

# OSPF (Open Short Path First) Multi-Area Configuration and Verification

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**Abstract** - As per the increased demands on the communication networks, some problems as been faced like real-time network traffic cannot be detected, better path selection cannot be selected and so on. To overcome this problem and bring up the Routing Protocols, Routing protocols determine the best routes to transfer data from one node to another and specify how routers communicate between each other in order to complete this task. In routing protocols, Interior Gateway Protocol, link-state routing protocols, such as OSPF and IS-IS and distance-vector routing protocols, such as Routing Information Protocols, RIP, IGRP and Exterior gateway protocols, are routing protocols used on the Internet for exchanging routing information between Autonomous systems, such Border Gateway Protocol as (BGP), Path Vector Routing Protocol. In this paper we will focus on understand the OSPF protocol and configuration and verification of OSPF multi area using Cisco Packet Tracer simulator.

**Key Words:** OSPFv2, OSPFv3, Routing protocols, cisco packet tracer simulator

## 1. INTRODUCTION

Routing is a process of moving a packet of a data from source to destination. Routing is usually performed by a dedicated device called a router. Routing is a key feature of the Internet because it enables messages to pass from one computer to another and eventually reach the target machine.

There are 3 types of routing process

[1] Static routing is a process in which we have to manually add routes in routing table. Static routes are used for interface with remote networks. In production networks, static routes are mainly implemented when routing from a particular network to a stub network. Stub networks are networks that can only be accessed through one point or one interface.

[2] Default Routing is the method where the router is implemented to send all packets towards a single router (next hop). It doesn't matter to which network the packet belongs, it is forwarded out to router which is configured for default routing. It is generally used with stub routers. A stub router is a router which has only one route to reach all other networks.

[3] Dynamic routing makes automatic modifying of the routes according to the present state of the route in the routing table. Dynamic routing uses protocols to reach the information from source to destination. The dynamic protocols are OSPF, IS-IS, RIP, IGRP, EIGR, BGP

## 1.1 OSPF (Open Short Path First)

OSPF is Interior Gateway Protocol (IGP), OSPF is fast convergence than RIP most of time it is less than 1 second, OSPF is classless. OSPF does this by building a map of the entire network and then choosing the best routes from that map.

OSPF basically works by sharing a Link State Advertisements (LSA), LSA is generated by a router is called router LSA. This LSA contain information about the subnet and some other network information, once a while LSA's have been flooded OSPF keeps all of this information in a linked state database this is also known as an LSDB. The goal here is to have each router with the same information in there LSDB. This is the general goal of an OSPF. It uses the shortest path first algorithm and dijkistra algorithm. The calculation is  $cost = 10^8 / BW$ . The administrative distance is 110 and it is a classless routing protocol. OSPF support VLSM, CIDR and equal cost load balancing. Introduce the concept of area's to easy management and control traffic

There are 3 main steps

OSPF neighboring is a process routers working on OSPF on the same network accept to form a neighbor relationship.

The neighbor routers exchange their LSDB data with each other routers is kwon as Exchange database information.

Each router chooses the best route to include it's routing table based on the LSDB data this method is known as choose the best routes

Before the relation formed each router needs to choose a router ID. A router ID is a number that can be used to identify an individual router it is in the format of an ipv4 address. The router ID can be set manually or let the router to decide for itself. There is a logic that router go through when choosing router ID's, first check this be manually set if it's been manually set that is the router ID if it's not been manually set then the router would choose the highest up loop back IP address, if there are no loop back interface on the router it will then choose the highest loop back IP address essentially it would choose the highest IP address on the router.

OSPFv2 stands for Open Shortest Path First version 2 and OSPFv3 stands for Open Shortest Path First version 3. OSPFv2 works on IPv4's OSPF version, similarly OSPFv3 works on IPv6's OSPF version. OSPFv2 runs on subnets

rather than links and OSPFv3 runs on links rather than subnets.

OSPF uses the concept of areas. An area is a logical grouping of contiguous networks and routers. All routers in the same area have the same topology table, but they don't know about routers in the other areas. The main benefits of creating areas is that the size of the topology and the routing table on a router is reduced, less time is required to run the SFP algorithm and routing updates are also reduced. A router that has interfaces in more than one area is called **Area Border Router (ABR)**. A router that connects an OSPF network to other routing domains is called **Autonomous System Border Router (ASBR)**.

