Module 2 – OSPF Configuration for Training Lab Network

Objective: All the workshop lab routers are configured with required basic & interface configuration according to the topology diagram below. Network level reachability testing between directly connected point-to-point links are successfully done in our previous module (Module 1). Participants will require to configure OSPF related configuration on this module for both IPv6 and IPv4 protocol. Workshop instructor will be presenting OSPF design goal & specification for this module. Workshop team has already been build and participants have got access to their designated routers.

Prerequisites: Basic routing concept, IP addressing, Cisco router CLI, Telnet/SSH software etc.

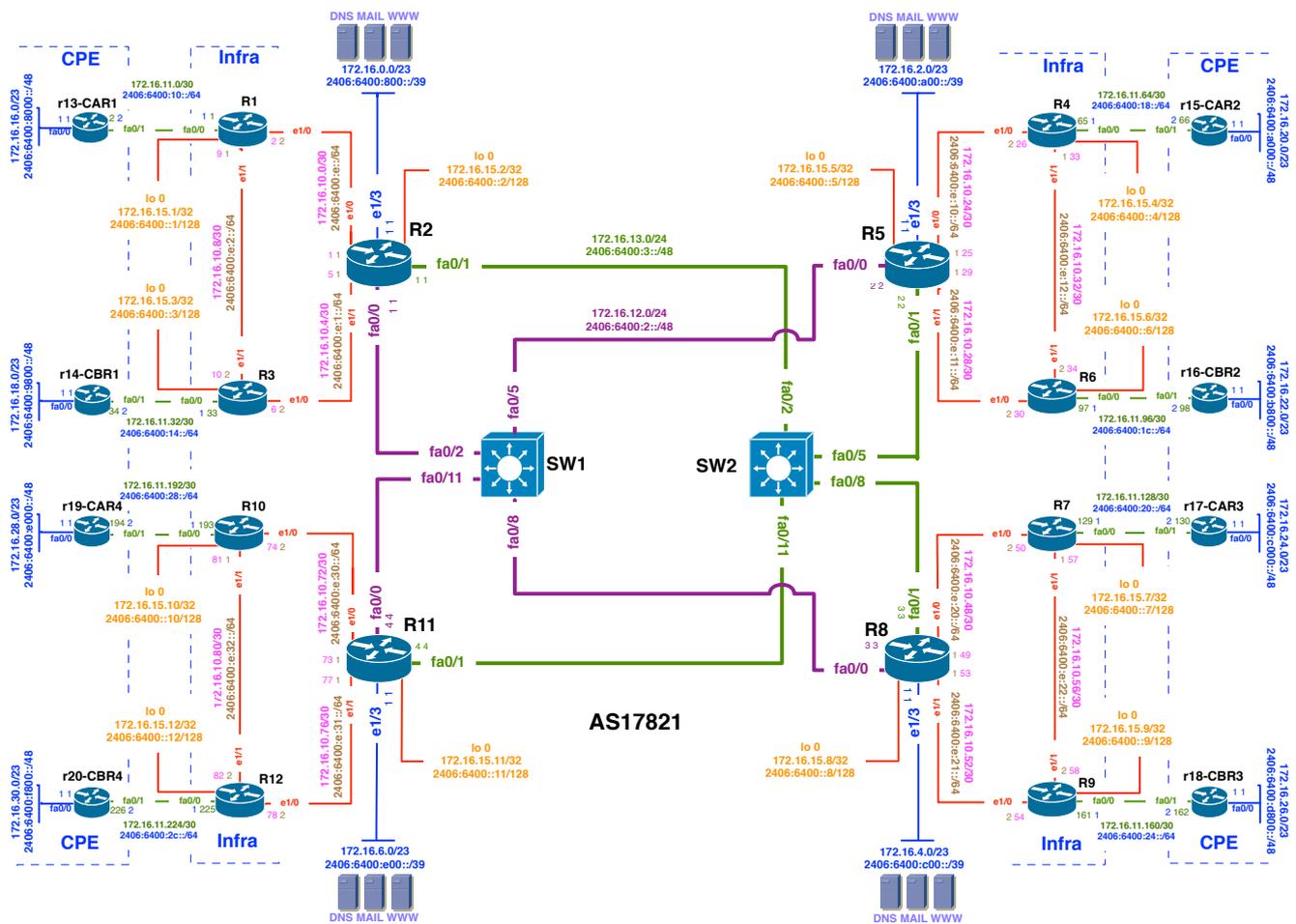The following will be the common topology and IP address plan used for the labs.

