

# Open Shortest Path First- A Case Study

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**Abstract:** Open Shortest Path First routing protocol or simply OSPF routing protocol is an Internal Gateway Protocol (IGP) used to exchange routing information within an Autonomous System (AS). OSPF follows Link-state routing protocol rather than the distance-vector protocol. In Link-state routing protocol, each router describes itself and its interfaces to its directly connected objects unlike distance-vector routing protocol which sends its neighbour a list of all known networks along with its own distance to each one of these networks. It uses LSAs to advertise the distance to directly connected links. It is a classless protocol and supports VLSM (Variable Length Subnet Masking). It uses the concept of areas to implement hierarchical routing and area 0 is considered as the backbone area and area n, where n=1, 2, 3,.. is connected to the backbone area using virtual links. In this paper OSPF routing protocol is being configured in an AS and routing is carried out using LSAs. OSPF is preferred over other routing protocols because in OSPF only the new or updated values are transferred instead of sending the entire code and has fast convergence. We use network simulator 3 to build the situation and solve the problem. In this paper we also illustrate the setting of CTY, TTY, AUX and VTY password, create interface loopbacks to test the advertisement by OSPF routing protocol configured on each router and other aspects of OSPF routing protocol with great fervour.

**Keywords:** Open Shortest Path First routing protocol, Autonomous System (AS), CTY, TTY, AUX and VTY password, fast convergence, hierarchical routing, VLSM (Variable Length Subnet Masking), route summarization, interface loopbacks.

## I. INTRODUCTION

Open Shortest Path First Routing Protocol (OSPF) configured on routers to effectively move packets around the computer network. OSPF uses the Dijkstra shortest path first algorithm [1] to determine the shortest path. Edsger. W .Dijkstra thought about the shortest path problem during his early days as a programmer at the Mathematical Centre in Amsterdam. He proposed a graphical representation for a real time problem and a systematic solution to it. OSPF follows the Link-state routing protocol.

According to the Link-state routing protocol [2]

- Each router establishes a relationship-an adjacency-with each of its neighbors.
- Each router sends Link State Advertisements (LSAs)
- Each router stores a copy of all the LSAs it has seen in a database.
- The completed topological database, called the Link-state database, describes a graph of the internetwork.

Using the Dijkstra algorithm [1] the shortest path is calculated and routing table is updated.

The OSPF process builds and maintains the three separate tables:

- Neighbor table [3]
- Topology table [4]
- Routing table [5]

OSPF's functionality is different across several different network topology types.

- Broadcast Multi-Access
- Point-to-Point
- Point-to-Multipoint
- Non-broadcast Multi-access Network

