PROJECT REPORT

A Comparative Study on Routing Protocols: RIP, OSPF and EIGRP and Their Analysis Using GNS-3

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CONTENTS:

OBJECTIVE/ PROBLEM STATEMENT:

A Comparative Study on Routing Protocols: RIP, OSPF and EIGRP using convergence time.

INTRODUCTION:

Brisk development of technology results in the advancement of communication network technologies. In Internet networks, dynamic routing protocols are used more commonly rather than static routing protocols. So, we need to design a new dynamic routing protocol which can update the changes in the network automatically without the human intervention [1]. Some dynamic routing protocols are using in networks, such as RIP version 1 and 2, OSPF version 2 and 3, EIGRP. All these routing protocols have their own merits and demerits. Based on the application and parameters either one or many of the protocols are used in any network.

Routing methods in networks:

In static routing, an entry for a route is configured to the router manually. This type of routing is also called nonadaptive routing since while sending data, the router makes use of a static route. In this technique, network administrator writes routing entries in the routing table manually using commands while configuring. For network securities static routing is useful. Static routing does not re-route the routes if there is any modification or failure in the network. Static routing configuration in GNS3 software is done using the following commands: R1# configure terminal //Enter to the configuration mode R1(config)# ip route 13.1.1.1 255.255.255.0 192.168.2.1 The above command makes entry for a static route i.e. if any packet destinated to address 13.1.1.1 then its next hop is 192.168.2.1. In dynamic routing techniques, routers communicate with each other and learn the topology of the network and adapt to a changing environment, and prepares their routing table. This type of routing is called adaptive routing since while sending data, the router makes use of dynamic routes automatically by adapting to network changes or failure. Routing protocols like RIP, OSPF, EIGRP, IGRP, and IS-IS are belonging to a dynamic protocol.

A. Routing Information Protocol (RIP)

Routing Information Protocol (RIP) is a distance vector type of routing protocol, which use a simple algorithm and its implementation is easy, so it is widely used in most of the networks . The number of in-between devices by which data reaches to a destination from the source is called a hop count. RIP uses number hop count (distance) as a metric to decide the best route from the source to the destination

• Each router in the network maintains a routing table, which indicates the distances to other routers in the network.

• The routing table of a router keeps the information of each network it knows and how to reach along with the next hop router address of the same network through which a packet has to reach its destination.

• In case any update receives by a router about a new path and is shorter, then the router will update its routing table entry with the length and next-hop address of the shortest path; else router will wait for later updates till the “hold-down” period if later updates show the higher metric then it leaves routing table as it is.

• RIP makes every routers to transmit their whole routing table to closest neighbor every 30 seconds.

1) RIPv1: Routing Information Protocol version 1

(RIPv1) is a basic distance vector type protocol. It has been incorporated with various techniques such as Split Horizon and Poison Reverse to enable it to perform better in complicated networks.

• Its longest path is 15 hops and 16 hops or above is treated as not reachable.

• RIP uses a static metric to compare routes.

• RIP uses the broadcast address to update.

• Maximum datagram size is 512 bytes without IP or UDP bytes.

2) RIPv2: Routing Information Protocol version 2

(RIPv2) is an updated version of RIPv1 it has been added with several features compared with ,

• Next hop router addresses.
• Authentication.
• Multi-cast support.

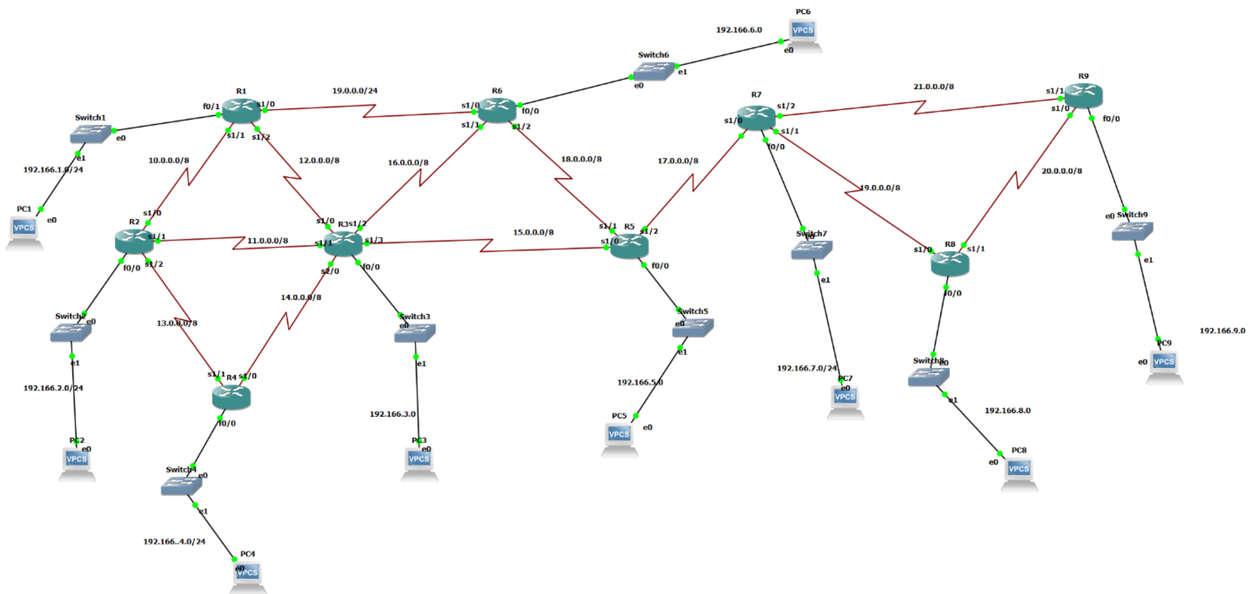
B. Open Shortest Path First (OSPF)

