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International
Journal
Of Modern Engineering Research (IJMER)

Comparative Analysis of Various Routing Protocols

Mirza Waseem Hussain [1], Sanjay Jamwal [2]
*(Baba Ghulam Shah Badshah University, India
** (Baba Ghulam Shah Badshah University, India)

ABSTRACT:- *With the recent advancement in the information and communication technology the amount of data over the World Wide Web has increased many folds resulting in the increase of packet count in the network. These packets need to be routed from source to destination in reliable and timely fashion. So routing plays an important role in forwarding the packets from source to destination. In this paper we analyzed and performed comparative analysis for different routing protocols like RIP, OSPF and EIGRP using Riverbed Modeler Academic Edition 17.5.*

Keywords:- *MTU, RIP, OSPF, EIGRP, Routing Protocols, MD5, UDP, IGP.*

I. INTRODUCTION

Routing is the process of communicating information across the internetwork from source to destination. Routing Protocols specifies how the information about the links like bandwidth, link failure and error rate is communicated between the routers. It includes the process of selecting the best route in a network, based on various routing metrics used by different protocols. The various metrics are [1]

- Reliability of the link.
- Length of the path.
- Available Bandwidth.
- Delay in a network.
- System load.
- Cost of communication.

Some protocols use multiple metrics and others combine the routing metrics to form a single hybrid metric.

II. TYPES OF ROUTING PROTOCOLS

The fundamental functioning of internet routing is the forwarding of packets [2].Routers use routing protocols to guide the packets to their destination. The routing protocols have been broadly classified into two classes; dynamic and static, while dynamic has been further divided into subclasses as show in Fig. 1.

1. Static and Dynamic routing protocols

In the Static routing the configuration file is manually populated by the administrator of the system by entering the route information into the device routing table. In this type of routing, changes if any, need to be incorporated manually by administrator. For 5 to 10 systems it works well, but as the number increases, the approach becomes almost impractical. To overcome the limitations of the static routing, dynamic routing is used which allows the routers to select the best path on the real time network topology. In this paper, only RIP, OSPF and EIGRP Protocols will be discussed.

1.1 Routing Information Protocol (RIP)

Routing Information Protocol is one of the oldest distance vector protocol using hop count as a metric [3][4][5][6].The RIP is interior gateway protocol (IGP), means this protocol can work within the autonomous system. It is formally described in RFC 1058 [7].RIP has evolved over a period of time to RIP2.The main difference being addition of authentication using Message-digest algorithm (MD5) and subnetting which was absent in former version. For message encapsulation the RIP uses port number 520 [8].The message consists of two parts.

- Request message: Request Message is send to the neighbouring routers conveying them to send the update.
- Response Message: It is the response of the neighbouring routers that contains the update of route.