Single area OSPF is useful in smaller networks where the web of router links is not complex, and paths to individual destinations are easily deduced.

OSPF multi area will reduce the size of our link state database. In OSPF multi area split the routers into area, an area is simply a group of routers. Generally recommended to have less than 50 routers in an area there is no real harp limit. It is depend on the processing power of your routers, when it comes to designing the OSPF areas there's some planning that needs to be done, start with area zero this is known as **Backbone** area every other area must join to the backbone area and the routers interface with two or more areas called special routers this gives summarize roots from each area that connects the areas.

## 2. VERIFICATION COMMANDS OF AN OSPF (Open Short Path First)

### 2.1 show ip route

It shows the current state of the routing table, use the **show ip route** command.

### 2.2 show ip ospf border-routers

It shows the internal Open Shortest Path First (OSPF) routing table entries to an Area Border Router (ABR) and Autonomous System Boundary Router (ASBR), use the **show ip ospf border-routers**.

### 2.3 show ip ospf neighbor

It shows Open Shortest Path First (OSPF) neighbor information on a per-interface basis, use the **show ip ospf neighbor** command.

### 2.4 show ip protocols

It shows the parameters and the current state of the active routing protocol process, use the **show ip protocols** command.

### 2.5 show ip ospf

It shows general information about Open Shortest Path First (OSPF) routing processes, use the **show ip ospf** command.

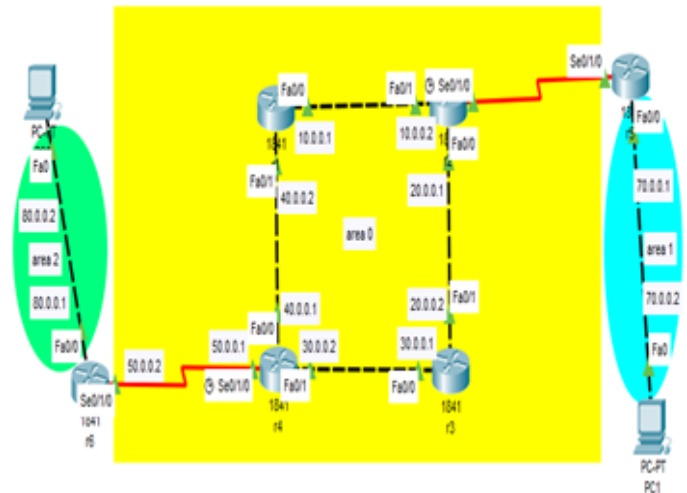


Fig-1: Network design

```
r6(config)#do show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
i - IS-IS, 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

O 10.0.0.0/8 [110/66] via 50.0.0.1, 00:12:46, Serial0/1/0
O 20.0.0.0/8 [110/66] via 50.0.0.1, 00:12:46, Serial0/1/0
O 30.0.0.0/8 [110/65] via 50.0.0.1, 00:12:46, Serial0/1/0
O 40.0.0.0/8 [110/65] via 50.0.0.1, 00:12:46, Serial0/1/0
C 50.0.0.0/8 is directly connected, Serial0/1/0
O 60.0.0.0/8 [110/130] via 50.0.0.1, 00:12:46, Serial0/1/0
O IA 70.0.0.0/8 [110/131] via 50.0.0.1, 00:11:23, Serial0/1/0
C 80.0.0.0/8 is directly connected, FastEthernet0/0
```

Fig-2 : Routing tabel of an r6 for OSPF protocol

```
r5(config)#do show ip ospf border-routers
OSPF Process 1 internal Routing Table

Codes: i - Intra-area route, I - Inter-area route

i 80.0.0.1 [130] via 60.0.0.1, Serial0/1/0, ABR, Area 0, SPF 130
```

Fig-3 : ABR and ASBR information of an r5 for OSPF protocol

```
r4(config)#do show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface
80.0.0.1 0 FULL/- 00:00:37 50.0.0.2 Serial0/1/0
30.0.0.1 1 FULL/DR 00:00:34 30.0.0.1 FastEthernet0/1
40.0.0.2 1 FULL/DR 00:00:39 40.0.0.2 FastEthernet0/0
```

