Dynamic Routing with Multi-Area OSPF and VLAN Implementation

Yassine El Ghazi

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1 Introduction

Dynamic routing using OSPF (Open Shortest Path First) combined with VLAN segmentation provides a robust and scalable networking solution. This configuration demonstrates the practical implementation of multi-area OSPF and VLANs in a network with four routers and multiple network segments.

2 Network Topology

Figure 1 shows the complete network topology with all routers, switches, VLANs, and their interconnections, organized into four OSPF areas.

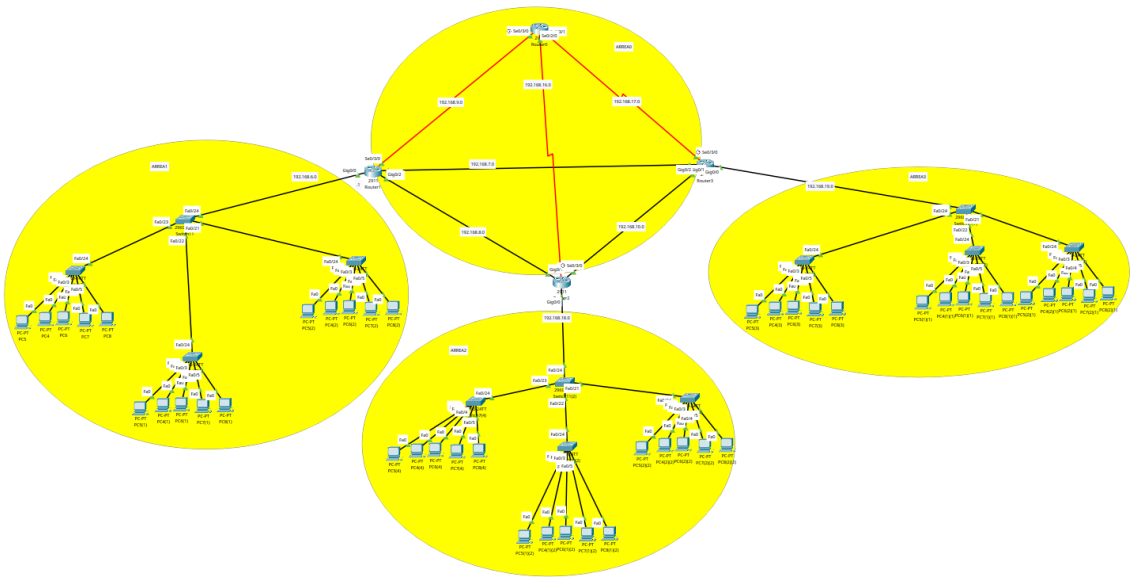

Figure 1: Network Topology with OSPF Areas and VLANs

3 Objectives

The objectives of this network configuration are:

- Implement VLAN segmentation (VLANs 10-50)
- Configure multi-area OSPF routing protocol
- Establish inter-VLAN routing using router-on-a-stick configuration
- Ensure path redundancy through multiple routers
- Enable fast convergence and optimal path selection
- Create hierarchical network design with proper area segregation

4 Router Configuration

4.1 Router0 (Core)

IP addresses and interface configuration:

Interface	IP Address	Mask
Se0/3/0	192.168.9.1	255.255.255.0
Se0/3/1	192.168.17.1	255.255.255.0
Se0/2/0	192.168.16.1	255.255.255.0

Table 1: Router0 Interface Configuration

Configuration commands:

```
enable
config terminal
interface Se0/3/0
ip address 192.168.9.1 255.255.255.0
no shutdown
interface Se0/3/1
ip address 192.168.17.1 255.255.255.0
no shutdown
interface Se0/2/0
ip address 192.168.16.1 255.255.255.0
no shutdown
router ospf 1
network 192.168.16.0 0.0.0.255 area 0
network 192.168.9.0 0.0.0.255 area 0
network 192.168.17.0 0.0.0.255 area 0
```

4.2 Router1

IP addresses and interface configuration:

Interface	IP Address	Mask	VLAN
Gig0/0.10	192.168.1.254	255.255.255.0	10
Gig0/0.20	192.168.2.254	255.255.255.0	20
Gig0/0.30	192.168.3.254	255.255.255.0	30
Gig0/0.40	192.168.4.254	255.255.255.0	40
Gig0/0.50	192.168.5.254	255.255.255.0	50

