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Simulation of OSPF and EIGRP on a Computer Network

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Abstract: A Communication Network consists of many interconnected nodes, sharing resources linked through communication channels. Routers, switches and other network elements are placed at the nodes, carrying out communication as per certain protocols applied on the network. The packets or frames are guided to their destination through the shortest path as defined by these protocols configured on the network. In this paper, we have considered a network consisting of routers placed at the nodes, linked by serial interfaces. OSPF is configured on the network for the packets to reach the destination through the shortest path. Open Shortest Path First (OSPF) is a dynamic and classless routing protocol. We have used Variable Length Subnet Masking (VLSM), during IP addressing in the network. The network is password protected and encrypted. Any router can be remotely accessed using Telnet. We have used GNS 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. Enhanced Interior Gateway Routing Protocol (EIGRP) is another dynamic routing protocol which can guide the packets to their intended destination, choosing the shortest path. Technical difference between EIGRP and OSPF is well highlighted in this paper with a live example/ problem statement.

Keywords: Open Shortest Path First (OSPF) Routing Protocol, CTY, TTY, AUX and VTY, Password Protected, VLSM (Variable Length Subnet Masking), Encrypted, Enhanced Interior Gateway Routing Protocol (EIGRP)

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 to determine the shortest path in the network. OSPF follows the Link-state routing protocol.

- Each router establishes a relationship-an adjacency-with each of its neighbors.
- Each router sends Link State Advertisements (LSAs) and each OSPF area is flooded with Link State Advertisements
- 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.

EIGRP is a Distance vector routing protocol. Unlike OSPF it doesn't employ LSA packets and is not as complex as OSPF. It doesn't employ the concept of areas. EIGRP updates contain metrics such as [2]

- Minimum bandwidth
- Delay
- Load
- Reliability
- MTU

II. PROBLEM STATEMENT

To build a communication network consisting of routers at the nodes, forwarding packets to intended destination. To configure Open Shortest Path First (OSPF) routing protocol and Enhanced Interior Gateway Protocol (EIGRP) on the network using VLSM IP addressing scheme.[3] The network needs to be password protected and encrypted. Setting of CTY and VTY password, create interface loopbacks to test the advertisement by OSPF routing protocol configured on each router. Telnet protocol to remotely access the target router(s). The difference between EIGRP and OSPF routing protocols needs to be experimentally analysed.

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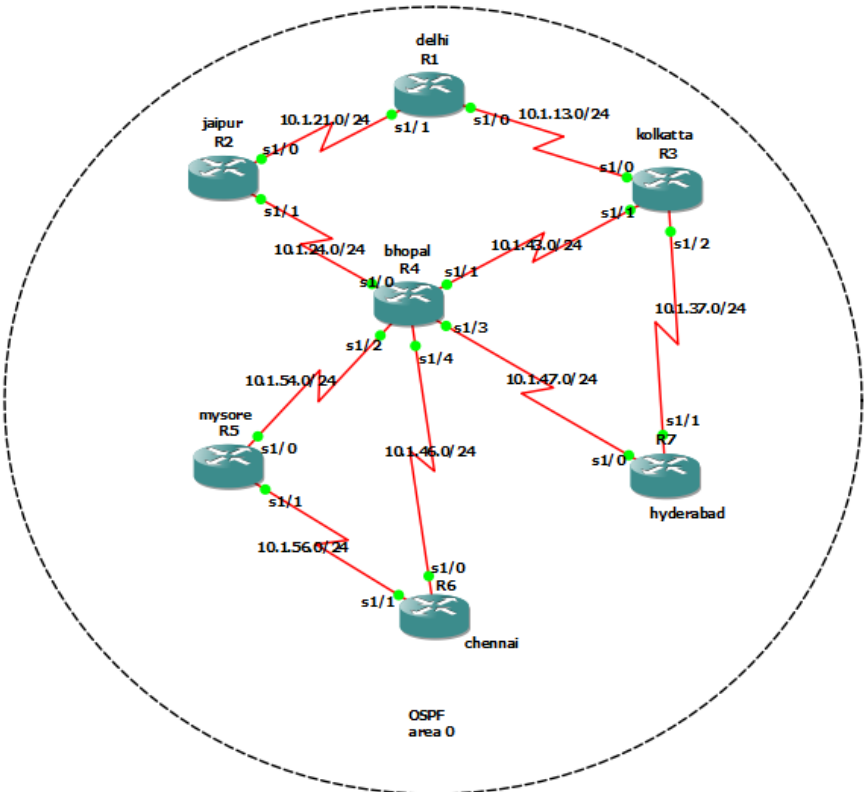

Figure 1 shows the network of interest.

```
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.

III. NETWORK

We have considered a network as shown in figure 1. OSPF area 0 is configured within the AS. Each router communicates 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 is connected in star toplogy 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.

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- VTY lines – VTY line called the Virtual Terminal Lines of the router, used solely to control inbound telnet connections. There is no hardware associted with them.
- AUX line – It is the auxilary 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 acccess 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 successgul, 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.[4]

```
*Jul 13 14:31:03.367: %OSPF-5-ADJCHG: Process 1, Nbr 7.7.7.7 on Serial1/2 from LOADING to FULL,
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.

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```
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.

D. EIGRP routing protocol

Unlike OSPF, EIGRP doesn't contain areas. Figure 7 shows the configuration of EIGRP on a router. A stub router is selected and an effort is made to ping to 10.1.12.1 and was successful.[5]

IV. CONCLUSION

Efforts were made to build a communication network, consisting of routers at different nodes and configured with OSPF to effectively forward / route the packet along the network to intended destination. EIGRP was also configured on the same network and encryption carried out. Various tests were conducted on the network to check the active participation of each router and the links interconnecting them. ICMP packets successfully echoed across the network indicating 100% success rate during PING. VTY, CTY and line console passwords were successfully set and the packets encrypted. On Telnet we were able to take remote access through VTY lines. It was found that OSPF is more complex than EIGRP.

```
 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.

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```
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.

```
!
interface Serial1/0
 ip address 10.1.12.1 255.255.255.0
 ip authentication mode eigrp 100 md5
 ip authentication key-chain eigrp 100 r1
 serial restart-delay 0
 clock rate 64000
!
interface Serial1/1
 ip address 10.1.13.1 255.255.255.0
 ip authentication mode eigrp 100 md5
 ip authentication key-chain eigrp 100 r1
 serial restart-delay 0
 clock rate 64000
!
```

Figure 7 shows the configuration of EIGRP on a router

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BIOGRAPHY

VISHESH S born on 13th June 1992, hails from Bangalore (Karnataka) and has completed B.E in Telecommunication Engineering from VTU, Belgaum, Karnataka in 2015. He also worked as an intern under Dr. Shivananju BN, former Research Scholar, Department of Instrumentation, IISc, Bangalore. His research interests include Embedded Systems, Wireless Communication, BAN and Medical Electronics. He is also the Founder and Managing Director of the corporate company Konigtronics Private Limited. He has guided over a thousand students/interns/professionals in their research work and projects. He is also the co-author of many International Research Papers. He is currently pursuing his MBA in e-Business and PG Diploma in International Business. Presently Konigtronics Private Limited has extended its services in the field of Software Engineering and Webpage Designing. Konigtronics also conducts technical and non-technical workshops on various topics.