



## Simulation Based Comparative Study of RIP, OSPF and EIGRP

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**Abstract - Routing protocols are the prime factor in this modern era of internet communication. Several type of routing protocols are used in the practical networks to communicate between different routers present in network. There are different type of routing protocols are available such as static, dynamic and hybrid routing protocols but the choice of the appropriate protocol is very much dependent upon the performance parameters. Here in this paper OPNET simulation tool is used to analyze the performance of different routing protocols RIP, OSPF and EIGRP in four network models in which three network models will perform on one routing protocol only while the fourth network will perform on combination of all three routing protocols cumulatively in one network model. The performance parameters taken in consideration are Response time, Throughput, Point to Point utilization and queuing delay.**

**Keywords : RIP, OSPF, EIGRP, OPNET.**

### I. INTRODUCTION

Routing is the prime factor in this modern era of internet communication. Several routing protocols are in existence in these days. The most commonly used routing protocols are RIP (Routing Information Protocol), OSPF (Open Shortest Path First), IGRP (Interior Gateway Routing Protocol) and EIGRP (Enhanced Interior Gateway Routing Protocol). Communication between two routing protocols is dependent upon the routing algorithm which is purely base dependent upon the metrics to find the path to transfer the data across two networks. Routing protocols are basically divided into two types. First type is interior gateway routing protocols which is further dived into three subtypes which are distance vector, link state and hybrid routing protocols. RIP, OSPF, IGRP and EIGRP are the examples of interior gateway routing protocols. Second type is Exterior gateway routing protocols. BGP and BGP4 are the examples of exterior gateway routing protocols. The basic functionality of routing protocols is to move traffic across the networks and the routers should be aware of where they forward the data in order to reach the correct destination node. For the success of network, routing protocols play the crucial role. In this paper three routing protocols, RIP (Distance vector protocol), OSPF (Link state Protocol) and EIGRP (Hybrid Protocol) are analyzed on the basis of Response time, Throughput, Point to Point utilization and queuing delay. The scheme of the paper is as follows. We explain routing protocols first, after that related work done, then simulation tool and performance metrics and at the last result of simulation done and conclusion.

### II. ROUTING PROTOCOLS

Three routing protocols used in this paper are RIP, OSPF and EIGRP. Below is the brief description of each protocol.

**Routing Information Protocol (RIP):** Routing information protocol is a distance vector protocol. It updates its routing table after a fixed time intervals, generally after every 30 seconds. Each router maintains its routing table by sending periodic updates to communicate with its neighboring routers. Its metric is the number of jumps. The maximum number of jumps in RIP is 15. It generates great amount of traffic in networks with periodic updates and it always do not select the fastest route for the packages. This is the reason why RIP is used in small and fixed size networks.

**Open Shortest Path First (OSPF):** Open Shortest Path First is a link state routing protocol. In this type each router works independently to calculate its own shorter route towards the destination. The updates are caused generally by change in the topology of network and leads to very fast reestablishment if route without loops. OSPF is designed for the networks with constant growth and able to handle the distributed routing table and fast propagation. Basic advantage of OSPF is the presence of subnet and super-net mask along with the provision of authentication.

**Enhanced Interior Gateway Routing Protocol (EIGRP):** Enhanced Interior Gateway Routing Protocol is a hybrid routing protocol. Its covers all the advantages of distance vector and link state routing protocols. EIGRP is an enhanced version of IGRP. This routing Protocol is developed by Cisco. EIGRP maintain its routing table as done by distance vector routing protocols, however it also uses HELLO protocol and forms neighbor relationships similar to link state protocols. EIGRP is a classless protocol that permits the use of VLSMs (Variable Length Subnet Masks) and supports CIDR (Classless Inter-Domain Routing) for a scalable allocation of IP addresses. Whenever an EIGRP router cannot find a route to a network based on all the information it currently has, it sends out a query to other routers, which is propagated until a route is found.

