Sheridan College		
Course	**TELE31831: Network Engineering II**	
Professor	**Ida Leung**	
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Table number		
Lab 2 : OSPF –OSPFv2v3		
Performed Date	**24 Feb 2021**	
Instructor's Sign		**(marks)**

Follow the procedure to configure your topology:

1. Define the topology like figure#1 with the router of your choice. Please set the hostname with your "initial_router#". Example R1 = IL_R1

2. Define the interfaces by use the following information; xx is your last two digits student ID. Example 02 then use 02 not 2

Router Interface	**Area in multi-area topology (no need to configure**	**IP address**	**IPv6 address**

	in first place)		
R1 Lo0	0	1.1.1.1	26xx::1/128
R2 Lo0	0	2.2.2.2	26xx::2/128
R3 Lo0	2	3.3.3.3	26xx::3/128
R5 Lo0	1	5.5.5.5	26xx::5/128
R6 Lo0	N/A	6.6.6.6	23xx::6/128
R1 f0/0	0	192.168.1.1	26xx:192.168:1::1/64
R2 f0/0	0	192.168.2.1	26xx:192.168:2::1/64
R3 f0/0	2	192.168.3.1	26xx:192.168:3::1/64
R5 f0/0	1	192.168.5.1	26xx:192.168:5::1/64
R6 f0/0	N/A	192.168.6.1	23xx:192.168:6::1/64
R1 G1/0	R2 G1/0 (0)	10.0.xx.0/30	26xx:11:10:0:xx:0::/127
R1 G2/0	R6 G2/0 (N/A)	11.0.xx.0/30	23xx:66:11:0:xx:0::/127
R2 G2/0	R3 G2/0 (1)	10.0.xx.8/30	26xx:22:10:0:xx:8::/127
R2 G3/0	R5 G2/0 (1)	10.0.xx12/30	26xx:33:10:0:xx:12::/127
R3 G3/0	R5 G3/0 (1)	10.0.xx.16/30	26xx:44:10:0:xx:16::/127

3. Turn up both OSPFv2 for IPv4 and OSPFv3 for IPv6 for all routers (except R6) in the topology. All routers are configured in their corresponding area based on step 2 table. Do not configure any router ID. Make sure all OSPF neighbors are up. Printscreen from each router. 15%

R1:

```
TP_R1#sh ip ospf neigh

Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           1   FULL/BDR        00:00:35    10.0.44.2       GigabitEthernet1/0
TP_R1#
```

Figure 1.

```
TP_R1#sh ipv6 ospf neigh

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

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
2.2.2.2           1   FULL/BDR        00:00:39    3               GigabitEthernet1/0
TP_R1#
```

Figure 2.

R2:

```
TP_R2#sh ip ospf neigh

Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           1   FULL/DR         00:00:39    10.0.44.1       GigabitEthernet1/0
5.5.5.5           1   FULL/BDR        00:00:33    10.0.44.14      GigabitEthernet3/0
3.3.3.3           1   FULL/BDR        00:00:36    10.0.44.10      GigabitEthernet2/0
TP_R2#
```

Figure 3.

```
TP_R2#sh ipv6 ospf neigh

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

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
1.1.1.1           1   FULL/DR         00:00:39    3               GigabitEthernet1/0
5.5.5.5           1   FULL/BDR        00:00:37    4               GigabitEthernet3/0
3.3.3.3           1   FULL/BDR        00:00:37    4               GigabitEthernet2/0
TP_R2#
```

Figure 4.

R3:

```
TP_R3#sh ip ospf neigh

Neighbor ID     Pri   State           Dead Time   Address         Interface
5.5.5.5           1   FULL/BDR        00:00:31    10.0.44.18      GigabitEthernet3/0
2.2.2.2           1   FULL/DR         00:00:32    10.0.44.9       GigabitEthernet2/0
TP_R3#
```

Figure 5.

```
TP_R3#sh ipv6 ospf neigh

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

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
5.5.5.5           1   FULL/BDR        00:00:37    5               GigabitEthernet3/0
2.2.2.2           1   FULL/DR         00:00:33    4               GigabitEthernet2/0
TP_R3#
```

Figure 6.