Open Shortest Path First (OSPF) is a link state type of routing protocol. It is an open standard protocol. It uses cost as a metric for its operation. It assumes that speed is high for lower cost i.e. speed is indirectly proportional to the cost. OSPF chooses a low-cost path for the transmission. In OSPF router makes use of Hello packet exchanges to identify its neighbors. The router checks its neighbor table for the entry if it exists ignore otherwise it will be added. Once the routers become neighbors, they exchange Link State Advertisement (LSA) packets to build their Link State Database (LSDB) table. The shortest path algorithm is used to select the best path.
OSPF uses seven states through which routers must undergo to form neighborship which is mentioned below:
• Down: Routers choose their Router ID (RID) in this state. RID is unique within the autonomous system. Router identifies each other using the RID.
• Attempt/Init: Neighborship building process starts from this state. In this state, a router generates and sends Hello packet to all its active interfaces. The Hello packet contains RID and a few essential configuration values. Routers refer to their neighboring table and update it.
• Two ways: Routers enters to two-way state when two routers become a neighbor by exchanging Hello packets.
• Exstart: In this state routers builds adjacency and decides who is going to be master and who is slave. Initial sequence number will be established.
• Exchange: Master and slave routers decide how much information needs to be exchanged.
• Loading: Actual routing information between routers will be exchanged. Routers use Link State Update (LSU) to exchange LSAs.
• Full state: Routers under state indicate that routers have exchanged all LSAs from Link State Request (LSR) list. Routers have identical LSDB

C. Enhanced Interior Gateway Routing Protocol (EIGRP)

The Enhanced interior gateway routing protocol (EIGRP) is an advanced distance-based vector type of routing protocol. It finds the best path using distance vector and link state algorithm. Its design is simple and easy to configure. It uses both delay and bandwidth as a metric. Whenever a network topology changes by the addition or deletion of a router, EIGRP applies three steps viz discovering a neighbor, exchanging of topology, and choose a router. Hello packet containing essential parameters is used by EIGRP routers to decide whether the router should become neighbor or not. Routers broadcast a topology change information when there is a topology change in the network so that they can update the changes. Each router in the network refers to the topology table to decide the best path as per the metric. A route with the lowest metric is chosen for the best path. EIGRP algorithm makes every router to calculate the two paths for every destination: successor and feasible successor. In case of failure in the successor path, EIGRP makes the router to follow the feasible successor without any route calculation like OSPF. Thus, EIGRP provides better convergence time compared with OSPF and RIP. Every router refers to the topology table for choosing the best route based on the cost metric. The lowest cost route will be selected. EIGRP performs better in large enterprise level networks since it utilizes fewer resources compared to that of link state Interior Gateway Protocol (IGP). Therefore, EIGRP is one of the best distance vectors IGP available.

BLOCK NETWORK TOPOLOGY:



The designed network topology consists of nine ethernet switches and nine Cisco c2691 routers and nine Virtual Personal computers (VPCs) as shown. The details of the router and switches used in the network topology are shown below:

- Ethernet Switch has eight ports of type “access” and with VLAN 1.
- Cisco c2691 Router has eighteen Fast Ethernet and five Serial ports.

PROCEDURE:

An enterprise level network is designed using GNS3. A real-time device environment is created in GNS3 and applied RIP, OSPF, and EIGRP routing algorithms for a chosen device environment. Packets are analyzed to compare the performances of the algorithms. In RIP, routers exchange the routing table information every 30 seconds whereas in OSPF routers exchanges Hello packets at every 10 seconds by default, and in EIGRP Hello packet exchanges at every 5 seconds by default. In the case of OSPF when there is any addition or deletion of a router or any route is updated because of any link down or up, it sends the updated data and not the whole routing database. When a change occurs (addition or deletion of a router or any route changed), EIGRP sends only modified data of the routing table instead of the whole table. Therefore, OSPF outperforms RIP and EIGRP in terms of delay time and, EIGRP outperforms OSPF and RIP in terms of convergence time.