### III. Related Work

The performance analysis of the routing protocols namely, RIP, OSPF, IGRP, and EIGRP for the parameters: packets dropping, traffic received, End-to-End delay, and variation in delay (jitter) is done by IKram Ud Din, Saeed Mahfooz, Muhammad Adnan [1]. Simulations have been done in OPNET for evaluating these routing protocols against each parameter. The results have been shown in the graphs which show that IGRP performs the best in packets dropping, traffic received, and End-to-End delay as compared to its other companions (RIP, OSPF, and EIGRP), while in case of jitter, RIP performs well comparatively. The performance of routing protocols is analyzed on the basis of the cost of delivery, amount of overhead on each router, number of updates needed, failure recovery, delay encountered and resultant throughput is done by Pankaj Rakheja, Prabhjot kaur, Anjali gupta, Aditi Sharma [2]. On analyzing the result they found that OSPF has best performance overall as it has the least cost of transmission, lower router overhead after RIP and maximum throughput amongst all routing protocol and queuing delay of it is second lowest after EIGRP and it also has second highest link utilization after EIGRP. Then EIGRP performs good as it has cost of transmission just above OSPF and has optimum router overhead and overall performance in terms of throughput, Queuing delay and link utilization. Voice over IP technology integrates data and voice networks. Routing is an essential data networking function that provides an efficient real-time data delivery VoIP requires. Xianhui Che, Lee J. Cobley studies how VoIP performance can be affected by different routing behaviors which include Routing Information Protocol, Open Shortest Path First and Enhanced Interior Gateway Routing Protocol [3]. Network modeling and simulation have been carried out with OPNET Modeler to evaluate and compare performances. Mr. R. M. Pethe and Miss S. R. Burnase hypothesized network using EIGRP will have a better routing performance [4]. They done comparisons of OSPF, IGRP and RIP with EIGRP, also there are problems with redistributing routes between RIP, OSPF or IGRP than in case of EIGRP. It includes the various trouble resolving techniques and traffic handling techniques during communication in simple as well as in bulky networks. Shraavan K. Narisetty and Santosh K. Balsu have chosen three different application i.e., video conferencing, e-mail and ftp [5]. They use OPNET to design and simulate the network and compare the performance of the EIGRP, IS-IS/RIP routing protocols in terms of convergence time, throughput and end-to-end delay and propose which routing is suitable for IP networks. After a several simulations in OPNET, the combination of IS-IS/RIP protocol shows better performance compared to EIGRP protocol in terms of throughput and end-to-end delay. Whereas, the network convergence of EIGRP protocol is better than IS-IS/RIP protocol.

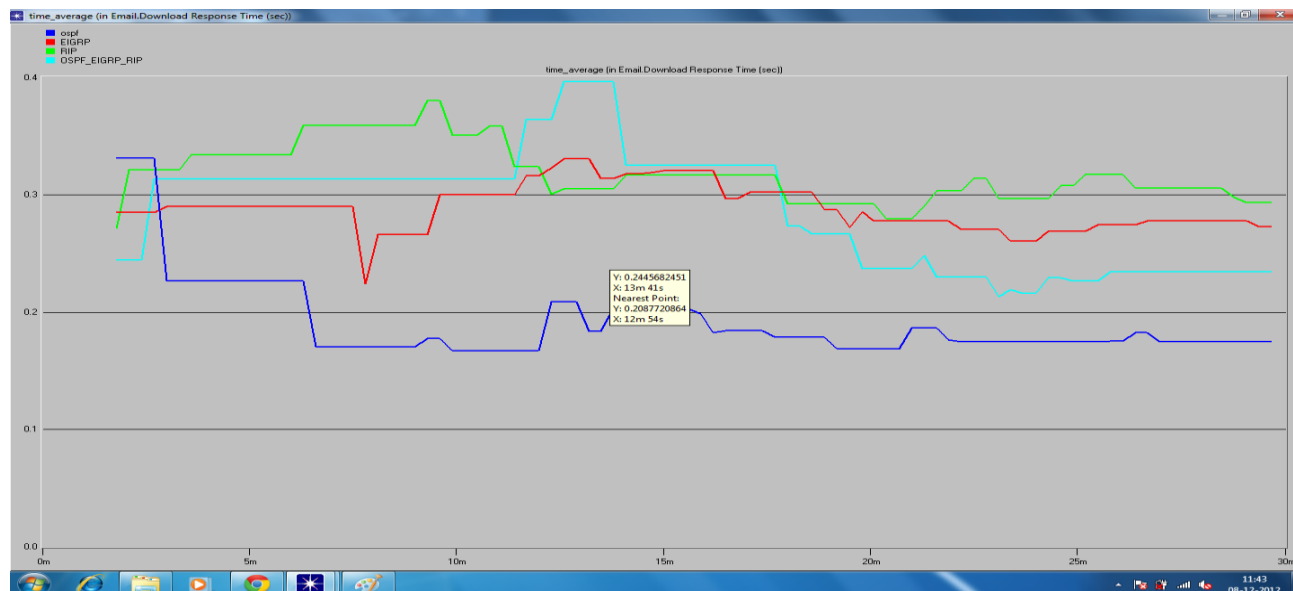
### IV. Simulation Setup and Performance Metrics