R5:

```
TP_R5#sh ip ospf neigh

Neighbor ID     Pri   State           Dead Time   Address         Interface
3.3.3.3           1   FULL/DR         00:00:36    10.0.44.17      GigabitEthernet3/0
2.2.2.2           1   FULL/DR         00:00:37    10.0.44.13      GigabitEthernet2/0
TP_R5#
```

Figure 7.

```
TP_R5#sh ipv6 ospf neigh

           OSPFv3 Router with ID (5.5.5.5) (Process ID 1)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
2.2.2.2           1   FULL/DR         00:00:34    5               GigabitEthernet2/0
3.3.3.3           1   FULL/DR         00:00:38    5               GigabitEthernet3/0
TP_R5#
```

Figure 8.

R6:

```
TP_R6#sh ip ospf neigh
TP_R6#sh ipv6 ospf neigh
TP_R6#
```

Figure 9.

4. What is the neighbor ID for R1? 2%

Neighbor = 2.2.2.2

5. On R2, add Router-ID 20.2.2.2 under ospf process. Do you see any change of neighbor ID on R1? If not, what you have to do to update the neighbor ID? 3%

Yes there is a change.

R1:

```
TP_R1#sh ip ospf neigh

Neighbor ID     Pri   State           Dead Time   Address         Interface
20.2.2.2          1   2WAY/DROTHER    00:00:36    10.0.44.2       GigabitEthernet1/0
TP_R1#
```

Figure 10.

6. Does router-id must be one of the interfaces' IP on the router? Why we usually use loopback IP as router-id? 10%

Router-id = loopback

We usually use loopback as router-id to find which routers are connected to which routers easily instead of having to look for the ip address of a network in a router, when the database comes up in a router it shows if it is router 1 by using 1.1.1.1 or router 4, 4.4.4.4. It also never goes down, it is software based.

7. Show the ospf and ospfv3 database. How many LSA type 1 in R1 area 1? How many LSA type 3 in R1 and in which area? Any LSA type 5 in R1? Explain your result with LSA type 5 in R1. Printscreen the results and answer the questions based on the printscreen 10%

IPv4:

```
TP_R1#sh ip ospf data

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

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
1.1.1.1         1.1.1.1         66          0x80000003 0x0066C2 3
20.2.2.2        20.2.2.2        46          0x80000003 0x00EC09 3

                Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
10.0.44.2       20.2.2.2        1003        0x80000001 0x0027A5

                Summary Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
3.3.3.3         20.2.2.2        21          0x80000001 0x0034E0
5.5.5.5         20.2.2.2        1           0x80000001 0x00D735
10.0.44.8       20.2.2.2        1036        0x80000001 0x00E9FC
10.0.44.12      20.2.2.2        1036        0x80000001 0x00C121
10.0.44.16      20.2.2.2        1036        0x80000001 0x00A33A
192.168.5.0     20.2.2.2        1036        0x80000001 0x00D5DC
TP_R1#
```

Figure 11.

LSA type 1: 0 in area 1, 2 in area 0
LSA type 3: 1 in area 0
LSA type 5: 6

IPv6:

```
TP_R1#sh ipv6 ospf data

           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         234         0x80000003  0           1           None
 2.2.2.2         171         0x80000004  0           1           B

               Net Link States (Area 0)

ADV Router       Age         Seq#       Link ID    Rtr count
 1.1.1.1         234         0x80000002  3          2

               Inter Area Prefix Link States (Area 0)

ADV Router       Age         Seq#       Prefix
 2.2.2.2         171         0x80000002  2644:22:10:0:44:8::/127
 2.2.2.2         171         0x80000002  2644:33:10:0:44:12::/127
 2.2.2.2         171         0x80000002  2644:44:10:0:44:16::/127
 2.2.2.2         171         0x80000002  2644:192:168:5::/64

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

ADV Router       Age         Seq#       Link ID    Interface
 1.1.1.1         234         0x80000002  3          Gi1/0
 2.2.2.2         171         0x80000002  3          Gi1/0
 1.1.1.1         234         0x80000002  2          Fa0/0

               Intra Area Prefix Link States (Area 0)

ADV Router       Age         Seq#       Link ID    Ref-lstype  Ref-LSID
 1.1.1.1         234         0x80000004  0          0x2001      0
 1.1.1.1         234         0x80000002  3072       0x2002      3
 2.2.2.2         171         0x80000004  0          0x2001      0
TP_R1#
```

Figure 12.

