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FINAL PROJECT

OSPF, EIGRP AND RIP PEFORMANCE ANALYSIS BASED ON OPNET

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ABSTRACT

Routing protocol is the key for the quality of modern communication network. EIGRP, OSPF and RIP are the dynamic routing protocols being used in the practical networks to propagate network topology information to the neighboring routers. There have been a large number of static and dynamic routing protocols available but choice of the right protocol for routing is dependent on many parameters critical being network convergence time, scalability, memory and CPU requirements, security and bandwidth requirement etc. This project uses OPNET simulation tool to analyze the performance of OSPF, EIGRP, and RIP commonly used in IP network today. According designed simulation experiment scenarios compare the difference between OSPE, EIGRP, and RIP routing protocols.

Keywords: *OSPF, EIGRP, RIP, Performance Analysis, OPNET*

I. INTRODUCTION

A routing protocol is work base on algorithm. Routing algorithm also based on metrics to find the path to transmit data across two networks. Metrics also include cost, bandwidth, Maximum Transmit Unit, delay, number of hop count these metrics also save or store in routing table. Routing protocol has two types. First one is interior gate way protocol and other one is Exterior gateway protocol. OSPF is also interior gate way protocol, other interior gate way Protocol are RIP, EIGRP, IGRP. BGP and BGP4 is Exterior gate way protocol.

The dynamic routing protocols keep the routing tables updated. This Project is specification of the Open Shortest Path First (OSPF), Enhanced Interior Gateway Routing Protocol (EIGRP) and Routing Information Protocol (RIP) TCP/IP internet routing. These three protocols are classier as Interior Gateway Protocol (IGP). The network based on TCP/IP protocol permits the efficient routing of data packets based on their IP address. Routers are used in the network to control and forward data.

In the packetized communication of information, the function of routing is moving traffic across networks and the routers should be aware of where they should forward the traffic next in order to reach the final destination. In order for routers to effectively and efficiently distribute data, the choice of the routing protocol becomes very critical factor to define the success of the network over time. Factors that differentiate one routing protocol from another include the speed that it adapts to topology changes called as convergence, the ability to choose the best route among multiple routes and the amount of network traffic that the routing protocol creates.

II.ROUTING PROTOCOLS

Most of the routing algorithms they are possible to be classified like one of two basic algorithms: Distance Vector and Link-State.

1. Distance Vector characteristics:

(1) The routing by distance vector collects data of the information of the routing table of its neighbors.
(2) The routing by distance vector determines the best route adding the metric value that receives as the routing information happens from router to another one.
(3) With most of the protocols of routing by distance vector, the updates for the changes of topology consist of periodic updates of the tables. The information happens from router to another one, giving generally like result one more a slower convergence.

RIP and EIGRP are examples of vector distance protocols.

2. Link state characteristics:

(1) The link state routing obtains a great vision of the topology of complete internetwork accumulating all the necessary LSA.
(2) In the link state routing, each router it works independently to calculate its own shorter route towards the networks destiny.
(3) With the protocols of routing of connection state, the updates are caused generally by changes in the topology. The relatively small LSA that have gone to all the others routers generally give like result faster times of convergence with any change of topology of the internetwork.

OSPF it’s an example of link state protocol.

A. Routing information protocol (RIP)

The RIP allows that routers update their routing tables at programmable intervals, generally every 30 seconds. One of the disadvantages of routers that use RIP is that constantly they are connected with routers neighboring to update his tables of routing, generating therefore a great amount of network traffic. This makes by means of a denominated concept vector-distance. A jump is entered whenever the data cross to router that is to say, happen through a new number of network, this is considered equivalent to a jump. A route that has an equal number of jumps to 4 indicates that the data which they are transported must cross 4 routers before arriving at their final destiny in the network. If there are multiple routes towards a destiny, the route with the smaller number of jumps is the route selected by router.

As the number of jumps is only metric of routing used by the RIP, not necessarily it selects the fastest route towards its destiny. A metric one is a measurement unit that allows making decisions and next will learn that other protocols of routing use other metric ones in addition to the number of jumps to find the best route of data transfer. Nevertheless, the RIP continues being very popular and it is continued implementing widely. The main reason of this is that he was one of the first protocols of routing that were developed. RIP characteristics:

(1) Distance vector routing protocol.
(2) It metric is the number of jumps.
(3) The maximum number of jumps is 15

(4) One updates every 30 seconds
(5) Not always it selects the fastest route for the packages
(6) It generates great amount of traffic of network with updates.