In this paper, network simulator, Optimized Network Engineering Tools (OPNET) IT GURU ACADMIC EDITION 9.1 has been used as a simulation environment. OPNET is a simulator built on top of discrete event system (DES) and it simulates the system behavior by modeling each event in the system and processes it through user defined processes. OPNET is very powerful software to simulate heterogeneous network with various protocols. OPNET is a high level user interface that is built as of C and C++ source code with huge library of OPNET function.

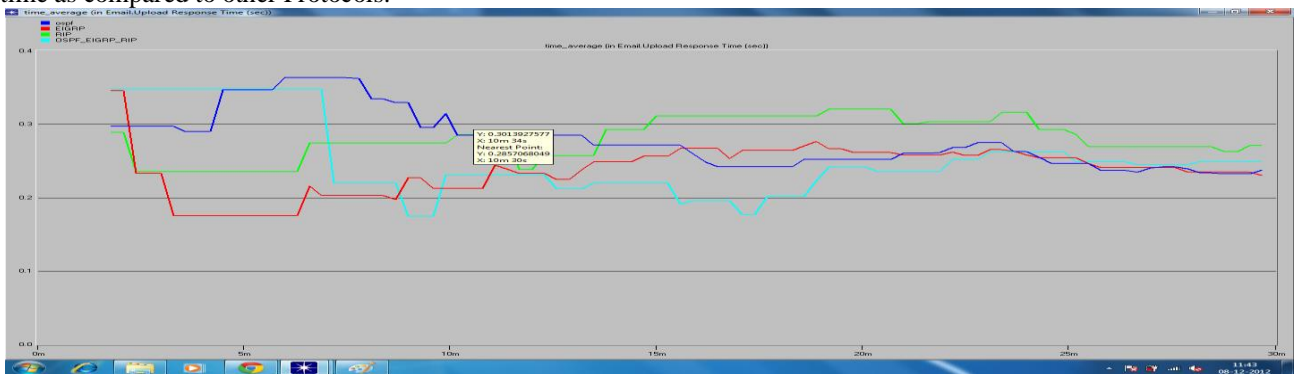
In this Paper, four scenarios are created where routers within each subnet are configured by using EIGRP, RIP and OSPF routing protocols. Three network scenarios are dedicated to RIP, OSPF and EIGRP respectively while the fourth network scenario is the combination of RIP, OSPF and EIGRP. The proposed routing protocols are compared and evaluated based on some quantitative metrics such as Response time, Throughput, Point to Point utilization and Queuing delay.