LSA type 1: 0 in area 1, 2 in area 0
LSA type 3: 1 in area 0
LSA type 5: None

8. Turn up the BGP routes between R1 and R6 on both IPv4 and IPv6. R1 AS# is 65002 and R6 AS# is 65001. Put network statement 192.168.6.0 255.255.255.0, 23xx:192:168:6::/64 under R6 BGP router configuration according to their address

family. Verify if the BGP neighbor is up (both ipv4 and ipv6). Printscreen your verification result. 5%

IPv4:

```
TP_R1#sh ip bgp
BGP table version is 3, local router ID is 1.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *   11.0.44.0/30     11.0.44.2                0             0 65001 i
 *>                   0.0.0.0                  0         32768 i
 *>  192.168.6.0      11.0.44.2                0             0 65001 i
TP_R1#
```

Figure 13.

IPv6:

```
TP_R1#sh bgp ipv6 unicast
BGP table version is 2, local router ID is 1.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *>  2344:192:168:6::/64
                      2344:66:11:0:44::1
                                               0             0 65001 i
TP_R1#
```

Figure 14.

9. Check R1 routing table. Do you see the routes advertise from R6? If so, how can you advertise the routes you learnt from R6 to rest of the OSPF network without redistribute the BGP into OSPF? Because redistribute BGP to OSPF can risk the router OSPF by introducing too many routes. So, I need an alternative solution. Please suggest and write down the required

configuration in the below blank space. Apply the solution to the router and check in other routers to see if that works. 15%

Yes, you can see the routes.

```
TP_R1#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

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        2.2.2.2 [110/2] via 10.0.44.2, 00:32:54, GigabitEthernet1/0
      3.0.0.0/32 is subnetted, 1 subnets
O IA     3.3.3.3 [110/3] via 10.0.44.2, 00:32:34, GigabitEthernet1/0
      5.0.0.0/32 is subnetted, 1 subnets
O IA     5.5.5.5 [110/3] via 10.0.44.2, 00:32:14, GigabitEthernet1/0
      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C        10.0.44.0/30 is directly connected, GigabitEthernet1/0
L        10.0.44.1/32 is directly connected, GigabitEthernet1/0
O IA     10.0.44.8/30 [110/2] via 10.0.44.2, 00:48:52, GigabitEthernet1/0
O IA     10.0.44.12/30 [110/2] via 10.0.44.2, 00:48:52, GigabitEthernet1/0
O IA     10.0.44.16/30 [110/3] via 10.0.44.2, 00:48:52, GigabitEthernet1/0
      11.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        11.0.44.0/30 is directly connected, GigabitEthernet2/0
L        11.0.44.1/32 is directly connected, GigabitEthernet2/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.1/32 is directly connected, FastEthernet0/0
O     192.168.2.0/24 [110/2] via 10.0.44.2, 00:48:52, GigabitEthernet1/0
O IA  192.168.5.0/24 [110/3] via 10.0.44.2, 00:48:52, GigabitEthernet1/0
B     192.168.6.0/24 [20/0] via 11.0.44.2, 00:21:09
TP_R1#
```

Figure 15.

Configuration:

In R1 bgp and ospf apply a static route.

Bgp:
Ip route 0.0.0.0 0.0.0.0 11.0.44.2

Ospf:
Ip route 0.0.0.0 0.0.0.0 11.0.44.2

In R6:

Bgp:
Ip route 0.0.0.0 0.0.0.0 11.0.44.1

Because there is only bgp in router 6 there is no need to configure ospf because it receives it from R1

10. Now we want to advertise the AS65002 (192.168.x.x) routes to AS65001. What is the best way to do it? Apply your configuration and verify from R6. Capture the screen and put in the below blank. 10%

Set the default route and/or aggregate all the networks.