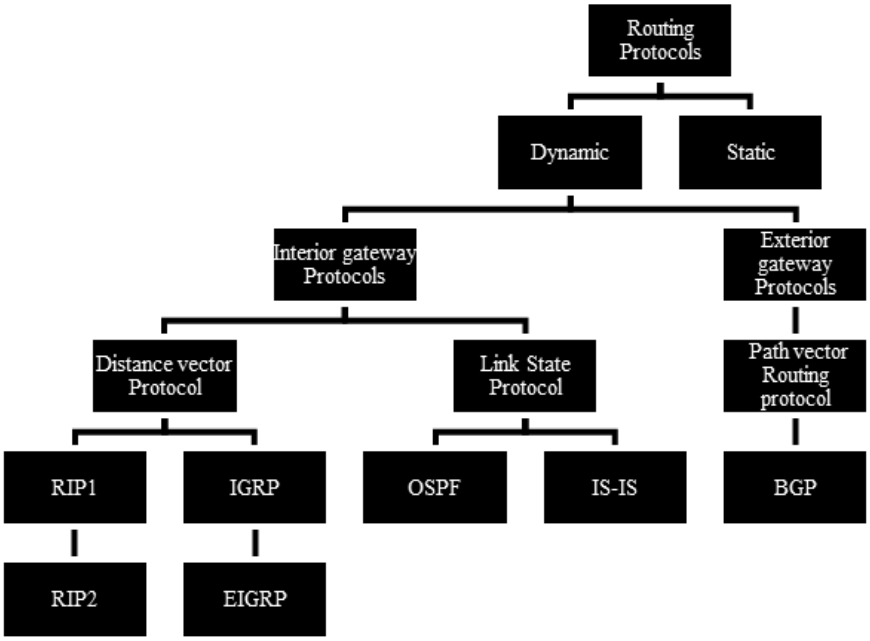

Figure 1 Representing classification of Routing Protocols

The RIP broadcasts the route information every 30 seconds by UDP to reflect the changes in the topology of the network .The maximum hop count the RIP supports is 15 to prevent route looping in the network. RIP based approach is usually used for small to medium scale network. For larger network this approach is not reliable, due to limitation of hop count it supports. Also it does take into consideration the factors like delay, reliability or bandwidth.

Advantages.

- Relative simple than other protocols.

Disadvantages.

- No concept of subnetting.
- Takes into account only Hop count metric to calculate the best route.
- Supports up to a maximum of 15 Hop counts.
- Slow convergence.

1.2 Open Shortest Path First (OSPF)

Open Shortest Path First (OSPF) is a link state protocol also know by the name of shortest path routing protocol, as it calculates the finest route in the network that is the shortest path from source to destination[9].The OSPF routing protocol is defined in the version 2 of RFC 2328 [2] [10] [11] based on link state algorithm. For each router within the province contains the database known as link state database, comprising list of routers in the network. Each and every router will have same list of routers used to define the topology of the network. Each router with itself as root constructs a shortest path tree using bandwidth as cost matric of sending packet across a certain interface, higher the bandwidth lower the cost and vice versa, calculated as:

$$\text{Cost} = (10^8/\text{bandwidth (bps)}) \quad (1)$$

There are five different types of packets in OSPF with their own specific purpose.

- Description of Database.
- Hello packet.
- Request update of link state.
- Link state update.
- Acknowledgement message of link state.

The exchange of information between the routers is done by flooding of link state advertisement. Each time the topology of the network changes link state advertisement is flooded.

Advantages
- Can handle variable length subnet mask.
- No limitation of hop counts.
- Converges faster as compared to RIP.
- Loop free routes are always determined.

Disadvantages
- Requirement of memory is much more.
- Difficult to configure.

1.3 Enhanced Interior gateway routing protocol

Enhanced Interior gateway routing protocol is the cisco proprietary combining the best features of both link state and distance vector routing protocol [3-6] [10-12], supporting maximum of 224 hop counts. EIGRP supports multiple routing protocols like IP, IPX, AppleTalk by using the concept of Protocol Dependent Module (PDM).Route in EIGRP is calculated by Diffusion Update Algorithm (DUAL) using bandwidth, reliability, Delay, load and maximum transmission unit (MTU) as a possible components for metric calculation. EIGRP makes use of three tables – Topology table, Neighbor table and Routing table for its normal operation. The EIGRP sends partial and incremental updates of routing table to make efficient utilization of bandwidth. Each router has a neighbor data structure containing the state information about its head-to-head neighbor. A Router with EIGRP protocol stores the routing table information of all of its neighbors. If no appropriate route is discovered, EIGRP inquiries its neighbors until one of the alternate route is found.

Advantages
- Supports Authentication.
- Uses Variable Length Subnet Mask (VLSM) and Classless Inerter Domain Routing (CIDR).
- Easy to configure.
- Converges very fast.

Disadvantages
- Sole propitiatory of CISCO.
- All the vendors are not able to utilize the EIGRP.

The Summary of RIP, OSPF and EIGRP is presented in Table I

Table I. Summary of RIP, OSPF and EIGRP.

Protocols	Hop Count	Security	Metric used	Support for Subnetting	Type	Standard
RIP	15	MD5	Hop Count	No	Distance vector	Open
OSPF	No	MD5	Shortest Path	Yes	Link state	Open
EIGRP	224	MD5	Bandwidth, reliability, Delay, load and maximum transmission unit (MTU)	Yes	Hybrid	Cisco Propriety

III. SIMULATION AND RESULTS

In this scenario we have designed network using Hybrid – Star, Ring topology comprising of 20 slip8_gateway via PPP_DS3 links using Riverbed Modeler Academic Edition 17.5. We have constructed three scenarios of this hybrid topology, first one using Routing Information Protocol (RIP) as shown in Fig.2.Second one uses OSPF as shown in Fig.3 and the third Scenario uses EIGRP as shown in Fig.4. The simulation is set to be 20 minutes, the first failure is set to 200 seconds and recovery time is set to 400 seconds. The second failure is set to 500 seconds with recovery time set as 600.