RESULT:

Convergence time is the time taken by a routing protocol to decide the new best path from a source to a destination when a path is failed or a new path is added in the network. To find the convergence time of RIP, OSPF and EIGRP we are transmitting packets with datagram size 200 and timeout of 3s to the targeted destination from a source with a repeat count of 600. We are blocking a path between the source and the targeted destination to determine the convergence time. By blocking a path few packets start dropping depends upon the type of routing protocol until the new path is chosen and decided by a router. Convergence time will be calculated by multiplying the number of packets lost with a timeout. This process is repeated six times and the average convergence time is calculated. The time taken to converge the traffic depends upon the routing protocol type. In this paper, we determine the convergence time of RIP, OSPF, and EIGRP for the chosen network topology shown. For the topology shown, we consider source as PC1 and targeted destination as a PC9. PC1 is connected to router R1 and PC9 is connected to router R9. PC1 is configured with an IP address of 192.168.1.2 255.255.255.0 with a gateway address of 192.168.1.1. PC9 is configured with an IP address of 192.168.9.2 255.255.255.0 with a gateway address of 192.168.9.1.

```
Gateway of last resort is not set

R    17.0.0.0/8 [120/2] via 19.0.0.2, 00:00:22, Serial1/0
                [120/2] via 12.0.0.2, 00:00:05, Serial1/2
R    16.0.0.0/8 [120/1] via 19.0.0.2, 00:00:22, Serial1/0
                [120/1] via 12.0.0.2, 00:00:05, Serial1/2
     19.0.0.0/24 is subnetted, 1 subnets
C       19.0.0.0 is directly connected, Serial1/0
R    18.0.0.0/8 [120/1] via 19.0.0.2, 00:00:22, Serial1/0
R    192.166.8.0/24 [120/4] via 19.0.0.2, 00:00:22, Serial1/0
                    [120/4] via 12.0.0.2, 00:00:05, Serial1/2
R    21.0.0.0/8 [120/3] via 19.0.0.2, 00:00:25, Serial1/0
                [120/3] via 12.0.0.2, 00:00:08, Serial1/2
R    192.166.9.0/24 [120/4] via 19.0.0.2, 00:00:25, Serial1/0
                    [120/4] via 12.0.0.2, 00:00:08, Serial1/2
R    20.0.0.0/8 [120/4] via 19.0.0.2, 00:00:26, Serial1/0
                [120/4] via 12.0.0.2, 00:00:09, Serial1/2
R    192.166.4.0/24 [120/2] via 12.0.0.2, 00:00:10, Serial1/2
                    [120/2] via 10.0.0.2, 00:00:12, Serial1/1
R    192.166.5.0/24 [120/2] via 19.0.0.2, 00:00:27, Serial1/0
                    [120/2] via 12.0.0.2, 00:00:10, Serial1/2
C    10.0.0.0/8 is directly connected, Serial1/1
R    192.166.6.0/24 [120/1] via 19.0.0.2, 00:00:27, Serial1/0
R    11.0.0.0/8 [120/1] via 12.0.0.2, 00:00:11, Serial1/2
                [120/1] via 10.0.0.2, 00:00:13, Serial1/1
R    192.166.7.0/24 [120/3] via 19.0.0.2, 00:00:00, Serial1/0
                    [120/3] via 12.0.0.2, 00:00:11, Serial1/2
C    12.0.0.0/8 is directly connected, Serial1/2
C    192.166.1.0/24 is directly connected, FastEthernet0/1
R    13.0.0.0/8 [120/1] via 10.0.0.2, 00:00:15, Serial1/1
R    192.166.2.0/24 [120/1] via 10.0.0.2, 00:00:15, Serial1/1
R    14.0.0.0/8 [120/1] via 12.0.0.2, 00:00:12, Serial1/2
R    192.166.3.0/24 [120/1] via 12.0.0.2, 00:00:13, Serial1/2
R    15.0.0.0/8 [120/1] via 12.0.0.2, 00:00:13, Serial1/2
R1#
```

RIP Configured Routing Table of Router R1.

