG-I: Configured from console by console
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ipv6 unicast
R1(config)#ipv6 unicast-routing
R1(config)#do wr
Building configuration...
[OK]
R1(config)#
*Mar  1 01:07:32.463: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up
R1(config)#ipv6 router ospf 1
R1(config-rtr)#
*Mar  1 01:15:08.575: %OSPFv3-4-NORTRID: OSPFv3 process 1 could not pick a router-id,
please configure manually
R1(config-rtr)#router-id 1.1.1.1
R1(config-rtr)#do sh ipv6 ospf
  Routing Process "ospfv3 1" with ID 1.1.1.1
    SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
    Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
    LSA group pacing timer 240 secs
    Interface flood pacing timer 33 msecs
    Retransmission pacing timer 66 msecs
    Number of external LSA 0. Checksum Sum 0x000000
    Number of areas in this router is 0. 0 normal 0 stub 0 nssa
    Reference bandwidth unit is 100 mbps

```

R2:

```

R2(config)#ipv6 uni
R2(config)#ipv6 unicast-routing
R2(config)#do wr
Building configuration...
[OK]
R2(config)#
*Mar  1 01:11:42.515: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed state to up
R2(config)#ipv6 router ospf 1
R2(config-rtr)#
*Mar  1 01:16:48.939: %OSPFv3-4-NORTRID: OSPFv3 process 1 could not pick a router-id,
please configure manually
R2(config-rtr)#router-id 2.2.2.2
R2(config-rtr)#do sh ipv6 ospf
  Routing Process "ospfv3 1" with ID 2.2.2.2
    SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
    Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
    LSA group pacing timer 240 secs
    Interface flood pacing timer 33 msecs
    Retransmission pacing timer 66 msecs
    Number of external LSA 0. Checksum Sum 0x000000
    Number of areas in this router is 0. 0 normal 0 stub 0 nssa
    Reference bandwidth unit is 100 mbps

```

R3:

```

R3(config)#ipv6 uni
R3(config)#ipv6 unicast-routing
R3(config)#do wr
Building configuration...
[OK]
R3(config)#do sh ip int br

```

```

Loopback7/0 unassigned YES unset up
R3(config)#ipv6 router ospf 1
R3(config-rtr)#
*Mar  1 01:17:10.371: %OSPFv3-4-NORTRID: OSPFv3 process 1 could not pick a router-id,
please configure manually
R3(config-rtr)#router-id 3.3.3.3
R3(config-rtr)#do sh ipv6 ospf
  Routing Process "ospfv3 1" with ID 3.3.3.3
    SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
    Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
    LSA group pacing timer 240 secs
    Interface flood pacing timer 33 msecs
    Retransmission pacing timer 66 msecs
    Number of external LSA 0. Checksum Sum 0x000000
    Number of areas in this router is 0. 0 normal 0 stub 0 nssa
    Reference bandwidth unit is 100 mbps

```

Step 4: Now we will configure multi-area OSPFv3 in all the router**R1:**

```

R1(config-rtr)#ex
R1(config)#int L0
R1(config-if)#ipv6 ospf 1 area 1
R1(config-if)#ipv6 ospf network point-to-point
R1(config-if)#int L1
R1(config-if)#ipv6 ospf 1 area 1
R1(config-if)#ipv6 ospf network point-to-point
R1(config-if)#int L2
R1(config-if)#ipv6 ospf 1 area 1
R1(config-if)#ipv6 ospf network point-to-point
R1(config-if)#int L3
R1(config-if)#ipv6 ospf 1 area 1
R1(config-if)#ipv6 ospf network point-to-point
R1(config-if)#int s0/0
R1(config-if)#ipv6 ospf 1 area 0
R1(config-if)#do wr
Building configuration...
[OK]
R1(config-if)#ex

```

R2:

```

R2(config-rtr)#int s0/0
R2(config-if)#ipv6 ospf 1 area 0
R2(config-if)#int L
*Mar  1 01:24:38.347: %OSPFv3-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Serial0/0 from LOADING to FULL, Loading Done
R2(config-if)#int s0/1
R2(config-if)#ipv6 ospf 1 area 0
R2(config-if)#int L8
R2(config-if)#ipv6 ospf 1 area 0
R2(config-if)#ipv6 ospf network point-to-point
R2(config-if)#do wr
Building configuration...
[OK]

```

R3:

```

R3(config)#int L4
R3(config-if)#ipv6 ospf 1 area 2
R3(config-if)#ipv6 ospf network point-to-point
R3(config-if)#int L5
R3(config-if)#ipv6 ospf 1 area 2
R3(config-if)#ipv6 ospf network point-to-point
R3(config-if)#int L6
R3(config-if)#ipv6 ospf 1 area 2
R3(config-if)#ipv6 ospf network point-to-point
R3(config-if)#int L7
R3(config-if)#ipv6 ospf 1 area 2
R3(config-if)#ipv6 ospf network point-to-point
R3(config-if)#int s0/1
R3(config-if)#ipv6 ospf 1 area 0
R3(config-if)#
*Mar  1 01:28:53.935: %OSPFv3-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial0/1 from LOADING to FULL, Loading Done
R3(config-if)#do wr
Building configuration...

```

Step 5: Use the show ipv6 protocols command to verify multi-area OSPFv3 status.

R1:

```
Enter configuration commands, one per line.
R1(config)#do sh ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "static"
IPv6 Routing Protocol is "ospf 1"
  Interfaces (Area 0):
    Serial0/0
  Interfaces (Area 1):
    Loopback3
    Loopback2
    Loopback1
    Loopback0
  Redistribution:
    None
R1(config)#
```

R2:

```
Enter configuration commands, one per line.
R2(config)#do sh ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "static"
IPv6 Routing Protocol is "ospf 1"
  Interfaces (Area 0):
    Serial0/1
    Serial0/0
    Loopback8
  Redistribution:
    None
R2(config)#
```

R3:

```
Enter configuration commands, one per line.
R3(config)#do sh ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "static"
IPv6 Routing Protocol is "ospf 1"
  Interfaces (Area 0):
    Serial0/1
  Interfaces (Area 2):
    Loopback7
    Loopback6
    Loopback5
    Loopback4
  Redistribution:
    None
R3(config)#
```


Step 6: Use the ‘show ipv6 ospf’ command to verify configurations.

R1:

```
R1#show ipv6 ospf
Routing Process "ospfv3 1" with ID 1.1.1.1
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
Number of external LSA 0. Checksum Sum 0x000000
Number of areas in this router is 2. 2 normal 0 stub 0 nssa
Reference bandwidth unit is 100 mbps
  Area BACKBONE(0)
    Number of interfaces in this area is 1
    SPF algorithm executed 3 times
    Number of LSA 16. Checksum Sum 0x094B54
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
  Area 1
    Number of interfaces in this area is 4
    SPF algorithm executed 2 times
    Number of LSA 13. Checksum Sum 0x091C51
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
```

R2:

```
R2#show ipv6 ospf
Routing Process "ospfv3 1" with ID 2.2.2.2
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
Number of external LSA 0. Checksum Sum 0x000000
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Reference bandwidth unit is 100 mbps
  Area BACKBONE(0)
    Number of interfaces in this area is 3
    SPF algorithm executed 2 times
    Number of LSA 19. Checksum Sum 0x0AADC7
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
```

R3:

```

ne
R3#show ipv6 ospf
Routing Process "ospfv3 1" with ID 3.3.3.3
It is an area border router
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
Retransmission pacing timer 66 msecs
Number of external LSA 0. Checksum Sum 0x000000
Number of areas in this router is 2. 2 normal 0 stub 0 nssa
Reference bandwidth unit is 100 mbps
  Area BACKBONE(0)
    Number of interfaces in this area is 1
    SPF algorithm executed 3 times
    Number of LSA 16. Checksum Sum 0x08E7F1
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
  Area 2
    Number of interfaces in this area is 4
    SPF algorithm executed 2 times
    Number of LSA 13. Checksum Sum 0x04C2C0
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
R3#

```

Step 7: Verify OSPFv3 neighbors and routing information.**R1:**

```

R1#
R1#sh ipv6 ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
2.2.2.2	1	FULL/ -	00:00:32	6	Serial0/0

```

R1#

```

R2:

```

R2#
R2#sh ipv6 ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
3.3.3.3	1	FULL/ -	00:00:38	7	Serial0/1
1.1.1.1	1	FULL/ -	00:00:38	6	Serial0/0

```

R2#

```

R3:

```

R3#sh ipv6 ospf neighbor

```

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
2.2.2.2	1	FULL/ -	00:00:34	7	Serial0/1

```

R3#

```

Step 8: Check 'show ipv6 route ospf' to see the OSPF configuration**R1:**

```

R1#
R1#show ipv6 route ospf
IPv6 Routing Table - 18 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
OI 2001:DB8:ACAD:4::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/0
OI 2001:DB8:ACAD:5::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/0
OI 2001:DB8:ACAD:6::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/0
OI 2001:DB8:ACAD:7::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/0
O 2001:DB8:ACAD:8::/64 [110/65]
    via FE80::C002:7EFF:FE1C:0, Serial0/0
O 2001:DB8:ACAD:23::/64 [110/128]
    via FE80::C002:7EFF:FE1C:0, Serial0/0
R1#

```

R2:

```

R2#
R2#show ipv6 route ospf
IPv6 Routing Table - 16 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
OI 2001:DB8:ACAD::/64 [110/65]
    via FE80::C001:56FF:FE40:0, Serial0/0
OI 2001:DB8:ACAD:1::/64 [110/65]
    via FE80::C001:56FF:FE40:0, Serial0/0
OI 2001:DB8:ACAD:2::/64 [110/65]
    via FE80::C001:56FF:FE40:0, Serial0/0
OI 2001:DB8:ACAD:3::/64 [110/65]
    via FE80::C001:56FF:FE40:0, Serial0/0
OI 2001:DB8:ACAD:4::/64 [110/65]
    via FE80::C003:66FF:FEC8:0, Serial0/1
OI 2001:DB8:ACAD:5::/64 [110/65]
    via FE80::C003:66FF:FEC8:0, Serial0/1
OI 2001:DB8:ACAD:6::/64 [110/65]
    via FE80::C003:66FF:FEC8:0, Serial0/1
OI 2001:DB8:ACAD:7::/64 [110/65]
    via FE80::C003:66FF:FEC8:0, Serial0/1
R2#

```

R3:

```

R3#
R3#show ipv6 route ospf
IPv6 Routing Table - 18 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
OI 2001:DB8:ACAD::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/1
OI 2001:DB8:ACAD:1::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/1
OI 2001:DB8:ACAD:2::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/1
OI 2001:DB8:ACAD:3::/64 [110/129]
    via FE80::C002:7EFF:FE1C:0, Serial0/1
O 2001:DB8:ACAD:8::/64 [110/65]
    via FE80::C002:7EFF:FE1C:0, Serial0/1
O 2001:DB8:ACAD:12::/64 [110/128]
    via FE80::C002:7EFF:FE1C:0, Serial0/1
R3#

```

Step 9: Issue the 'show ipv6 ospf database' command on all routers to check the IPv6 OSPF Database

R1:

```

R1#show ipv6 ospf database

      OSPFv3 Router with ID (1.1.1.1) (Process ID 1)

      Router Link States (Area 0)

ADV Router    Age      Seq#      Fragment ID  Link count  Bits
1.1.1.1       884      0x80000002  0            1           B
2.2.2.2       885      0x80000002  0            2           None
3.3.3.3       885      0x80000002  0            1           B

      Inter Area Prefix Link States (Area 0)

ADV Router    Age      Seq#      Prefix
1.1.1.1       885      0x80000001  2001:DB8:ACAD:3::/64
1.1.1.1       885      0x80000001  2001:DB8:ACAD:2::/64
1.1.1.1       885      0x80000001  2001:DB8:ACAD:1::/64
1.1.1.1       885      0x80000001  2001:DB8:ACAD::/64
3.3.3.3       887      0x80000001  2001:DB8:ACAD:7::/64
3.3.3.3       887      0x80000001  2001:DB8:ACAD:6::/64
3.3.3.3       887      0x80000001  2001:DB8:ACAD:5::/64
3.3.3.3       887      0x80000001  2001:DB8:ACAD:4::/64

      Link (Type-8) Link States (Area 0)

ADV Router    Age      Seq#      Link ID      Interface
1.1.1.1       889      0x80000002  6            Se0/0
2.2.2.2       890      0x80000002  6            Se0/0

      Intra Area Prefix Link States (Area 0)

ADV Router    Age      Seq#      Link ID      Ref-lstyp  Ref-LSID
1.1.1.1       889      0x80000001  0            0x2001     0
2.2.2.2       892      0x80000002  0            0x2001     0
3.3.3.3       891      0x80000001  0            0x2001     0

      Router Link States (Area 1)

ADV Router    Age      Seq#      Fragment ID  Link count  Bits
1.1.1.1       897      0x80000001  0            0           B

      Inter Area Prefix Link States (Area 1)

ADV Router    Age      Seq#      Prefix
1.1.1.1       888      0x80000001  2001:DB8:ACAD:12::/64
1.1.1.1       878      0x80000001  2001:DB8:ACAD:23::/64
1.1.1.1       879      0x80000001  2001:DB8:ACAD:8::/64
1.1.1.1       879      0x80000001  2001:DB8:ACAD:4::/64
1.1.1.1       881      0x80000001  2001:DB8:ACAD:5::/64
1.1.1.1       881      0x80000001  2001:DB8:ACAD:6::/64
1.1.1.1       881      0x80000001  2001:DB8:ACAD:7::/64

      Link (Type-8) Link States (Area 1)

ADV Router    Age      Seq#      Link ID      Interface
1.1.1.1       901      0x80000001  31           Lo3
1.1.1.1       901      0x80000001  30           Lo2
1.1.1.1       901      0x80000001  29           Lo1
1.1.1.1       901      0x80000001  28           Lo0

```

R2:

```

Via FE80::C003:66FF:FE08:0, Serial0/1
R2#show ipv6 ospf database

    OSPFv3 Router with ID (2.2.2.2) (Process ID 1)