Fig-4 : Neighbor information of an r4 for OSPF protocol

```
r5(config)#do show 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 70.0.0.1
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    60.0.0.0 0.255.255.255 area 0
    70.0.0.0 0.255.255.255 area 1
  Routing Information Sources:
    Gateway         Distance      Last Update
  30.0.0.1          110           00:28:29
  40.0.0.2          110           00:28:39
  50.0.0.1          110           00:27:54
  60.0.0.1          110           00:29:20
  70.0.0.1          110           00:02:56
  80.0.0.1          110           00:27:52
  Distance: (default is 110)
```

Fig-5: Information of active routing protocol process of an r5 for OSPF protocol

```
r2(config)#do show ip ospf
Routing Process "ospf 1" with ID 60.0.0.1
  Supports only single TOS(TOS0) routes
  Supports opaque LSA
  SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
  Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
  Number of external LSA 0. Checksum Sum 0x000000
  Number of opaque AS LSA 0. Checksum Sum 0x000000
  Number of DCbitless external and opaque AS LSA 0
  Number of DoNotAge external and opaque AS LSA 0
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  External flood list length 0
  Area BACKBONE(0)
    Number of interfaces in this area is 3
    Area has no authentication
    SPF algorithm executed 18 times
    Area ranges are
    Number of LSA 12. Checksum Sum 0x0671f2
    Number of opaque link LSA 0. Checksum Sum 0x000000
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
    Flood list length 0
```

Fig-6: Information of OSPF routing process of an r2 for OSPF protocol

```
Command Prompt
C:\>ping 80.0.0.2

Pinging 80.0.0.2 with 32 bytes of data:

Reply from 80.0.0.2: bytes=32 time=2ms TTL=123
Reply from 80.0.0.2: bytes=32 time=2ms TTL=123
Reply from 80.0.0.2: bytes=32 time=2ms TTL=123
Reply from 80.0.0.2: bytes=32 time=2ms TTL=123

Ping statistics for 80.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 2ms, Average = 2ms
```

Fig-7 : Ping from PC1 to PC0

```
Command Prompt
C:\>ping 70.0.0.2

Pinging 70.0.0.2 with 32 bytes of data:

Reply from 70.0.0.2: bytes=32 time=4ms TTL=123
Reply from 70.0.0.2: bytes=32 time=4ms TTL=123
Reply from 70.0.0.2: bytes=32 time=2ms TTL=123
Reply from 70.0.0.2: bytes=32 time=9ms TTL=123

Ping statistics for 70.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 9ms, Average = 4ms
```

Fig-8 : Ping from PC0 to PC1

```
Command Prompt
C:\>
C:\>tracert 80.0.0.2

Tracing route to 80.0.0.2 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    70.0.0.1
  2  1 ms    3 ms    1 ms    60.0.0.1
  3  0 ms    1 ms    1 ms    20.0.0.2
  4  10 ms   11 ms   11 ms   40.0.0.1
  5  11 ms   11 ms   11 ms   50.0.0.2
  6  13 ms   12 ms   13 ms   80.0.0.2
```

Fig-9 : Tracing the route from PC1 to PC0

```

Command Prompt
C:\>
C:\>tracert 70.0.0.2

Tracing route to 70.0.0.2 over a maximum of 30 hops:

  1  0 ms    0 ms    0 ms    80.0.0.1
  2  3 ms    1 ms    2 ms    50.0.0.1
  3  1 ms    3 ms    4 ms    40.0.0.2
  4  3 ms    11 ms   12 ms   20.0.0.1
  5  12 ms   12 ms   13 ms   60.0.0.2
  6  14 ms   12 ms   11 ms   70.0.0.2
    
```

**Fig-10** : Tracing the route from PC0 to PC1

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### 3. CONCLUSION

In this paper, we have described the configuration and verification of an OSPF Multi-Area. The network design is demonstrated using Cisco Packet Tracer simulator with OSPF routing protocol. The results show that the best route from PC1 to PC0 for OSPF protocol is r5-r2-r3-r4-r6 and best route from PC0 to PC1 for OSPF protocol is r6-r4-r3-r2-r5. OSPF has no hop limitations and is fast convergence time. It can be performed efficiently in large networks. Therefore, OSPF routing protocol can be used for large networks.

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