11. Are hosts on 192.168.3.0 network able to ping to 192.168.6.0 hosts after step 7? Test with .1 IP in both end. Means you need to specify your ping source and destination IP. Capture the result and explain why not. 5%

No, I cannot because it is in a different area. Using a vpc I assigned the pc 192.168.3.10 and tried to ping 192.168.6.1

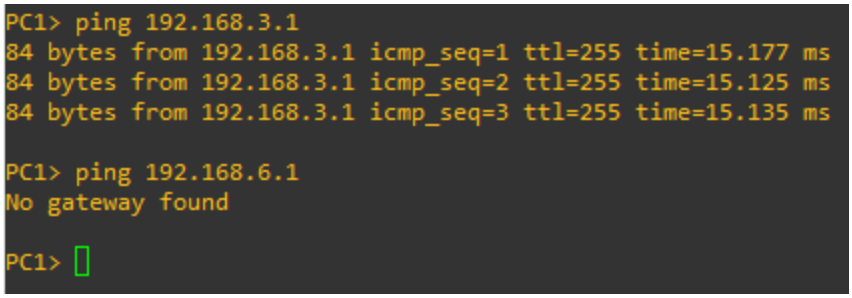

PC1> ping 192.168.3.1
84 bytes from 192.168.3.1 icmp_seq=1 ttl=255 time=15.177 ms
84 bytes from 192.168.3.1 icmp_seq=2 ttl=255 time=15.125 ms
84 bytes from 192.168.3.1 icmp_seq=3 ttl=255 time=15.135 ms
PC1> ping 192.168.6.1
No gateway found
PC1>

Figure 17.

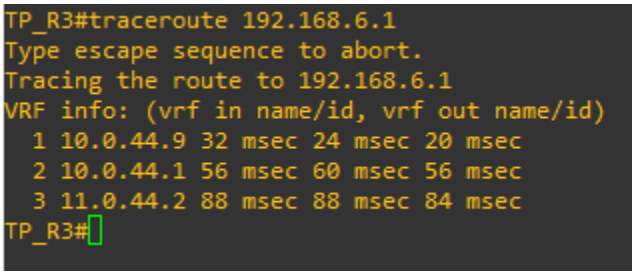
12. Apply your solution and ping again. Please capture your solution in the blank. 10%

R1:
Router ospf 1
Area 1 virtual-link 3.3.3.3
Ipv6 ospf 1
Area 1 virtual-link 3.3.3.3

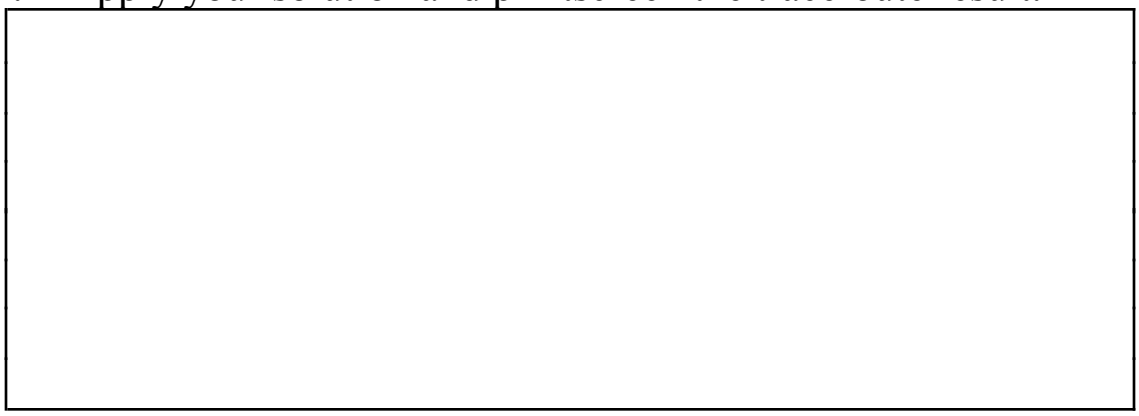
R3:
Router ospf 1
Area 1 virtual-link 1.1.1.1
Ipv6 ospf 1
Area 1 virtual-link 1.1.1.1

13. Traceroute from R6 to R3, which path is taken and why? What can you do to change the packet to use another path ? How can you apply your solution for both R6-R3 and R3-R6? 10%