From the above table it is observed that source (PC1) has two paths to the targeted destination (192.168.9.0) i.e. via 19.1.1.2 through R6 and via 12.1.1.2 through R3. A packet with a datagram size of 200 and a timeout of 3s transmit from the source user (PC1) to the targeted user (PC9) with a repeat count of 600. During the transmission of packets, we have blocked port S1/0 of router R6 to calculate the convergence time. We found the loss of a few packets during the convergence of traffic. We know that the packets have time out of 3s. Convergence time can be calculated by multiplying the number of packets lost with packet timeout and this process we have continued four times and the average is taken. Protocol feature to react to a path failure and offer a new best path based on the type of routing protocol. Figures below will show the number packets lost during the convergence for RIP protocol and which are noted and is found that average convergence time using RIP protocol of six attempts is 12 seconds.

RIP Configuration when port S1/0 of R6 is blocked attempt 1,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
.........
*Mar  1 01:43:02.391: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0, changed state to down..!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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Success rate is 98 percent (589/600), round-trip min/avg/max = 80/146/324 ms
R1#
```

RIP Configuration when port S1/0 of R6 is blocked attempt 2,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
.......
*Mar  1 00:38:12.027: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0, changed state to down..!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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Success rate is 98 percent (591/600), round-trip min/avg/max = 100/136/196 ms
R1#
```

RIP Configuration when port S1/0 of R6 is blocked attempt 3,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
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Success rate is 100 percent (600/600), round-trip min/avg/max = 80/140/2980 ms
R1#
```

The next few figures show the number packets lost during the convergence for OSPF protocol and which are noted and is found that average convergence time using OSPF protocol of six attempts is 9 seconds.

OSPF Configuration when port S1/0 of R6 is blocked attempt 1,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
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Success rate is 99 percent (599/600), round-trip min/avg/max = 104/136/172 ms
R1#
```

OSPF Configuration when port S1/0 of R6 is blocked attempt 2,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
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Success rate is 99 percent (599/600), round-trip min/avg/max = 124/166/204 ms
R1#
```

OSPF Configuration when port S1/0 of R6 is blocked attempt 3,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
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Success rate is 99 percent (599/600), round-trip min/avg/max = 132/166/204 ms
R1#
```

Figures next show the number packets lost during the convergence for EIGRP protocol and which are noted and the average convergence time using EIGRP protocol of six attempts is 3 seconds. Henceforth, OSPF has the lowest delay time and from the results we found that EIGRP has the lowest convergence time; because EIGRP maintains a feasible successor (which is the next best path in case of failure in the best path). So EIGRP offers a new path within a few seconds. Therefore, we found that EIGRP performs better than OSPF and RIP with respect to convergence time.

EIGRP Configuration when port S1/0 of R6 is blocked attempt 1,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
.!!!!!!
*Mar  1 00:43:32.123: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/0, changed state to down!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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Success rate is 99 percent (599/600), round-trip min/avg/max = 112/165/320 ms
R1#
```

EIGRP Configuration when port S1/0 of R6 is blocked attempt 2,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
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Success rate is 99 percent (599/600), round-trip min/avg/max = 112/175/588 ms
R1#
```

EIGRP Configuration when port S1/0 of R6 is blocked attempt 3,

```
R1#ping 192.166.9.100 repeat 600 size 200 timeout 3

Type escape sequence to abort.
Sending 600, 200-byte ICMP Echos to 192.166.9.100, timeout is 3 seconds:
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 99 percent (599/600), round-trip min/avg/max = 112/172/300 ms
R1#
```

CONCLUSION:

Routing protocols like RIP, OSPF, and EIGRP are applied for an enterprise level designed topology and analyzed their performances using GNS3. The RIP algorithm is simple and easier to configure and implement the routers compared with EIGRP and OSPF. An Authenticated secure connection is established between the routers by providing username and password through point-to-point protocol. parameters like delay and convergence time are determined for the designed topology. Convergence time is the primary concern in any network Performance. Results of the simulation show that EIGRP and OSPF have a better delay time compared with RIP. **Results of the simulation show that the EIGRP has the least convergence time compared with OSPF and RIP. It can be concluded that for an enterprise level network EIGRP is the best routing protocol.**

REFERENCES:

[1] V. Bahl, “Performance issues and evaluation considerations of web traffic for rip & ospf dynamic routing protocols for hybrid networks using opnet,” 2012.

[2] D. Xu and L. Trajkovic, “Performance analysis of rip, eigrp, and ospf using opnet,” 05 2012.

[3] S. U. Masruroh, K. H. P. Widya, A. Fiade, and I. R. Julia, “Performance evaluation dmvpn using routing protocol rip, ospf, and eigrp,” in 2018 6th International Conference on Cyber and IT Service Management(CITSM),2018,pp.1–6

[4] M. Jayakumar, N. Ramya Shanthi Rekha, and B. Bharathi, “A comparative study on rip and ospf protocols,” in 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), 2015, pp. 1–5.