Another one of the problems that the use of the RIP presents is that sometimes a destiny can be located too much far like being attainable. The RIP allows fifteen as maximum limit for the number of jumps through which data can be sent. The network destiny is considered unreachable if there are more than fifteen jumps of router.

B. Enhanced Interior Gateway Routing Protocol (EIGRP)

As its name suggests, EIGRP is an enhanced version of IGRP (Interior Gateway Routing Protocol), an obsolete routing protocol that was developed by Cisco. EIGRP is an advanced distance-vector protocol that implements some characteristics similar to those of link-state protocols. Some Cisco documentation refers to EIGRP as a hybrid protocol. EIGRP advertises its routing table to its neighbors as distance-vector protocols do, however it uses the hello protocol and forms neighbor relationships similar to link-state protocols. EIGRP sends partial updates when a metric or the topology on the network changes. It does not send full routing-table updates in periodic fashion as distance-vector protocols do. 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.

EIGRP uses the metrics like bandwidth, delay, reliability, load, and MTU in making its routing decisions .The default metrics used are bandwidth and delay. For a more granular level of control, EIGRP multiplies each of the metrics by 256 before performing the calculation of the composite metric. EIGRP has been designed to make much better use of bandwidth, and to allow routers to have a much better awareness of neighboring routers. Instead of sending its entire routing table out at regular intervals, an EIGRP router sends out only partial updates, and even then, only when a route changes. This makes a better use of the available network bandwidth. An EIGRP router also has a more complete view of the network than a typical distance vector protocol as it not only maintains its own routing table, but also keeps a copy of the routing tables of neighboring routers. When 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.

C. Open shortest path first (OSPF)

In 1988, the group: Internet Engineers Task Force (IETF) began to develop a new protocol of routing that it would replace to protocol RIP. Then development the Open Shortest Path First protocol (OSPF). Protocol OSPF proposes the use of shorter and accessible routes by the construction of a map of the network and data base maintenance with information on local and neighboring systems, this way he is able to calculate the metric for each route, and then the shorter routing routes are chosen. In this process the metric of state of the connection and distance are calculate in the case of RIP calculates only the distance and not the link traffic, by this cause OSPF is a routing protocol designed for networks with growth constant and able to handle a distributed routing table and fast propagation, between the best characteristics of OSPF are:

(1) Fast detection of changes in the topology and very fast reestablishment of routes without loops.
(2) Low overload, use updates that inform about changes on routes.
(3) Division of traffic by several equivalent routes.
(4) Routing according type of service.
(5) Use of multi-send in local area networks.
(6) Subnet and Super-net mask.
(7) Authentication

III. SIMULATION

1. Simulation Methodology

Network is simulated using OPNET® Modeler. OPNET® is extensive and powerful simulation software with wide variety of capabilities. It enables the possibility to simulate entire heterogeneous networks with various protocols.

The simulated network for this project is shown as the fig.1.