Figure 1 – ISP Lab Topology

Tuesday, August 27, 2013

Lab Notes

This workshop is intended to be run on a real cisco routers or Dynamips server with the above lab topologies set up. The routers are using both IPv4 and IPv6 supported IOS software. Participants should do their workshop module two configuration to achieve following goals.

1. After finishing the required interface configuration in module one we only can ping those directly connected interfaces. Loopback, and point-to-point interfaces are still not reachable (ping) from remote routers.
2. For the scalability purpose of IGP (i.e. OSPF) it is advisable to advertise only infrastructure prefixes to OSPF. It includes loopback, infrastructure point-to-point, and transport prefixes only. Please note customer site point-to-point (i.e. link between R1 to r13-CAR1 etc) and data centre (i.e. R1 e1/3 etc) prefixes are not advertised to OSPF. Because it might restrict your network growth as it will cause the growth of your OSPF.
3. For the same purpose we are using hierarchical OSPF areas to create separate topology database for different regional networks. On all four core routers loopback address is published to OSPF area 0.
4. There will not be any OSPF protocol running with the customer routers. So no OSPF configuration is required on those.
5. After finishing OSPF configuration we would like to see following 26 new prefixes in all infrastructure routers routing table.

Loopback	Point-to-point	Transport
R1=> 2406:6400::1/128	R2-R1=> 2406:6400:e::/64	Purple=> 2406:6400:2::/48
R2=> 2406:6400::2/128	R2-R3=> 2406:6400:e:1::/64	Green=> 2406:6400:3::/48
R3=> 2406:6400::3/128	R1-R3=> 2406:6400:e:2::/64	
R4=> 2406:6400::4/128	R5-R4=> 2406:6400:e:10::/64	
R5=> 2406:6400::5/128	R5-R6=> 2406:6400:e:11::/64	
R6=> 2406:6400::6/128	R4-R6=> 2406:6400:e:12::/64	
R7=> 2406:6400::7/128	R8-R7=> 2406:6400:e:20::/64	
R8=> 2406:6400::8/128	R8-R9=> 2406:6400:e:21::/64	
R9=> 2406:6400::9/128	R7-R9=> 2406:6400:e:22::/64	
R10=> 2406:6400::10/128	R11-R10=> 2406:6400:e:30::/64	
R11=> 2406:6400::11/128	R11-R12=> 2406:6400:e:31::/64	
R12=> 2406:6400::12/128	R11-R12=> 2406:6400:e:32::/64	

6. Due to time restriction in workshop OSPF analysis and example will cover IPv6 prefixes only. You can check IPv4 prefixes for your own understanding purpose.

Lab Exercise

1. **IPv6 OSPF (OSPFv3) Configuration:** This configuration on Cisco IOS can be done from interface configuration mode. This configuration will activate a separate OSPF process on your cisco router if you already have OSPFv2 running. For a dual stack router you need to run both OSPFv2 and v3 at the same time. Please notice OSPFv3 router ID which is still 32bit number.

   Example Config on a Router:

   ```
   config t
   ```
   To enter into a cisco router global configuration mode.

   ```
   interface loopback 0
   ipv6 ospf 17821 area 1
   interface e1/0
   ipv6 ospf 17821 area 1
   ipv6 ospf network point-to-point
   ```
   We are using Ethernet interface which is broadcast multi-access type of network for OSPF. By default OSPF will automatically detect the interface type and elect DR/BDR. If we use this command then OSPF will consider it as point to point link and no DR/BDR will be elected.