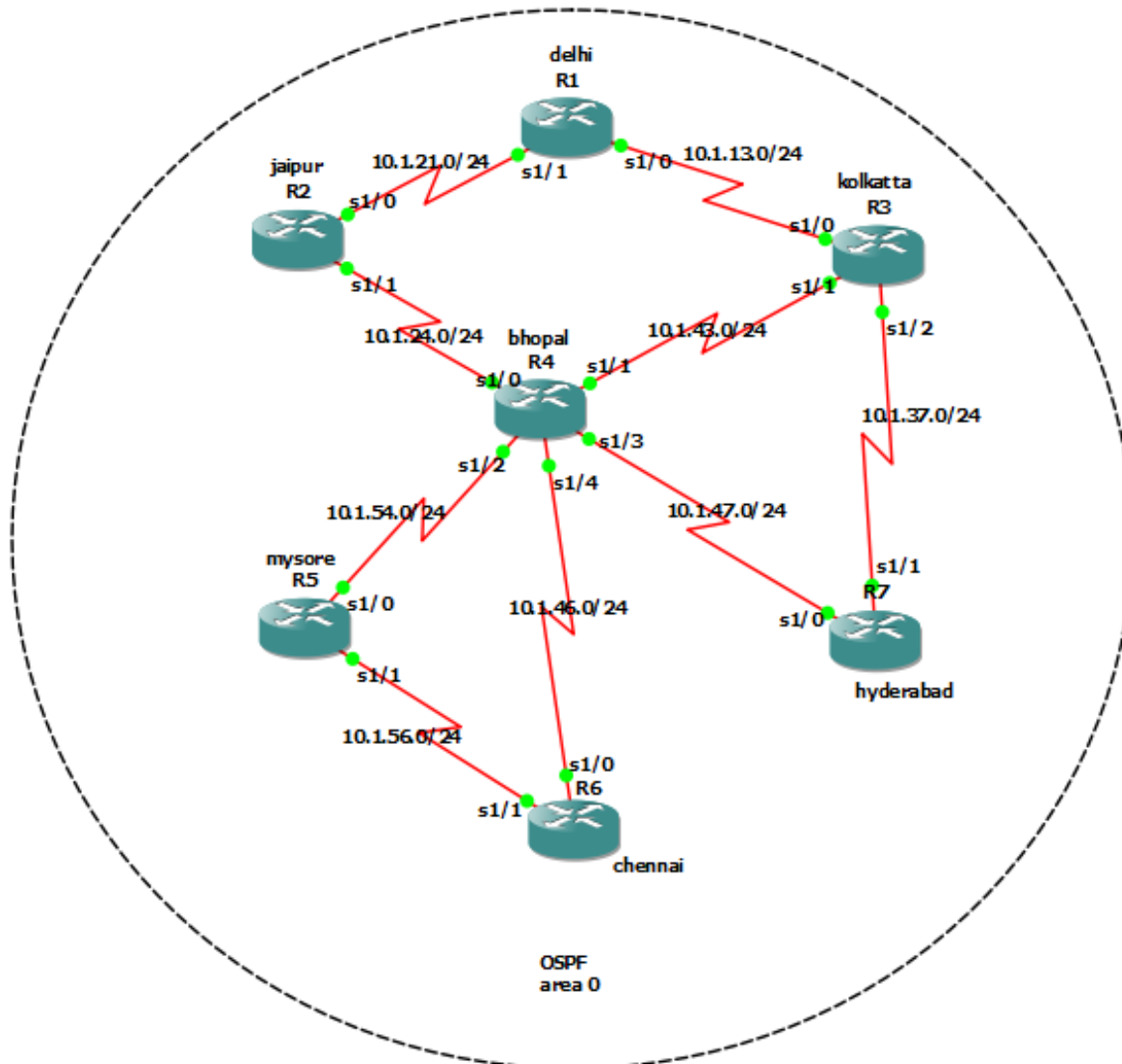


Figure 1 shows the network of interest.

```

bhopal#
bhopal#sh ip interface brief
Interface                IP-Address      OK? Method Status      Protocol
FastEthernet0/0          unassigned      YES unset    administratively down down
Serial1/0                 10.1.24.4       YES manual  up          up
Serial1/1                 10.1.43.4       YES manual  up          up
Serial1/2                 10.1.54.4       YES manual  up          up
Serial1/3                 10.1.47.4       YES manual  up          up
Serial1/4                 10.1.46.4       YES manual  up          up
Serial1/5                 unassigned      YES unset    administratively down down
Serial1/6                 unassigned      YES unset    administratively down down
Serial1/7                 unassigned      YES unset    administratively down down
SSLVPN-VIF0              unassigned      NO  unset    up          up
bhopal#

```

Figure 2 shows the router at bhopal and all its serial port interfaces.

## II. NETWORK

We have considered a network as shown in figure 1. OSPF area 0 is configured within the AS. Now each router communicate with each other by sending packets based on Link-state routing protocol and Dijkstra algorithm to find



the shortest path from source to a specific destination. In the above network, the routers R1, R2, R3, R5, R6 and R7 are connected in star topology to router R4 which is the central router and the most powerful router. A central router is selected in such a way that it is physically equidistant from all other routers. Further R3 is connected to R1 and R7, R6 to R5 and R1 to R2. These connections may be wired or wireless, CTY or TTY or AUX or VTY lines or underground. Figure 2 shows the router at bhopal and all its serial port interfaces. Figure 3 shows the router at kolkata and all its serial port interfaces. 3.3.3.3/24 and 33.33.33.33/24 are the interface loopback 0 and interface loopback 1 of router at kolkata respectively.

#### A. Setting CTY, TTY, AUX and VTY passwords

- CTY line

The CTY line-type is the console port. On any router, it appears in the router configuration as line con 0 and in the output of the show line as cty. It is mainly used for local system access using a console terminal.

- TTY lines

TTY lines are asynchronous lines used for inbound or outbound modem and terminal connections and can be seen in a router or access server configuration as line x. The specific line numbers are a function of the hardware built into or installed on the router or access server.

- VTY lines –

VTY line called the Virtual Terminal Lines of the router, used solely to control inbound telnet connections. There is no hardware associated with them.

- AUX line – It is the auxiliary port.

Figure 4 shows line con 0, line aux 0 and line vty 0 4 and password protection on CTY and VTY lines.

#### B. Telnet and ping

Figure 5 shows the effort to ping to IP address 10.1.56.5 from chennai and was successful. It also shows an effort by router at chennai to telnet IP address 10.1.47.4 to get remote access to router at Bhopal through VTY lines protected using password. After telnet an access to configure the router at bhopal is obtained. Ping is done to check the connectivity in a network by sending 5 packets. If the ping is successful, meaning all 5 packets were successfully echoed. There is proper network connection else there will be connection error and needs to be taken care of.