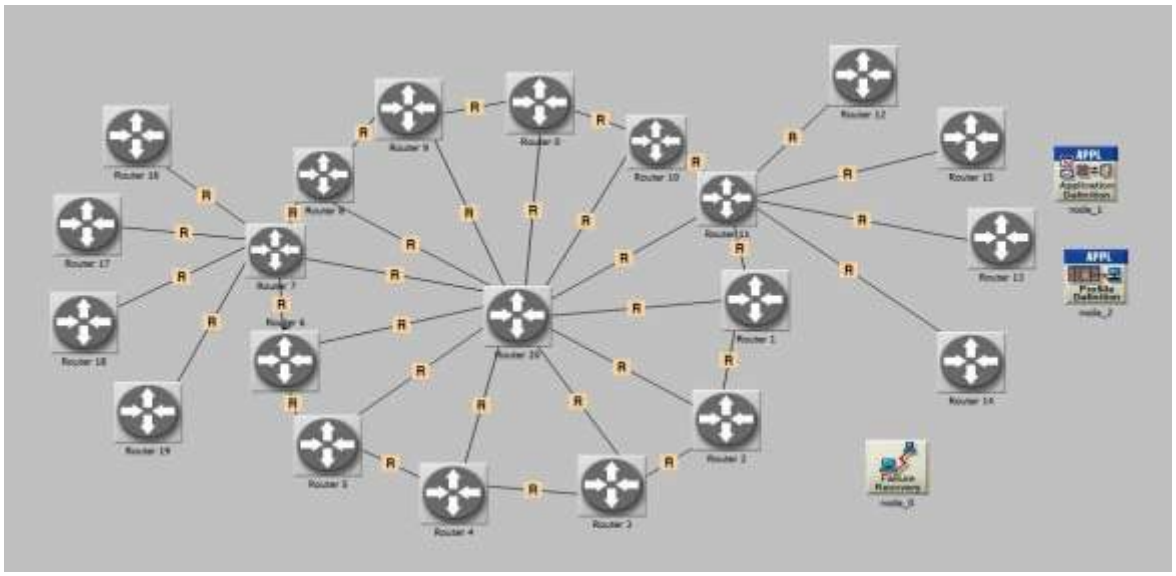

Figure 2 Hybrid Network using RIP

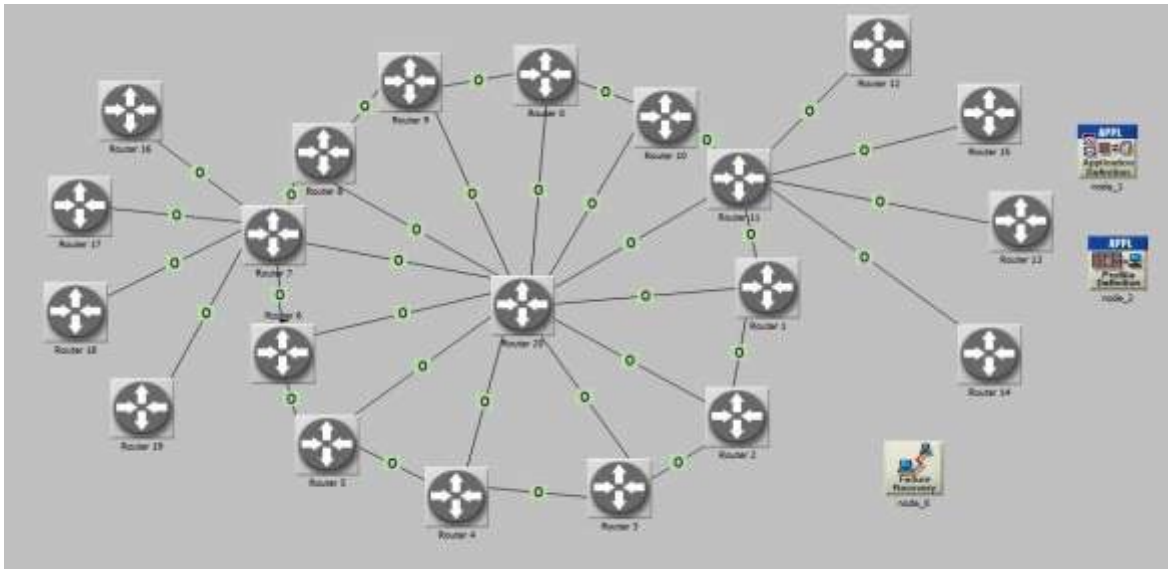

Figure 3 Hybrid Network using OSPF

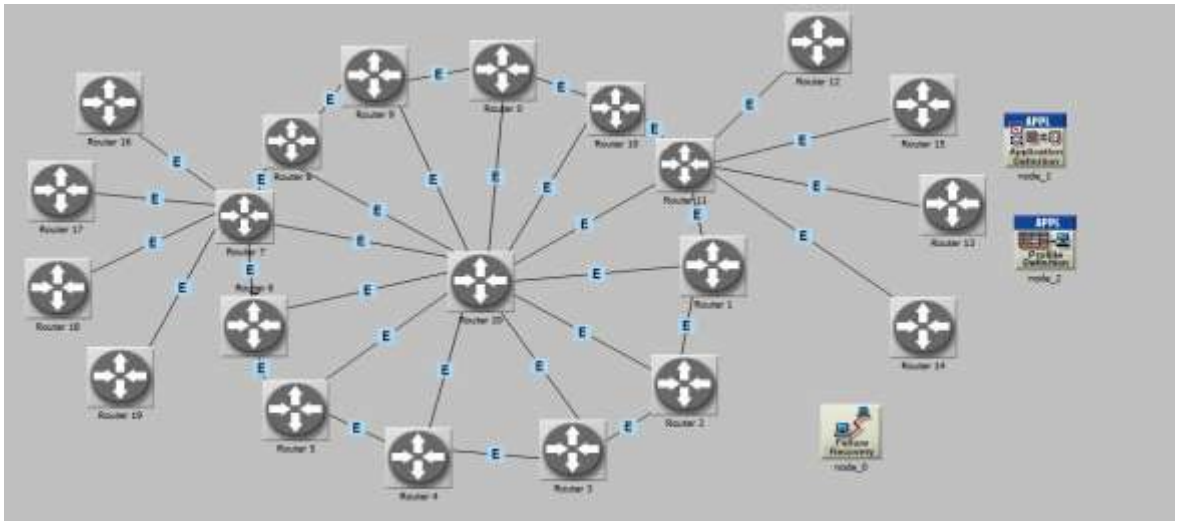

Figure 4 Hybrid Network using EIGRP

Fig.5, Fig.6, Fig.7 shows the convergence activity of RIP, OSPF and EIGRP .In the Fig.8 Green color shows the convergence time of RIP, Red color shows the convergence time of OSPF and Blue shows the convergence time of EIGRP. From the Fig. 8 it is evident that RIP takes more time for convergence as compared to OSPF and EIGRP. RIP takes 14.15 sec for convergence with variance of 16.86, OSPF takes 7.2 sec with variance of 5.38, and while as EIGRP takes 5.00 with variance of 2.10 graphically depicted as in fig5.

Tabular data in table II clearly reveal the difference, RIP takes almost double time as compared to OSPF and triple as compare to EIGRP to converge.

Table II. RIP VS OSPF VS EIGRP convergence duration

Statistics	variance	Average	Statistics	variance	Average	Statistics	variance
RIP	16.86	14.15 sec	RIP	16.86	14.15 sec	RIP	16.86
OSPF	5.38	7.2 sec	OSPF	5.38	7.2 sec	OSPF	5.38
EIGRP	2.10	5.00	EIGRP	2.10	5.00	EIGRP	2.10