   ```
   interface e1/1
   ipv6 ospf 17821 area 1
   ipv6 ospf network point-to-point
   exit
   exit
   wr
   ```

   Interface loopback 0, e1/0 and e1/1 will be participating in OSPFv3 process ID 17821 area 1. Prefixes configured on these interfaces will be advertised.

2. **IPv4 OSPF (OSPFv2) Configuration:** This configuration can be done from the global configuration of mode of a Cisco router. Same process ID can be used but still it is unique because same process id is used for 2 different service i.e OSPFv2 and OSPFv3.

   Example Config on a Router:

   ```
   config t
   ```
   To enter into a cisco router global configuration mode.

   ```
   router ospf 17821
   ```
   Create ospfv2 process 17821

   ```
   log-adjacency-changes
   ```
   Keep log of OSPF neighbour relationship status if it is changed

   ```
   passive-interface default
   ```
   Do not create hello message by default to all interface. This approach is very effective if we would like to build OSPF adjacency on the selected interface. Specially if there is an external facing interface and no OSPF routing to them.

   ```
   network 172.16.15.2 0.0.0.0 area 0
   ```
   Loopback interface is not generating any hello but adding prefixes to OSPF

```
no passive-interface e1/0
```
Interface e1/0 will generate hello to build adjacency with connected link.

```
network 172.16.10.0 0.0.0.3 area 1
```
And advertise network 172.16.10.0 mask 255.255.255.252 to area 1. Wildcard mask is reverse to subnet mask.

```
no passive-interface e1/1
network 172.16.10.4 0.0.0.3 area 1
no passive-interface fa0/0
network 172.16.12.0 0.0.0.255 area 0
no passive-interface fa0/1
network 172.16.13.0 0.0.0.255 area 0
exit
int e1/0
ip ospf network point-to-point
```
We are using Ethernet interface which is broadcast multi-access type of network for OSPF. By default OSPF will automatically detect the interface type and elect DR/BDR. If we use this command then OSPF will consider it as point to point link and no DR/BDR will be elected.

```
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

3. Verify IPv6 OSPF Configuration:

Example IPv6 protocol verification on a Router:

```
sh ipv6 ospf neighbor
```
[To check OSPFv3 neighbor table]
```
sh ipv6 ospf database
```
[To check OSPFv3 topology table]
```
sh ipv6 route ospf
```
[To check ipv6 routing table prefixes learn by OSPFv3]
```
ping [router1….up to router12 loopback] !!!!!
ping [all WAN interface & transport interface] !!!!!
ping [any datacenter prefix] .....
ping [any customer prefix] .....
debug ipv6 ospf packet
debug ipv6 ospf adj
```

You need to replace router name with the loopback address. Please look at the topology diagram on page 1 for further detail.

Example IPv4 protocol verification on a Router:

```
sh ip ospf neighbor
```
[To check OSPFv2 neighbor table]
```
sh ip ospf database
```
[To check OSPFv2 topology table]
```
sh ip route ospf
```
[To check ipv4 routing table prefixes learn by OSPFv2]
```
ping [router1….up to router12 loopback] !!!!!
ping [all WAN interface & transport interface] !!!!!
ping [any datacenter prefix] .....
ping [any customer prefix] .....
debug ip ospf packet
debug ip ospf adj
```
<div align="center">END OF MODULE TWO……</div>
<div align="center">Next pages for reference template used on different routers….</div>

'Workshop templates for reference purpose only'

Configuration of OSPF in training ISP network Region1:
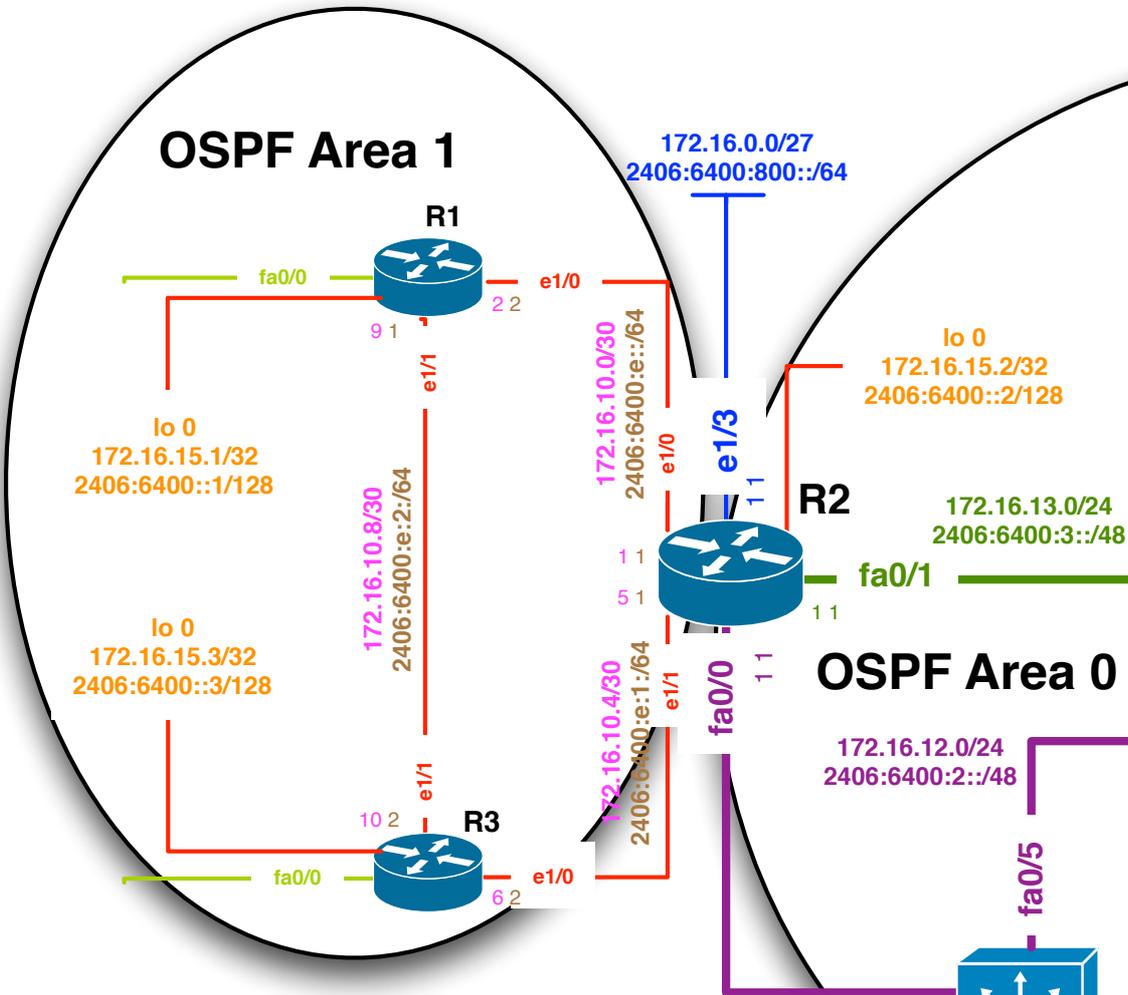
IPv4 OSPF Conf Router1:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.1 0.0.0.0 area 1
no passive-interface e1/0
network 172.16.10.0 0.0.0.3 area 1
no passive-interface e1/1
network 172.16.10.8 0.0.0.3 area 1
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router1:

```
config t
interface loopback 0
ipv6 ospf 17821 area 1
interface e1/0
ipv6 ospf 17821 area 1
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 1
ipv6 ospf network point-to-point
exit
exit
wr
```

IPv4 OSPF Conf Router2:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.2 0.0.0.0 area 0
no passive-interface e1/0
network 172.16.10.0 0.0.0.3 area 1
no passive-interface e1/1
network 172.16.10.4 0.0.0.3 area 1
no passive-interface fa0/0
network 172.16.12.0 0.0.0.255 area 0
no passive-interface fa0/1
network 172.16.13.0 0.0.0.255 area 0
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router2:

```
config t
interface loopback 0
ipv6 ospf 17821 area 0
interface fa0/0
ipv6 ospf 17821 area 0
interface fa0/1
ipv6 ospf 17821 area 0
interface e1/0
ipv6 ospf 17821 area 1
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 1
ipv6 ospf network point-to-point
exit
exit
wr
```
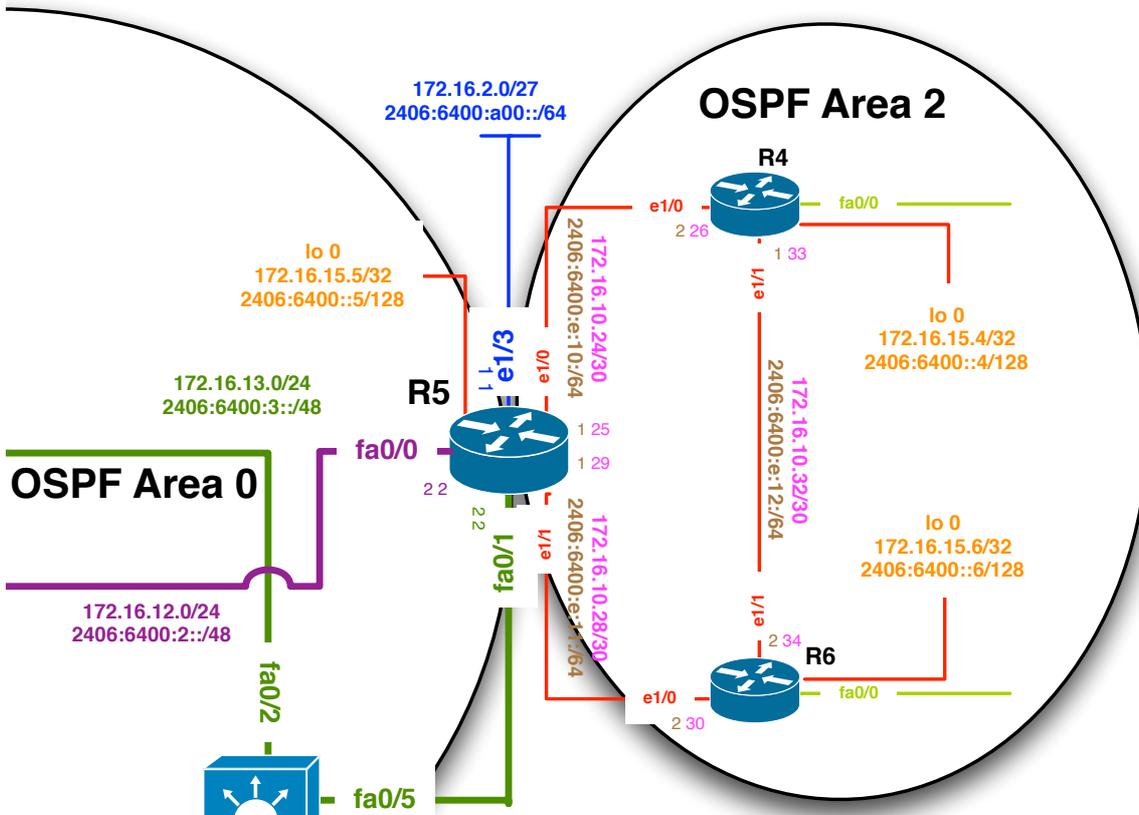
IPv4 OSPF Conf Router3:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.3 0.0.0.0 area 1
no passive-interface e1/0
network 172.16.10.4 0.0.0.3 area 1
no passive-interface e1/1
network 172.16.10.8 0.0.0.3 area 1
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router3:

```
config t
interface loopback 0
ipv6 ospf 17821 area 1
interface e1/0
ipv6 ospf 17821 area 1
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 1
ipv6 ospf network point-to-point
exit
exit
wr
```

Configuration of OSPF in training ISP network Region2:

IPv4 OSPF Conf Router4:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.4 0.0.0.0 area 2
no passive-interface e1/0
network 172.16.10.24 0.0.0.3 area 2
no passive-interface e1/1
network 172.16.10.32 0.0.0.3 area 2
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router4:

```
config t
interface loopback 0
ipv6 ospf 17821 area 2
interface e1/0
ipv6 ospf 17821 area 2
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 2
ipv6 ospf network point-to-point
exit
exit
wr
```

IPv4 OSPF Conf Router5:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.5 0.0.0.0 area 0
no passive-interface e1/0
network 172.16.10.24 0.0.0.3 area 2
no passive-interface e1/1
network 172.16.10.28 0.0.0.3 area 2
no passive-interface fa0/0
network 172.16.12.0 0.0.0.255 area 0
no passive-interface fa0/1
network 172.16.13.0 0.0.0.255 area 0
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router5:

```
config t
interface loopback 0
ipv6 ospf 17821 area 0
interface fa0/0
ipv6 ospf 17821 area 0
interface fa0/1
ipv6 ospf 17821 area 0
interface e1/0
ipv6 ospf 17821 area 2
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 2
ipv6 ospf network point-to-point
exit
exit
wr
```
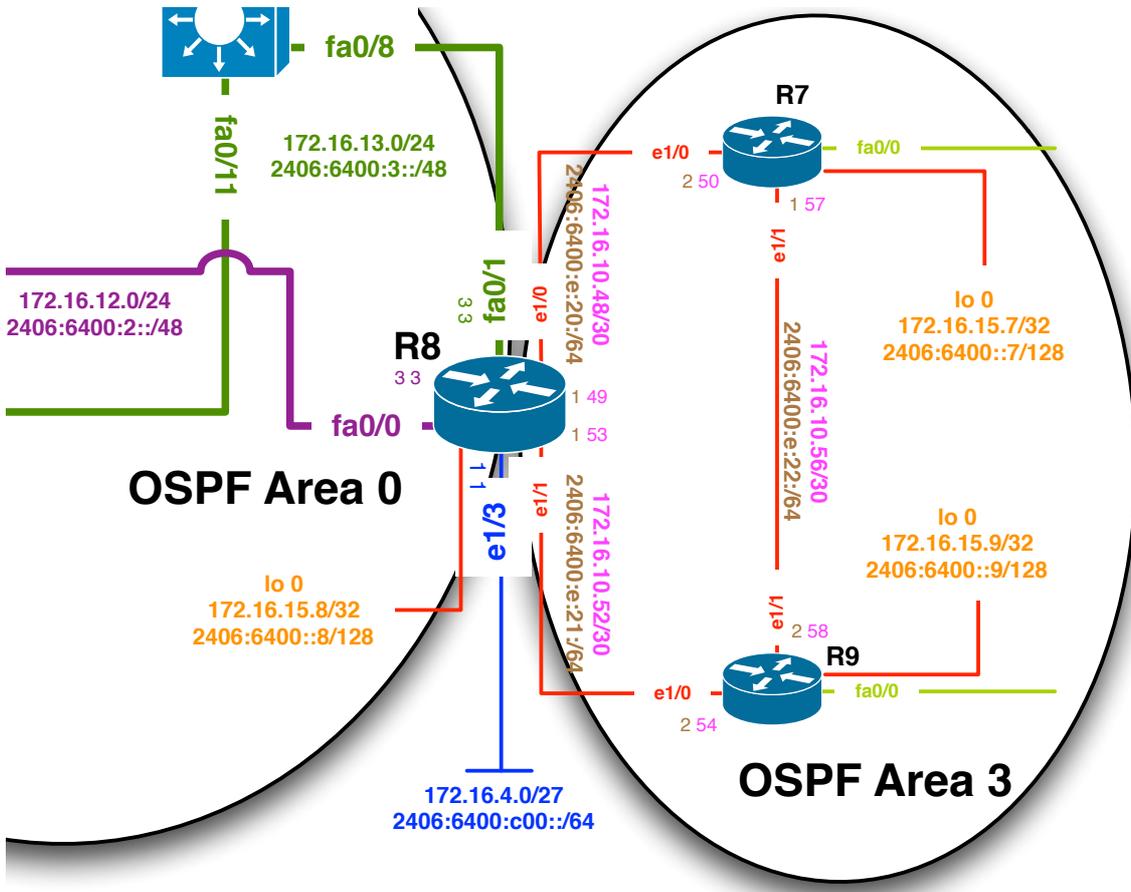
IPv4 OSPF Conf Router6:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.6 0.0.0.0 area 2
no passive-interface e1/0
network 172.16.10.28 0.0.0.3 area 2
no passive-interface e1/1
network 172.16.10.32 0.0.0.3 area 2
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router6:

```
config t
interface loopback 0
ipv6 ospf 17821 area 2
interface e1/0
ipv6 ospf 17821 area 2
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 2
ipv6 ospf network point-to-point
exit
exit
wr
```

Configuration of OSPF in training ISP network Region3:

IPv4 OSPF Conf Router7:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.7 0.0.0.0 area 3
no passive-interface e1/0
network 172.16.10.48 0.0.0.3 area 3
no passive-interface e1/1
network 172.16.10.56 0.0.0.3 area 3
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router7:

```
config t
interface loopback 0
ipv6 ospf 17821 area 3
interface e1/0
ipv6 ospf 17821 area 3
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 3
ipv6 ospf network point-to-point
exit
exit
wr
```

IPv4 OSPF Conf Router8:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.8 0.0.0.0 area 0
no passive-interface e1/0
network 172.16.10.48 0.0.0.3 area 3
no passive-interface e1/1
network 172.16.10.52 0.0.0.3 area 3
no passive-interface fa0/0
network 172.16.12.0 0.0.0.255 area 0
no passive-interface fa0/1
network 172.16.13.0 0.0.0.255 area 0
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router8:

```
config t
interface loopback 0
ipv6 ospf 17821 area 0
interface fa0/0
ipv6 ospf 17821 area 0
interface fa0/1
ipv6 ospf 17821 area 0
interface e1/0
ipv6 ospf 17821 area 3
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 3
ipv6 ospf network point-to-point
exit
exit
wr
```
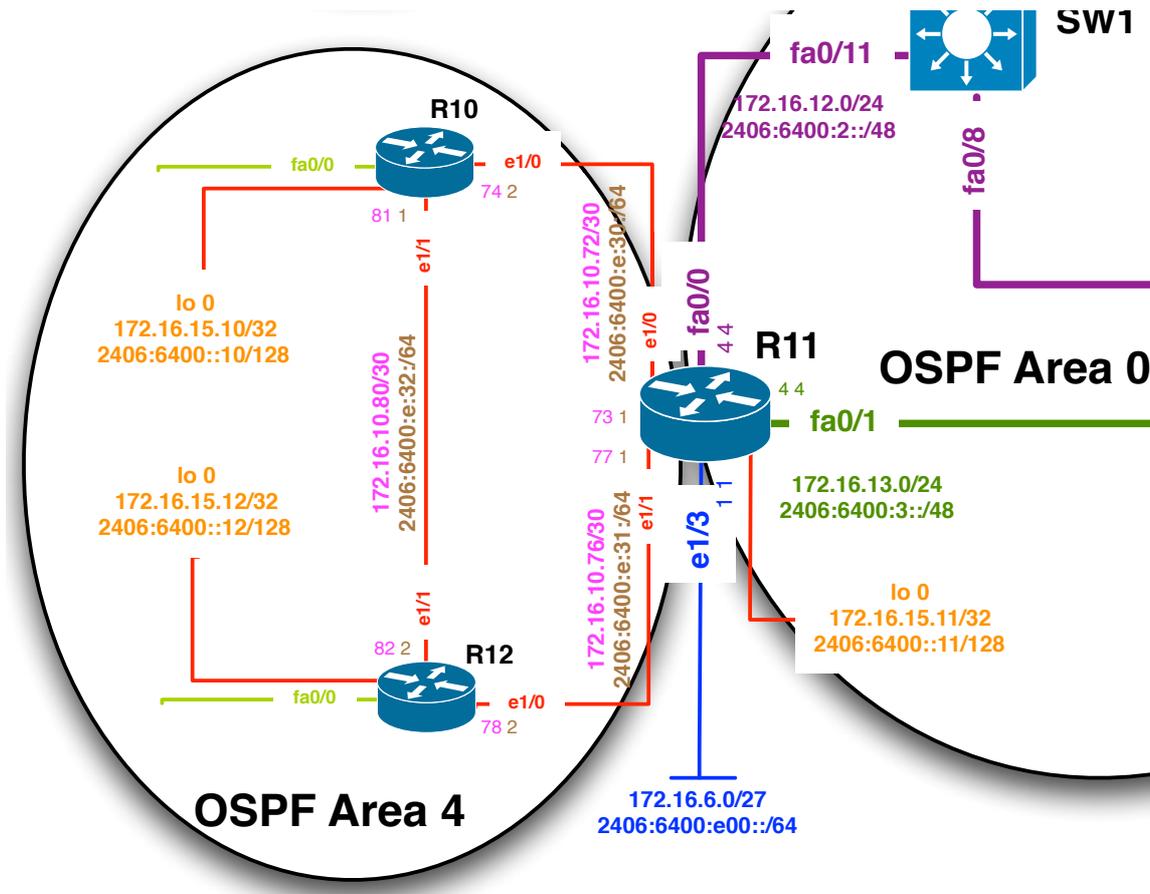
IPv4 OSPF Conf Router9:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.9 0.0.0.0 area 3
no passive-interface e1/0
network 172.16.10.52 0.0.0.3 area 3
no passive-interface e1/1
network 172.16.10.56 0.0.0.3 area 3
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router9:

```
config t
interface loopback 0
ipv6 ospf 17821 area 3
interface e1/0
ipv6 ospf 17821 area 3
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 3
ipv6 ospf network point-to-point
exit
exit
wr
```

Configuration of OSPF in training ISP network Region4:

IPv4 OSPF Conf Router10:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.10 0.0.0.0 area 4
no passive-interface e1/0
network 172.16.10.72 0.0.0.3 area 4
no passive-interface e1/1
network 172.16.10.80 0.0.0.3 area 4
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router10:

```
config t
interface loopback 0
ipv6 ospf 17821 area 4
interface e1/0
ipv6 ospf 17821 area 4
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 4
ipv6 ospf network point-to-point
exit
exit
wr
```

IPv4 OSPF Conf Router11:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.11 0.0.0.0 area 0
no passive-interface e1/0
network 172.16.10.72 0.0.0.3 area 4
no passive-interface e1/1
network 172.16.10.76 0.0.0.3 area 4
no passive-interface fa0/0
network 172.16.12.0 0.0.0.255 area 0
no passive-interface fa0/1
network 172.16.13.0 0.0.0.255 area 0
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router11:

```
config t
interface loopback 0
ipv6 ospf 17821 area 0
interface fa0/0
ipv6 ospf 17821 area 0
interface fa0/1
ipv6 ospf 17821 area 0
interface e1/0
ipv6 ospf 17821 area 4
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 4
ipv6 ospf network point-to-point
exit
exit
wr
```

IPv4 OSPF Conf Router12:

```
config t
router ospf 17821
log-adjacency-changes
passive-interface default
network 172.16.15.12 0.0.0.0 area 4
no passive-interface e1/0
network 172.16.10.76 0.0.0.3 area 4
no passive-interface e1/1
network 172.16.10.80 0.0.0.3 area 4
exit
int e1/0
ip ospf network point-to-point
int e1/1
ip ospf network point-to-point
exit
exit
wr
```

IPv6 OSPF Conf Router12:

```
config t
interface loopback 0
ipv6 ospf 17821 area 4
interface e1/0
ipv6 ospf 17821 area 4
ipv6 ospf network point-to-point
interface e1/1
ipv6 ospf 17821 area 4
ipv6 ospf network point-to-point
exit
exit
wr
```