Traceroute R3-R6



14. Apply your solution and printscreen the traceroute result.



15. Please include all the routers final configuration in this document with answers from questions and submit to the submission folder. 5%

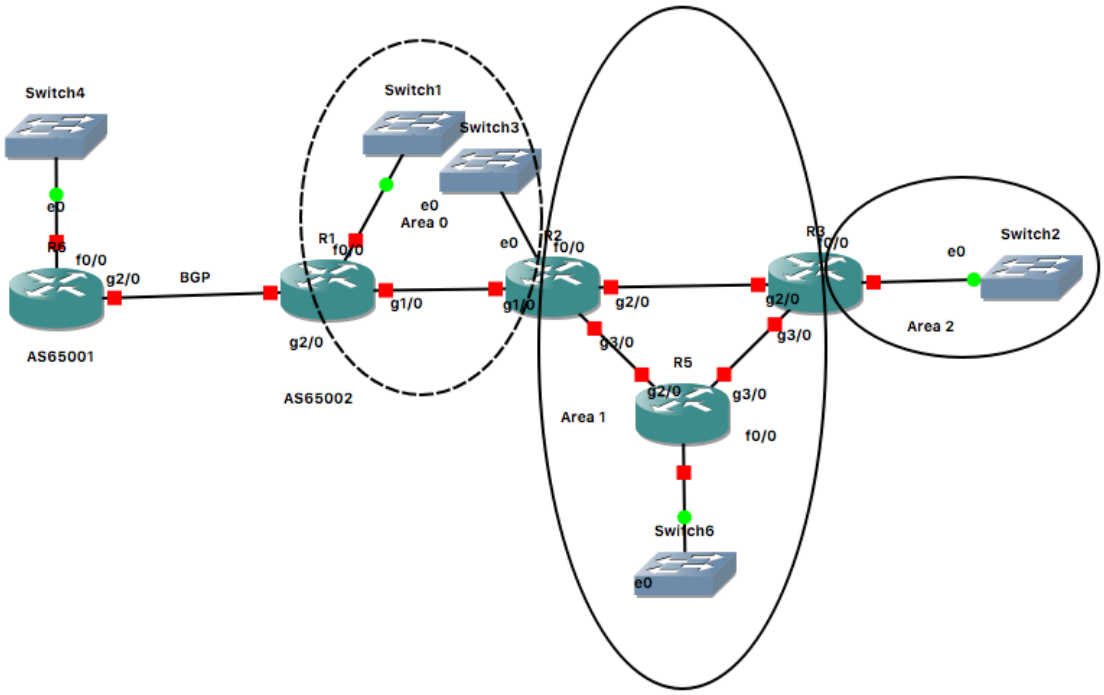


Figure 1 Network Topology

Configurations:

R1:

```
interface Loopback0
 ip address 1.1.1.1 255.255.255.255
 ipv6 address 2644::1/128
 ipv6 enable
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex full
 ipv6 address 2644:192:168:1::1/64
 ipv6 enable
 ipv6 ospf 1 area 0
!
interface GigabitEthernet1/0
 ip address 10.0.44.1 255.255.255.252
 negotiation auto
 ipv6 address 2644:11:10:0:44::/127
 ipv6 enable
 ipv6 ospf 1 area 0
!
interface GigabitEthernet2/0
 ip address 11.0.44.1 255.255.255.252
 negotiation auto
 ipv6 address 2344:66:11:0:44::/127
!
interface GigabitEthernet3/0
 no ip address
 shutdown
 negotiation auto
!
interface FastEthernet4/0
 no ip address
 shutdown
 speed auto
 duplex auto
!
interface FastEthernet4/1
 no ip address
 shutdown
 speed auto
 duplex auto
!
router ospf 1
 area 1 virtual-link 192.168.1.1
 network 1.1.1.1 0.0.0.0 area 0
 network 10.0.44.0 0.0.0.3 area 0
 network 192.168.1.0 0.0.0.255 area 0
 default-information originate
!
router bgp 65002
 bgp log-neighbor-changes
 neighbor 11.0.44.2 remote-as 65001
 neighbor 2344:66:11:0:44::1 remote-as 65001
 !
 address-family ipv4
  network 0.0.0.0
  network 11.0.44.0 mask 255.255.255.252
  network 192.168.6.0
  neighbor 11.0.44.2 activate
  no neighbor 2344:66:11:0:44::1 activate
 exit-address-family
 !
 address-family ipv6
  neighbor 2344:66:11:0:44::1 activate
```