### V. Simulation Results

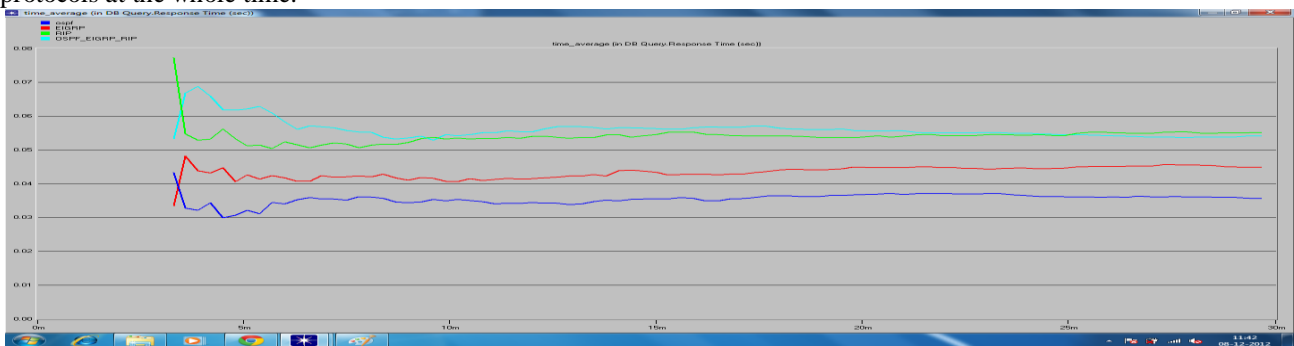
**Email Download Response Time:** The E-MAIL access is done from the mail server in the network E-MAIL download response time in above graph shows that the RIP protocol performs very well for the simulation time while the OSPF protocol gave poor results.



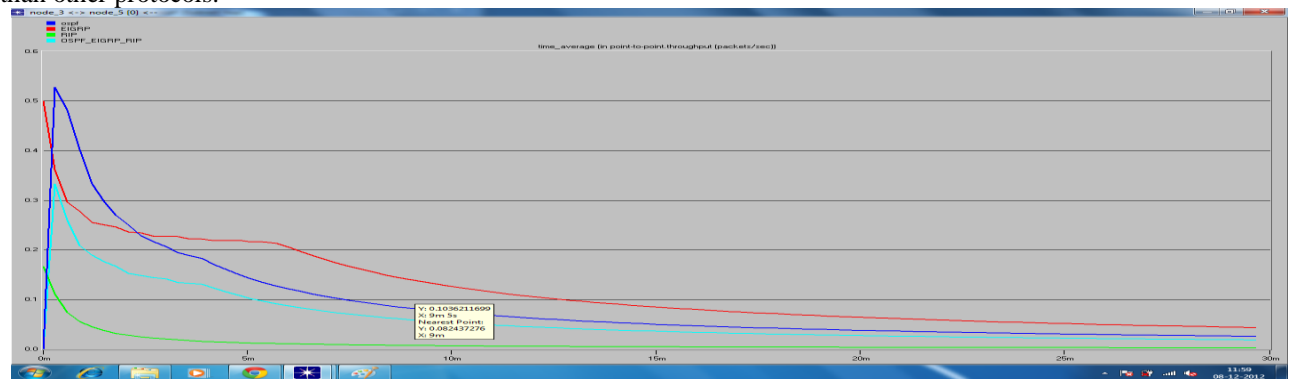
**Email Upload Response Time:** E-MAIL upload Response time in above graph shows that the RIP protocol performs very well as it performs well in download response time. On the other hand, we can see that EIGRP has low response time as compared to other Protocols.