Table 2: Router1 Interface Configuration

Configuration commands (partial):

```
enable
config terminal
interface Gig0/0
ip address 192.168.6.1 255.255.255.0
interface Gig0/0.10
encapsulation dot1Q 10
ip address 192.168.1.254 255.255.255.0
router ospf 1
network 192.168.1.0 0.0.0.255 area 1
network 192.168.2.0 0.0.0.255 area 1
```

4.3 Router2

IP addresses and interface configuration:

Interface	IP Address	Mask	VLAN
Gig0/0.10	192.168.21.254	255.255.255.0	10
Gig0/0.20	192.168.22.254	255.255.255.0	20
Gig0/0.30	192.168.23.254	255.255.255.0	30
Gig0/0.40	192.168.24.254	255.255.255.0	40
Gig0/0.50	192.168.25.254	255.255.255.0	50

Table 3: Router2 Interface Configuration

Configuration commands (partial):

```
enable
config terminal
interface Gig0/0
ip address 192.168.18.1 255.255.255.0
interface Gig0/0.10
encapsulation dot1Q 10
ip address 192.168.21.254 255.255.255.0
router ospf 1
network 192.168.21.0 0.0.0.255 area 2
network 192.168.22.0 0.0.0.255 area 2
```

4.4 Router3

IP addresses and interface configuration:

Interface	IP Address	Mask	VLAN
Gig0/0.10	192.168.11.254	255.255.255.0	10
Gig0/0.20	192.168.12.254	255.255.255.0	20
Gig0/0.30	192.168.13.254	255.255.255.0	30
Gig0/0.40	192.168.14.254	255.255.255.0	40
Gig0/0.50	192.168.15.254	255.255.255.0	50

Table 4: Router3 Interface Configuration

Configuration commands (partial):

```
enable
config terminal
interface Gig0/0
ip address 192.168.19.1 255.255.255.0
interface Gig0/0.10
encapsulation dot1Q 10
ip address 192.168.11.254 255.255.255.0
router ospf 1
network 192.168.11.0 0.0.0.255 area 3
network 192.168.12.0 0.0.0.255 area 3
```

5 VLAN Configuration

5.1 Switch VLAN Creation

```
vlan 10
exit
vlan 20
exit
vlan 30
exit
vlan 40
exit
vlan 50
exit
```

5.2 Access Port Configuration

```
interface fastEthernet 0/1
switchport mode access
switchport access vlan 10
exit
[Similar configuration for other access ports...]
```

5.3 Trunk Port Configuration

```
interface fastEthernet 0/24
switchport mode trunk
switchport trunk native vlan 1
switchport trunk allowed vlan 10,20,30,40
```

6 VLAN Distribution

VLAN ID	Router1 Network	Router2 Network	Router3 Network
10	192.168.1.0/24	192.168.21.0/24	192.168.11.0/24
20	192.168.2.0/24	192.168.22.0/24	192.168.12.0/24
30	192.168.3.0/24	192.168.23.0/24	192.168.13.0/24
40	192.168.4.0/24	192.168.24.0/24	192.168.14.0/24
50	192.168.5.0/24	192.168.25.0/24	192.168.15.0/24

Table 5: VLAN Network Distribution

7 Advantages and Disadvantages

7.1 Advantages

- Logical network segmentation through VLANs
- Efficient routing through multi-area OSPF design
- Improved network security through VLAN isolation
- Fast convergence and optimal path selection
- Scalable hierarchical design
- Load balancing through multiple paths

7.2 Disadvantages

- Complex configuration requirements
- Higher resource usage for OSPF operations
- Need for careful IP address planning
- More complex troubleshooting
- Increased management overhead
- Higher bandwidth consumption for OSPF updates

8 Conclusion

The implemented network design successfully combines VLAN segmentation with multi-area OSPF routing to create a scalable and efficient network infrastructure. The hierarchical design with separate areas provides optimal routing while maintaining network security through VLAN implementation. Future enhancements could include implementing OSPF authentication, route summarization, and additional redundancy measures.