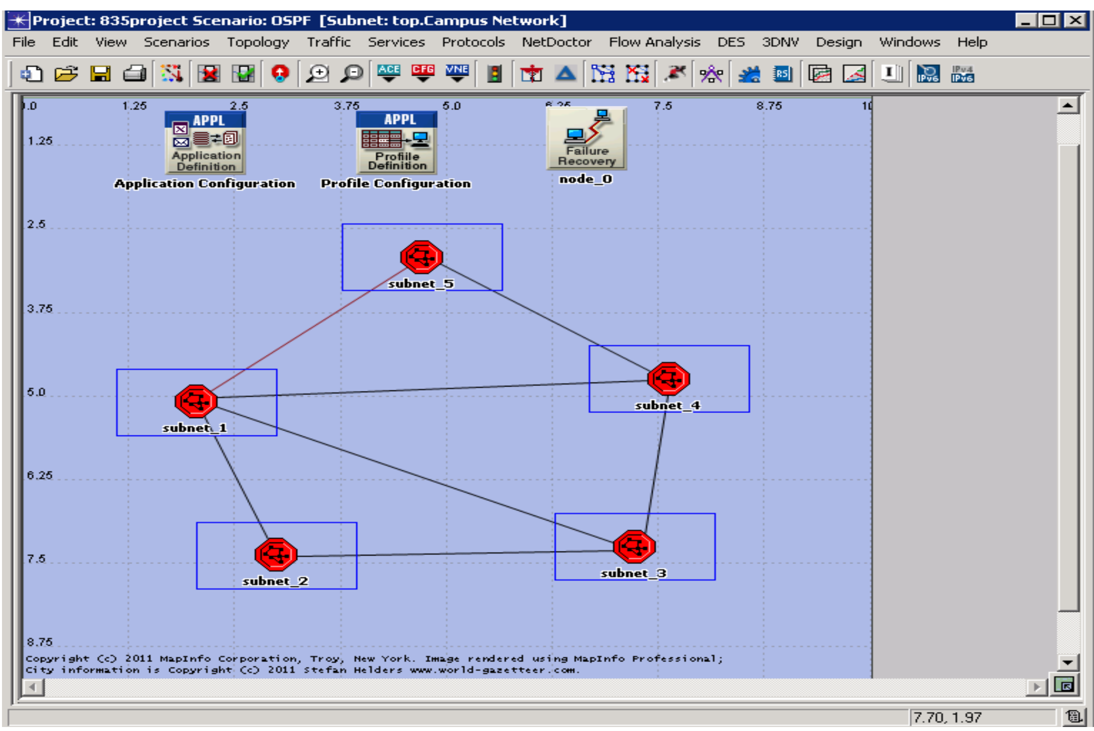

Fig. 1: Network Topology

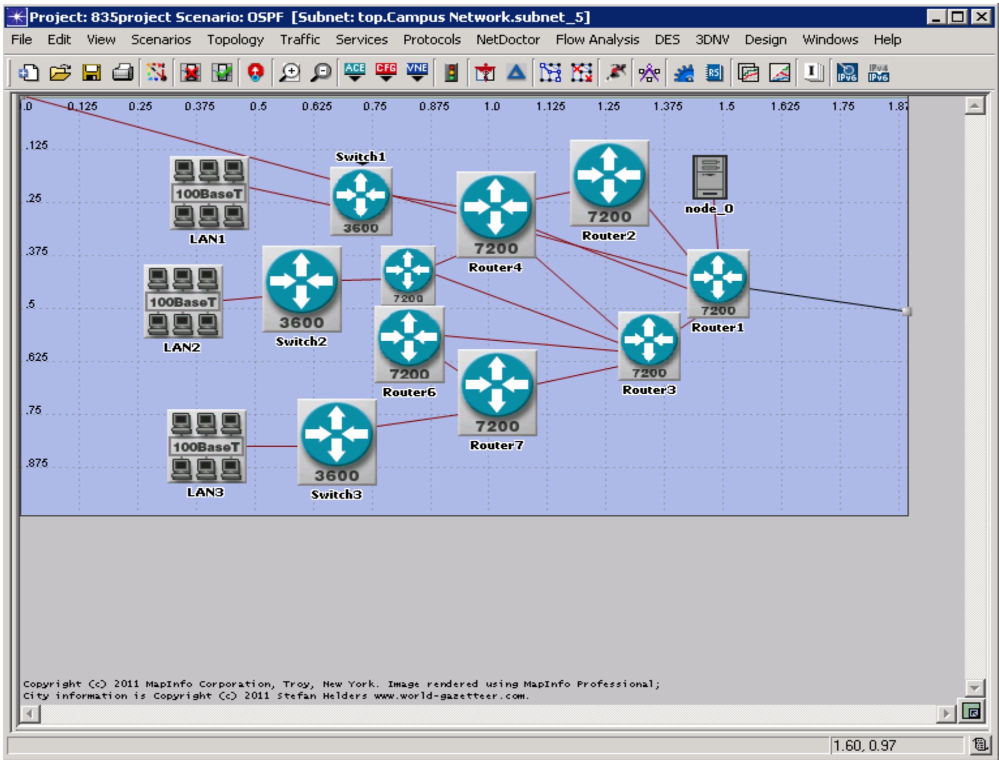

Fig 2: LAN network setup within subnet node

I have first built the network with RIP as the routing protocol and the same model is repeated for analysis as second and third scenarios using OSPF and EIGRP as routing protocols. These 3 scenarios are named as RIP No Fail, OSPF No Fail, and EIGRP No Fail. Then added the Failure/Recovery into each scenario, then created other 3 more scenarios and named as RIP, OSPF, and EIGRP. The Fig 3 shows the details about these 6 scenarios and Fig 4 shows the setting of applications.