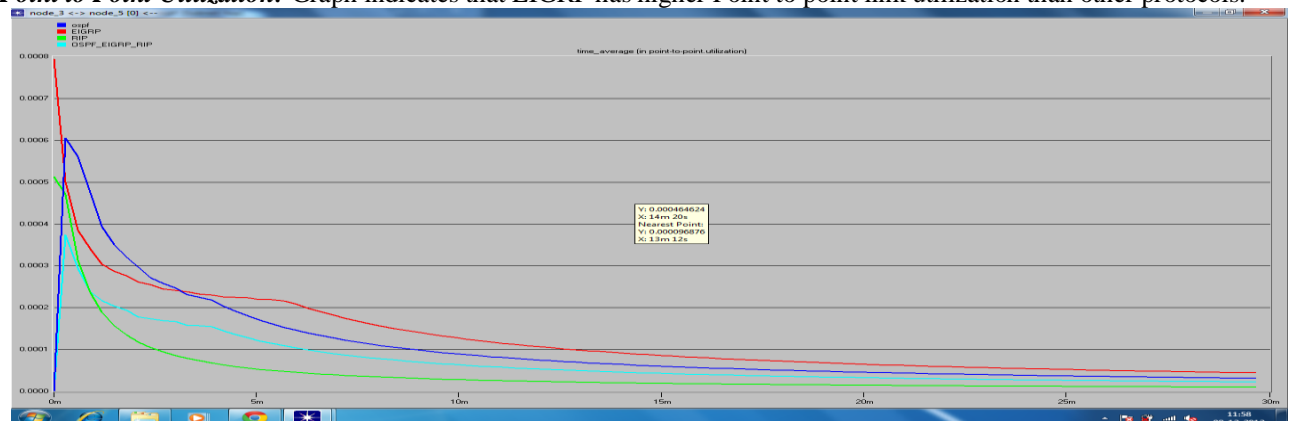
**Database Query Response Time:** The Lan Network Is Able To Access The Database From The Server, So In This Scenario Shows How The Protocols Affect The Performance To Access The Database From The Server. In the comparison of these protocols in database query response time, RIP shows a better response time than of the other protocols at the whole time.



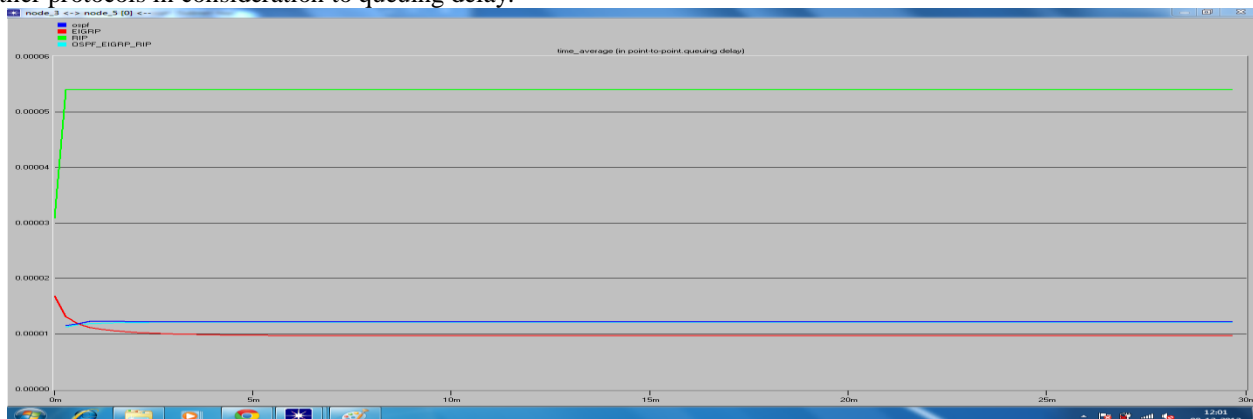
**Throughput:** The throughput is a key parameter to determine the rate at which total data packets are successfully delivered through the channel in the network. Graph indicates that EIGRP has higher throughput and less packet loss than other protocols.



**Point to Point Utilization:** Graph indicates that EIGRP has higher Point to point link utilization than other protocols.



**Queuing Delay:** Graph indicates that EIGRP has Lowest queuing delay than other protocols so EIGRP is better than all other protocols in consideration to queuing delay.



## VI. Conclusion

This project compares the performance of three Intra-domain routing protocols EIGRP, RIP and OSPF for LAN network of 7 routers by using OPNET simulator and performed simulations to examine the behavior of these routing protocols. Our results reveal out that EIGRP protocol behaves well in terms of point-to-point link utilization, throughput, Queuing delay and HTTP page response time but by considering other important network parameters, it performs poor for Email download and upload response time and DB query response time. While RIP performs well where EIGRP performs poor. On the other hand OSPF and combination of OSPF, RIP and EIGRP are moderate in all cases. So from analysis of the results of Simulation, it is recommended EIGRP routing protocol to be used to deploy in small to medium sized network. EIGRP behaves well and its performance is better than RIP, OSPF and RIP\_OSPF\_EIGRP combination

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