R2:

```
interface Loopback0
 ip address 2.2.2.2 255.255.255.255
 ipv6 address 2644::2/128
!
interface FastEthernet0/0
 ip address 192.168.2.1 255.255.255.0
 duplex full
 ipv6 address 2644:192:168:2:1::1/64
 ipv6 enable
 ipv6 ospf 1 area 0
!
interface GigabitEthernet1/0
 ip address 10.0.44.2 255.255.255.252
 negotiation auto
 ipv6 address 2644:11:10:0:44::1/127
 ipv6 enable
 ipv6 ospf 1 area 0
!
interface GigabitEthernet2/0
 ip address 10.0.44.9 255.255.255.252
 negotiation auto
 ipv6 address 2644:22:10:0:44:8::/127
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface GigabitEthernet3/0
 ip address 10.0.44.13 255.255.255.252
 negotiation auto
 ipv6 address 2644:33:10:0:44:12::/127
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface FastEthernet4/0
 no ip address
 shutdown
 speed auto
 duplex auto
!
interface FastEthernet4/1
 no ip address
 shutdown
 speed auto
 duplex auto
!
router ospf 1
 router-id 20.2.2.2
 area 1 virtual-link 3.3.3.3
 network 2.2.2.2 0.0.0.0 area 0
 network 10.0.44.0 0.0.0.3 area 0
 network 10.0.44.8 0.0.0.3 area 1
 network 10.0.44.12 0.0.0.3 area 1
 network 192.168.2.0 0.0.0.255 area 0
!
```

R3:

```
interface Loopback0
 ip address 3.3.3.3 255.255.255.255
 ipv6 address 2644::3/128
 ipv6 enable
!
interface FastEthernet0/0
 ip address 192.168.3.1 255.255.255.0
 duplex full
 ipv6 address 2644:192:168:3::1/64
 ipv6 enable
 ipv6 ospf 1 area 2
!
interface GigabitEthernet1/0
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet2/0
 ip address 10.0.44.10 255.255.255.252
 negotiation auto
 ipv6 address 2644:22:10:0:44:8:0:1/127
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface GigabitEthernet3/0
 ip address 10.0.44.17 255.255.255.252
 negotiation auto
 ipv6 address 2644:44:10:0:44:16::/127
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface FastEthernet4/0
 no ip address
 shutdown
 speed auto
 duplex auto
!
interface FastEthernet4/1
 no ip address
 shutdown
 speed auto
 duplex auto
!
router ospf 1
 area 1 virtual-link 2.2.2.2
 area 1 virtual-link 192.168.3.1
 network 3.3.3.3 0.0.0.0 area 1
 network 10.0.44.8 0.0.0.3 area 1
 network 10.0.44.16 0.0.0.3 area 1
 network 192.168.3.0 0.0.0.255 area 2
!
ip forward-protocol nd
```