Scenario Name	Routing Protocol	Failure Link	Fail Time	Recovery Time
OSPF No Fail	OSPF	N/A	N/A	N/A
EIGRP No Fail	EIGRP	N/A	N/A	N/A
RIP No Fail	RIP	N/A	N/A	N/A
OSPF	OSPF	Subnet 1-Subnet5	300s	500s
EIGRP	EIGRP	Subnet 1-Subnet5	300s	500s
RIP	RIP	Subnet 1-Subnet5	300s	500s

Fig 3: Six Simulation Scenarios

Video Conferencing	15 frames/sec, 128X240 Pixels
Voice	IP Telephony and Silence Suppressed
Http	Http1.1, Heavy Browsing
Email	High Load

Fig 4: Applications configuration

IV. NETWORK ANALYSIS

In order to analyse the network in terms of network convergence activity and protocol traffic sent are chosen. In the six different scenarios, RIP, OSPF and EIGRP are chosen under global statistics as shown in the figures 5, 6, 7, and 8.

Network Convergence: For EIGRP network convergence time is the shortest and OSPF is longest.

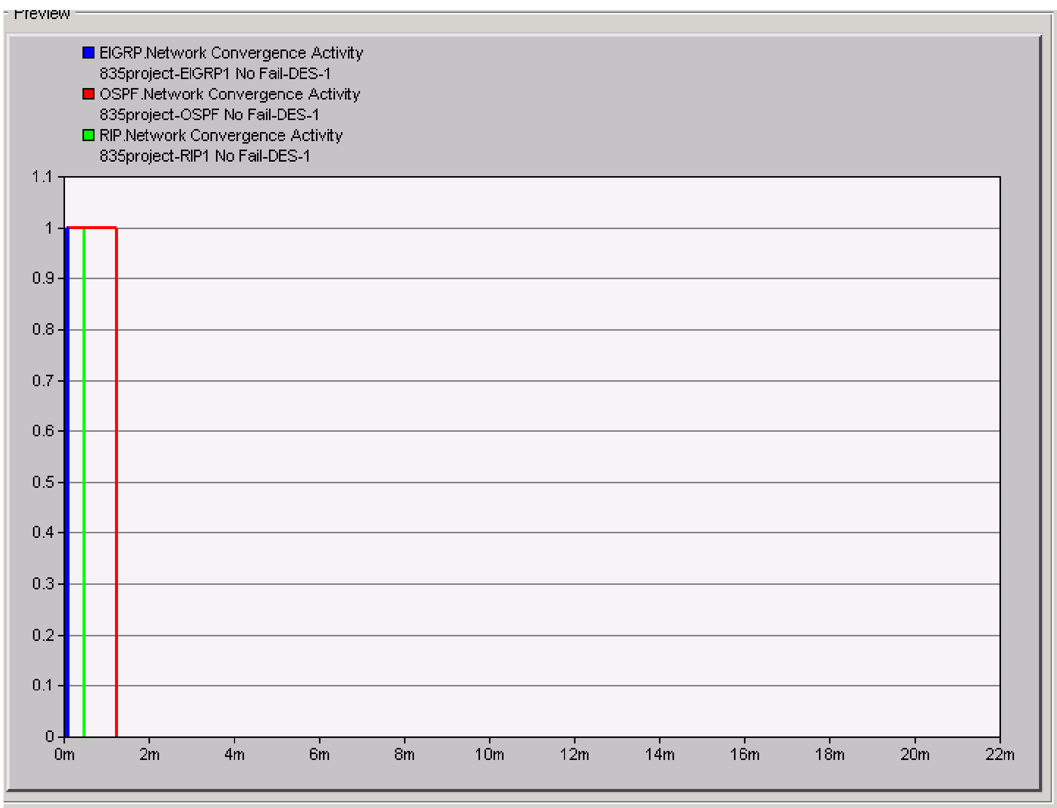

Fig 5: Network Convergence Activity of RIP No Fail, OSPF No Fail, and EIGRP No Fail