      Router Link States (Area 0)

ADV Router    Age      Seq#      Fragment ID  Link count  Bits
1.1.1.1       949      0x80000002  0            1           B
2.2.2.2       948      0x80000002  0            2           None
3.3.3.3       949      0x80000002  0            1           B

      Inter Area Prefix Link States (Area 0)

ADV Router    Age      Seq#      Prefix
1.1.1.1       950      0x80000001  2001:DB8:ACAD:3::/64
1.1.1.1       950      0x80000001  2001:DB8:ACAD:2::/64
1.1.1.1       950      0x80000001  2001:DB8:ACAD:1::/64
1.1.1.1       950      0x80000001  2001:DB8:ACAD::/64
3.3.3.3       950      0x80000001  2001:DB8:ACAD:7::/64
3.3.3.3       950      0x80000001  2001:DB8:ACAD:6::/64
3.3.3.3       950      0x80000001  2001:DB8:ACAD:5::/64
3.3.3.3       950      0x80000001  2001:DB8:ACAD:4::/64

      Link (Type-8) Link States (Area 0)

ADV Router    Age      Seq#      Link ID      Interface
2.2.2.2       953      0x80000002  7            Se0/1
3.3.3.3       954      0x80000002  7            Se0/1
1.1.1.1       954      0x80000002  6            Se0/0
2.2.2.2       953      0x80000002  6            Se0/0
2.2.2.2       961      0x80000001  28           Lo8

      Intra Area Prefix Link States (Area 0)

ADV Router    Age      Seq#      Link ID      Ref-lstype  Ref-LSID
1.1.1.1       954      0x80000001  0            0x2001      0
2.2.2.2       959      0x80000002  0            0x2001      0
3.3.3.3       958      0x80000001  0            0x2001      0
R2#
R2#

```


R3:

```

R3#show ipv6 ospf database

    OSPFv3 Router with ID (3.3.3.3) (Process ID 1)

    Router Link States (Area 0)

ADV Router    Age      Seq#      Fragment ID  Link count  Bits
1.1.1.1       982      0x80000002  0            1           B
2.2.2.2       982      0x80000002  0            2           None
3.3.3.3       981      0x80000002  0            1           B

    Inter Area Prefix Link States (Area 0)

ADV Router    Age      Seq#      Prefix
1.1.1.1       983      0x80000001  2001:DB8:ACAD:3::/64
1.1.1.1       983      0x80000001  2001:DB8:ACAD:2::/64
1.1.1.1       983      0x80000001  2001:DB8:ACAD:1::/64
1.1.1.1       983      0x80000001  2001:DB8:ACAD::/64
3.3.3.3       981      0x80000001  2001:DB8:ACAD:7::/64
3.3.3.3       981      0x80000001  2001:DB8:ACAD:6::/64
3.3.3.3       981      0x80000001  2001:DB8:ACAD:5::/64
3.3.3.3       981      0x80000001  2001:DB8:ACAD:4::/64

    Link (Type-8) Link States (Area 0)

ADV Router    Age      Seq#      Link ID      Interface
2.2.2.2       986      0x80000002  7            Se0/1
3.3.3.3       985      0x80000002  7            Se0/1

    Intra Area Prefix Link States (Area 0)

ADV Router    Age      Seq#      Link ID      Ref-lstype  Ref-LSID
1.1.1.1       987      0x80000001  0            0x2001      0
2.2.2.2       988      0x80000002  0            0x2001      0
3.3.3.3       985      0x80000001  0            0x2001      0

    Router Link States (Area 2)

ADV Router    Age      Seq#      Fragment ID  Link count  Bits
3.3.3.3       993      0x80000001  0            0           B

    Inter Area Prefix Link States (Area 2)

ADV Router    Age      Seq#      Prefix
3.3.3.3       984      0x80000001  2001:DB8:ACAD:23::/64
3.3.3.3       975      0x80000001  2001:DB8:ACAD:12::/64
3.3.3.3       975      0x80000001  2001:DB8:ACAD:8::/64
3.3.3.3       976      0x80000001  2001:DB8:ACAD::/64
3.3.3.3       976      0x80000001  2001:DB8:ACAD:1::/64
3.3.3.3       976      0x80000001  2001:DB8:ACAD:2::/64
3.3.3.3       976      0x80000001  2001:DB8:ACAD:3::/64

    Link (Type-8) Link States (Area 2)

ADV Router    Age      Seq#      Link ID      Interface
3.3.3.3       997      0x80000001  32           Lo7
3.3.3.3       997      0x80000001  31           Lo6
3.3.3.3       997      0x80000001  30           Lo5
3.3.3.3       1000     0x80000001  29           Lo4

```

Now you have successfully configured multi-area OSPF v3 using IPv6