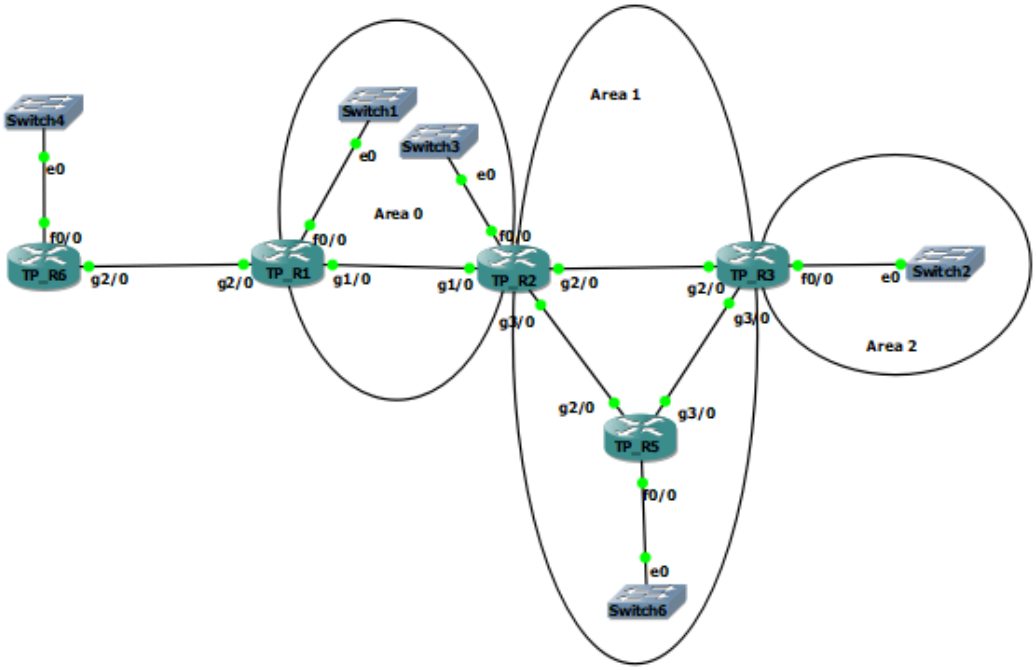
R5:

```
interface Loopback0
 ip address 5.5.5.5 255.255.255.255
 ipv6 address 2644::5/128
!
interface FastEthernet0/0
 ip address 192.168.5.1 255.255.255.0
 duplex full
 ipv6 address 2644:192:168:5::1/64
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface GigabitEthernet1/0
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet2/0
 ip address 10.0.44.14 255.255.255.252
 negotiation auto
 ipv6 address 2644:33:10:0:44:12:0:1/127
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface GigabitEthernet3/0
 ip address 10.0.44.18 255.255.255.252
 negotiation auto
 ipv6 address 2644:44:10:0:44:16:0:1/127
 ipv6 enable
 ipv6 ospf 1 area 1
!
interface FastEthernet4/0
 no ip address
 shutdown
 speed auto
 duplex auto
!
interface FastEthernet4/1
 no ip address
 shutdown
 speed auto
 duplex auto
!
router ospf 1
 network 5.5.5.5 0.0.0.0 area 1
 network 10.0.44.12 0.0.0.3 area 1
 network 10.0.44.16 0.0.0.3 area 1
 network 192.168.5.1 0.0.0.0 area 1
!
```

R6:

```
interface Loopback0
 ip address 6.6.6.6 255.255.255.255
 ipv6 address 2344::6/128
!
interface FastEthernet0/0
 ip address 192.168.6.1 255.255.255.0
 duplex full
 ipv6 address 2344:192:168:6::1/64
 ipv6 enable
!
interface GigabitEthernet1/0
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet2/0
 ip address 11.0.44.2 255.255.255.252
 negotiation auto
 ipv6 address 2344:66:11:0:44::1/127
 ipv6 enable
!
interface GigabitEthernet3/0
 no ip address
 shutdown
 negotiation auto
!
interface FastEthernet4/0
 no ip address
 shutdown
 speed auto
 duplex auto
!
interface FastEthernet4/1
 no ip address
 shutdown
 speed auto
 duplex auto
!
router bgp 65001
 bgp log-neighbor-changes
 neighbor 11.0.44.1 remote-as 65002
 neighbor 2344:66:11:0:44:: remote-as 65002
 !
 address-family ipv4
  network 0.0.0.0
  network 11.0.44.0 mask 255.255.255.252
  network 192.168.6.0
  neighbor 11.0.44.1 activate
  neighbor 11.0.44.1 default-originate
  no neighbor 2344:66:11:0:44:: activate
 exit-address-family
 !
 address-family ipv6
  network 2344:192:168:6::/64
  neighbor 2344:66:11:0:44:: activate
 exit-address-family
!
```

Topology:


Switch4
e0
f0/0
TP_R6
g2/0
g2/0
TP_R1
f0/0
Switch1
e0
Switch3
e0
Area 0
g1/0
g1/0
TP_R2
f0/0
Area 1
g2/0
g2/0
TP_R3
f0/0
e0
Switch2
Area 2
g3/0
g3/0
g2/0
g3/0
TP_R5
f0/0
e0
Switch6