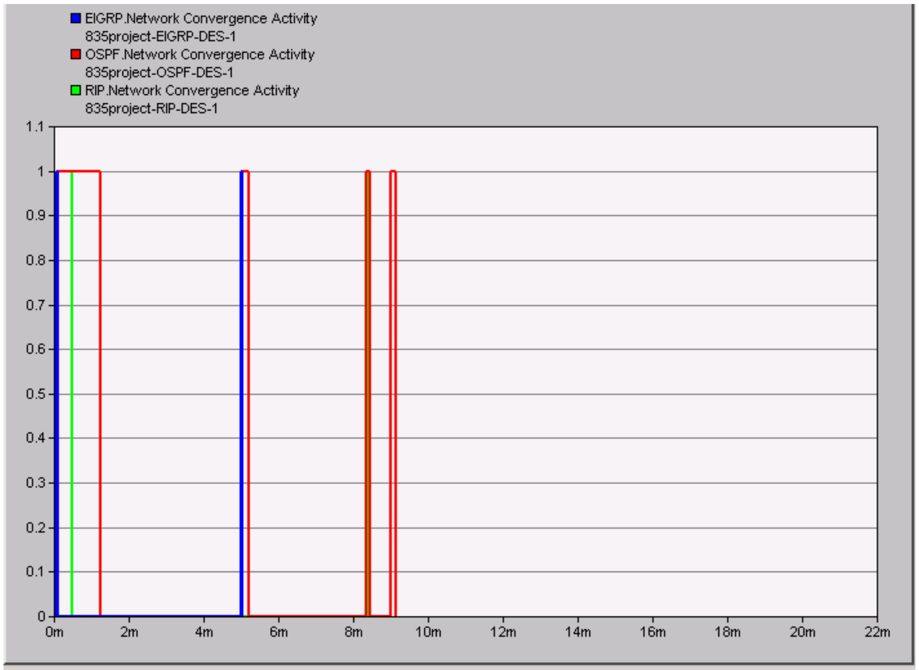

Fig 6: Network Convergence Activity of RIP, OSPF, and EIGRP

Routing Traffic: OSPF protocol provides higher traffic compared to EIGRP and RIP. After failure/recovery happened, OSPF protocol provides lower traffic than EIGRP.

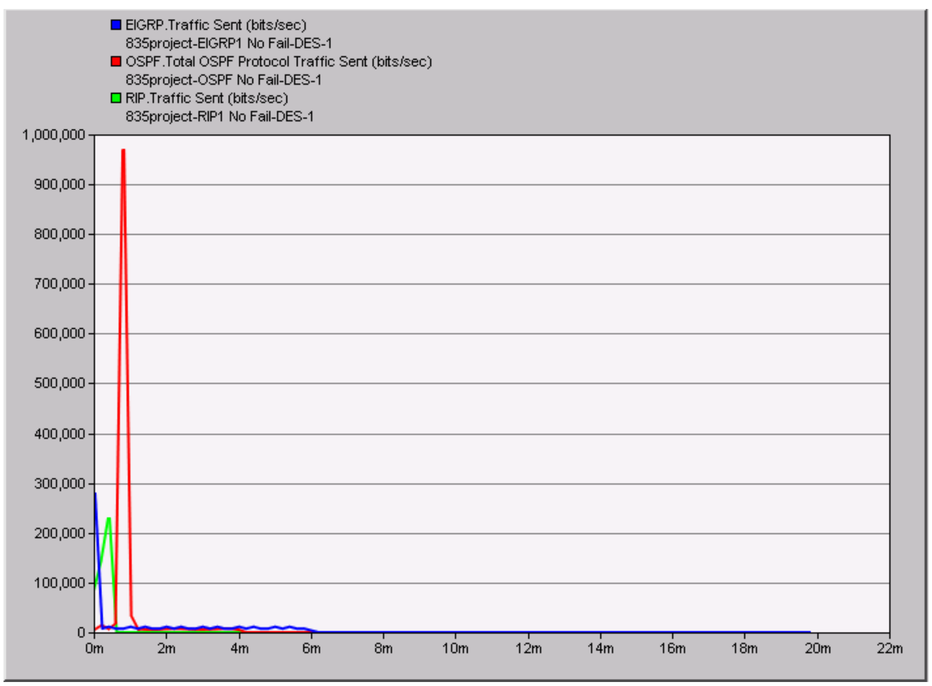

Fig 7: Protocol Traffic Sent (bits/sec) of RIP No Fail, OSPF No Fail, and EIGRP No Fail