#### C. OSPF routing protocol

Figure 6 shows the router at Bhopal configured with OSPF routing protocol using show run command. Similarly all other routers are configured in the same manner. Interface loopbacks are created to test the advertisement by OSPF routing protocol configured on each router.

Figure 7 shows an effort by router at bhopal to ping to interface loopback 0 (3.3.3.3/24) at R3 (kolkata) to check proper OSPF routing and route advertisement. We were successful in our attempt. All 5 packets successfully sent and received with a average round trip time of 374ms and with a 2 second timeout.

```
*Jul 13 14:31:03.367: %OSPF-5-ADJCHG: Process 1, Nbr 7.7.7.7 on Serial1/2 from LOADING to FULL, Loading Done
kolkatta#sh ip interface brief
Interface                IP-Address      OK? Method Status      Protocol
FastEthernet0/0          unassigned      YES unset    administratively down down
Serial1/0                 10.1.13.3       YES manual   up          up
Serial1/1                 10.1.43.3       YES manual   up          up
Serial1/2                 10.1.37.3       YES manual   up          up
Serial1/3                 unassigned      YES unset    administratively down down
Serial1/4                 unassigned      YES unset    administratively down down
Serial1/5                 unassigned      YES unset    administratively down down
Serial1/6                 unassigned      YES unset    administratively down down
Serial1/7                 unassigned      YES unset    administratively down down
SSLVPN-VIF0              unassigned      NO  unset    up          up
Loopback0                 3.3.3.3         YES manual   up          up
Loopback1                 33.33.33.33    YES manual   up          up
kolkatta#
```

Figure 3 shows the router at kolkata and all its serial port interfaces.



```

!
line con 0
  exec-timeout 0 0
  privilege level 15
  password network
  logging synchronous
  login
  stopbits 1
line aux 0
  exec-timeout 0 0
  privilege level 15
  logging synchronous
  stopbits 1
line vty 0 4
  password network
  logging synchronous
  login
!
end
bhopal#

```

Figure 4 shows line con 0, line aux 0 and line vty 0 4 and password protection on CTY and VTY lines.

```

chennai#telnet 10.1.47.4
Trying 10.1.47.4 ... Open

User Access Verification

Password:
bhopal>en
Password:
bhopal#

Building configuration...
[OK]
chennai#
chennai#ping 10.1.56.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.56.5, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 188/255/384 ms
chennai#

```

Figure 5 shows the effort to ping to IP address 10.1.56.5 from chennai and was successful.

### III. CONCLUSIONS

Choosing a routing protocol is as equally important as choosing the right network topology when it comes to communication. In this paper we have preferred the Open Shortest Path First (OSPF) routing protocol because of its advantages as a Link-State routing protocol. After initialization, OSPF only sends updates on routing table sections which have changed; it does not send the entire routing table. Using areas, OSPF networks can be logically segmented to decrease the size of the routing table and also by using route summarization.

```
serial restart-delay 0
!
router ospf 1
 log-adjacency-changes
 network 10.1.13.1 0.0.0.0 area 0
 network 10.1.13.3 0.0.0.0 area 0
 network 10.1.21.1 0.0.0.0 area 0
 network 10.1.21.2 0.0.0.0 area 0
 network 10.1.24.2 0.0.0.0 area 0
 network 10.1.24.4 0.0.0.0 area 0
 network 10.1.37.3 0.0.0.0 area 0
 network 10.1.37.7 0.0.0.0 area 0
 network 10.1.43.3 0.0.0.0 area 0
 network 10.1.43.4 0.0.0.0 area 0
 network 10.1.46.4 0.0.0.0 area 0
 network 10.1.46.6 0.0.0.0 area 0
 network 10.1.47.4 0.0.0.0 area 0
 network 10.1.47.7 0.0.0.0 area 0
 network 10.1.54.4 0.0.0.0 area 0
 network 10.1.54.5 0.0.0.0 area 0
 network 10.1.56.5 0.0.0.0 area 0
 network 10.1.56.6 0.0.0.0 area 0
!
ip forward-protocol nd
```

Figure 6 shows the router at Bhopal configured with OSPF routing protocol using show run command.

```
Router#
bhopal#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 = 196/374/700 ms
bhopal#
```

Figure 7 shows an effort by router at bhopal to ping to interface loopback 0 (3.3.3.3/24) at R3 (kolkata) to check proper OSPF routing and route advertisement.

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