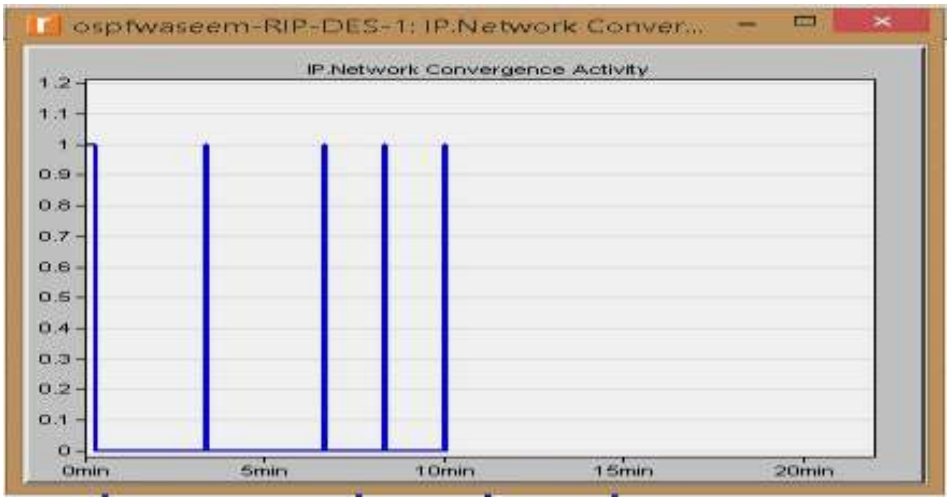

Figure 5 convergence activity of OSPF

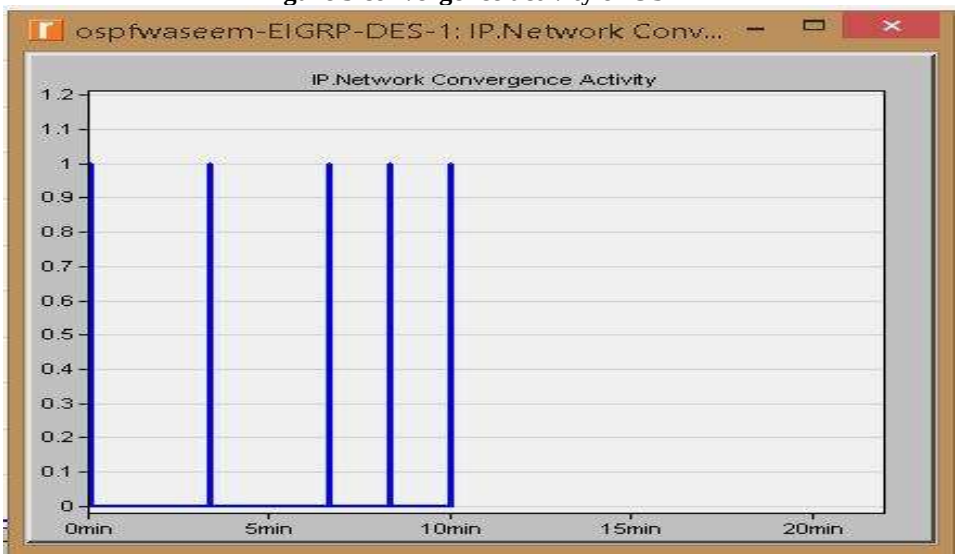

Figure 6 Convergence activity of EIGRP

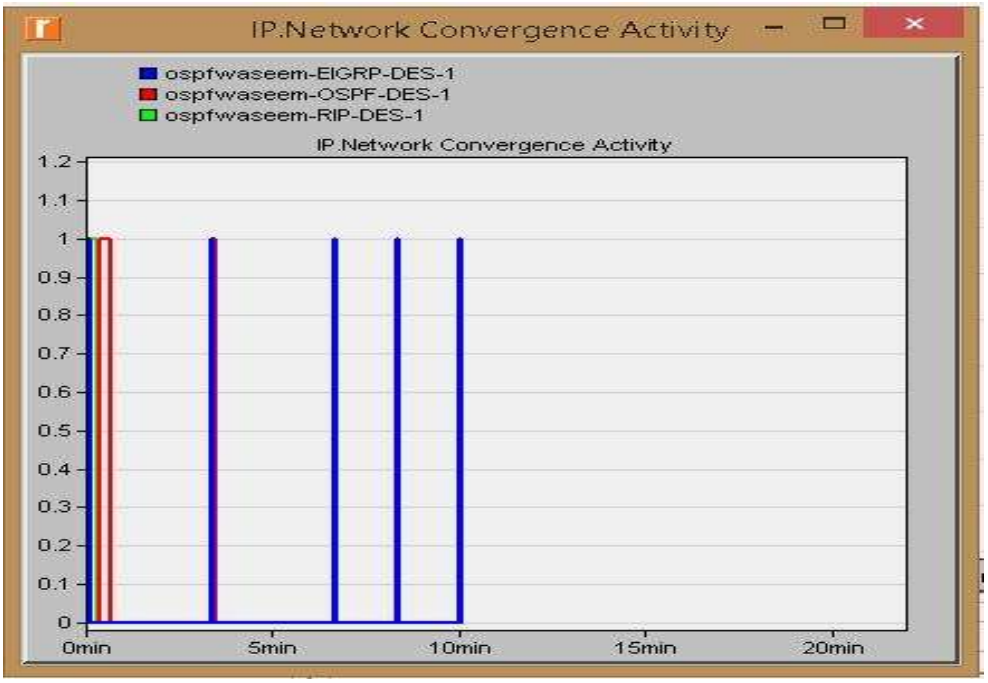

Figure 7 Convergence activity of RIP, OSPF and EIGRP

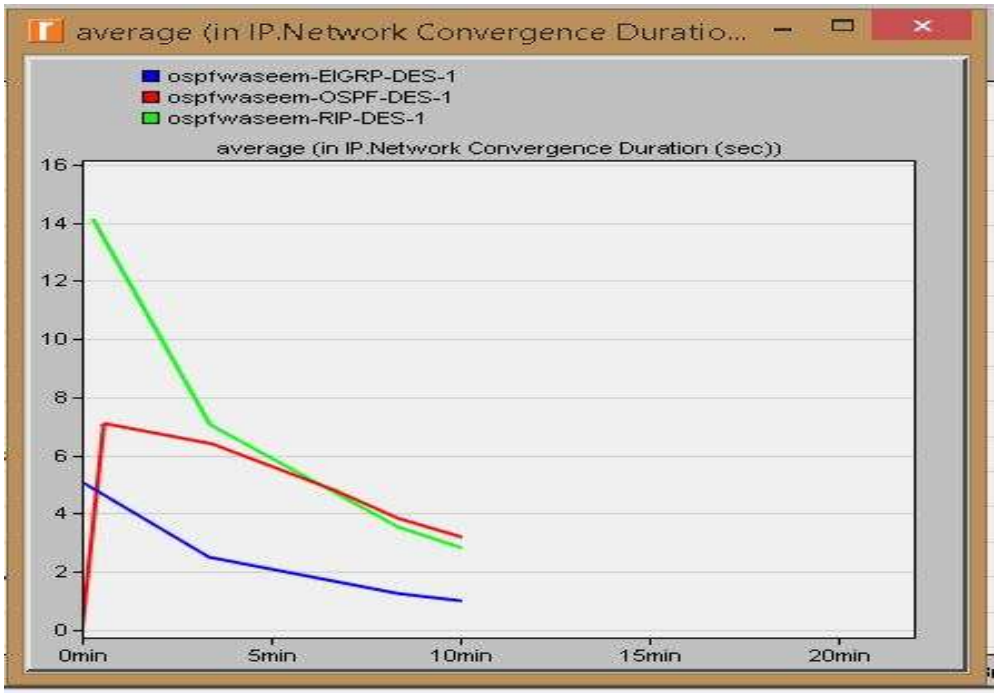

Figure 8 RIP VS OSPF VS EIGRP convergence duration.

IV. CONCLUSION

RIP, OSPF and EIGRP are commonly used protocols in networking. We analyzed RIP, OSPF and EIGRP with the same hybrid –Ring, star topology. In simulation environment specific parameters have been set to analyze the performance of the network. The simulation activity shows that the convergence duration of RIP is greater as compared to OSPF and EIGRP. Results show that convergence of RIP takes 14.15 sec, OSPF 7.2 and EIGRP takes 5.00 sec that is 1/3rd of the RIP. From the above results, we conclude that EIGRP converges faster in Large Network as compared to other two. In future we will do security and CPU utilization analysis of RIP, OSPF, and EIGRP.

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