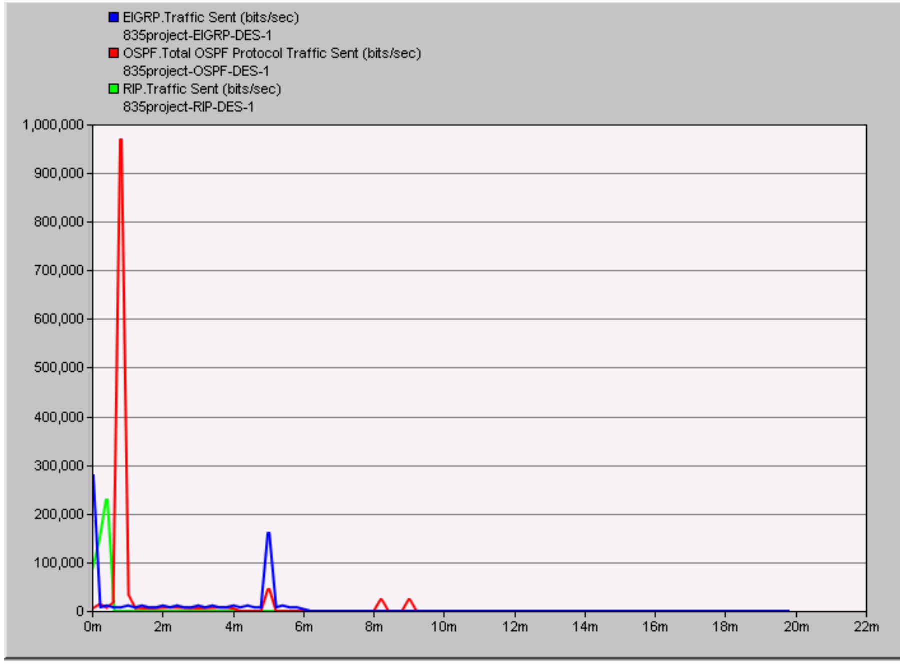

Fig 8: Protocol Traffic Sent (bits/sec) of RIP, OSPF, and EIGRP

In order to analyse the network performances in terms of average Ethernet delay, email upload response time, HTTP page response time, video conferencing packet End-to-End delay, and Voice Packet Delay. The results show in figures 9, 10, 11, 12, and 13.

Ethernet Delay: EIGRP provides lowest delay and RIP provides highest delay.

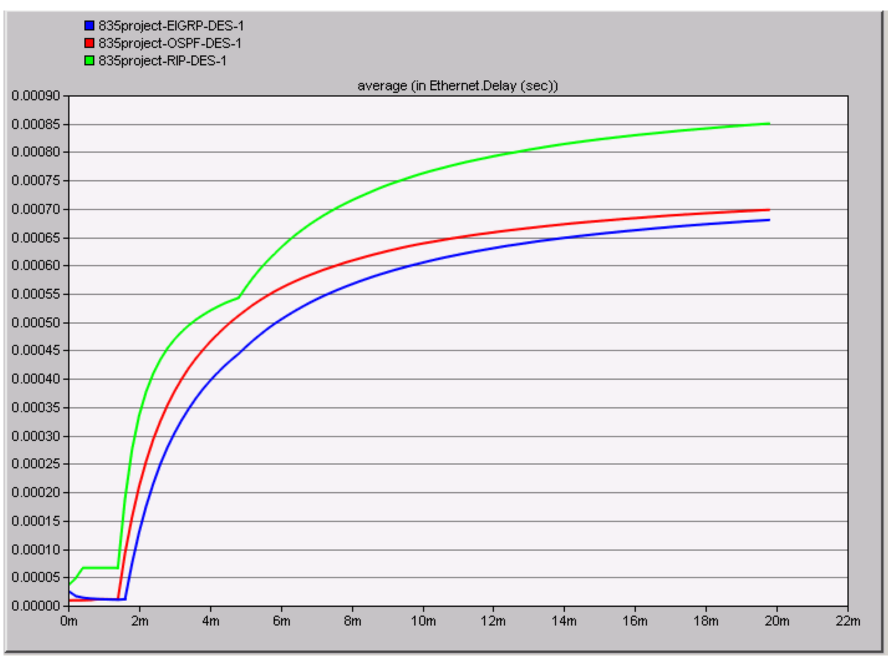

Fig 9: Average Ethernet Delay (sec) of RIP, OSPF, and EIGRP

Email Upload Response Time: OSPF protocol provides the shortest response time before failure, after recovery becomes the highest one.

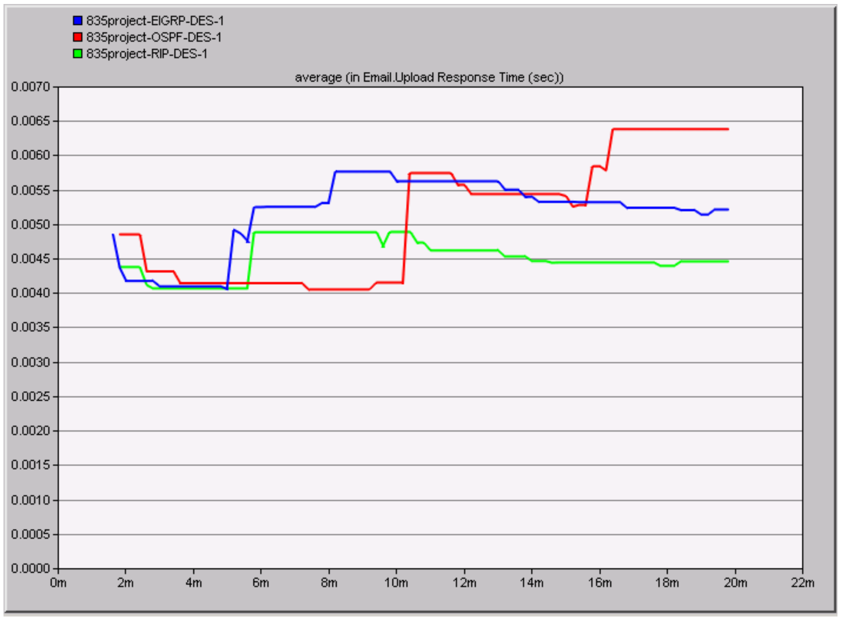

Fig 10: Average Email Upload Response Time (sec) of RIP, OSPF, and EIGRP

HTTP Page Response Time: OSPF protocol provides the lowest response time.

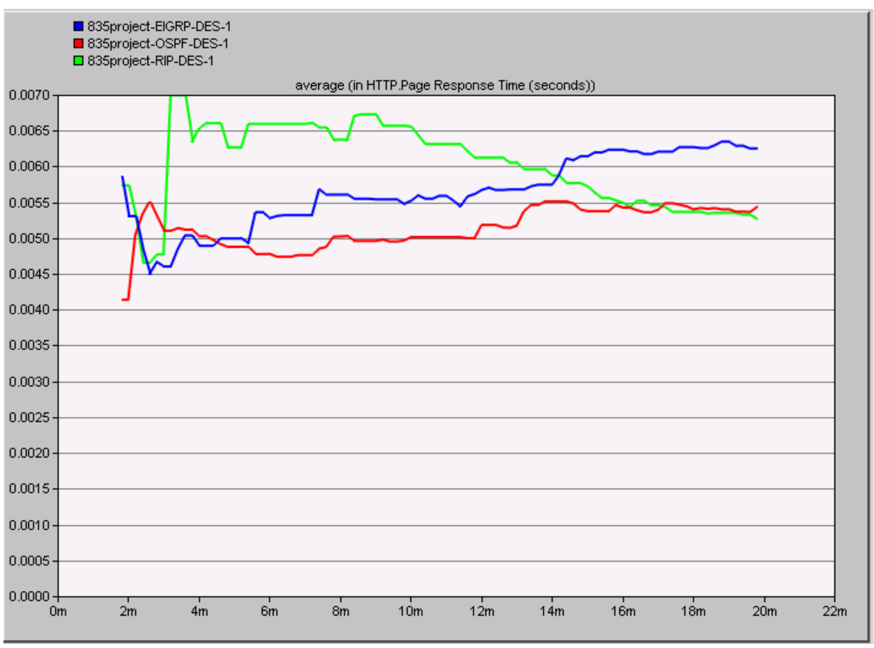

Fig 11: Average HTTP Page Response Time (sec) of RIP, OSPF, and EIGRP

Video Conferencing Packet End-to-End Delay: OSPF protocol provides the lowest delay.

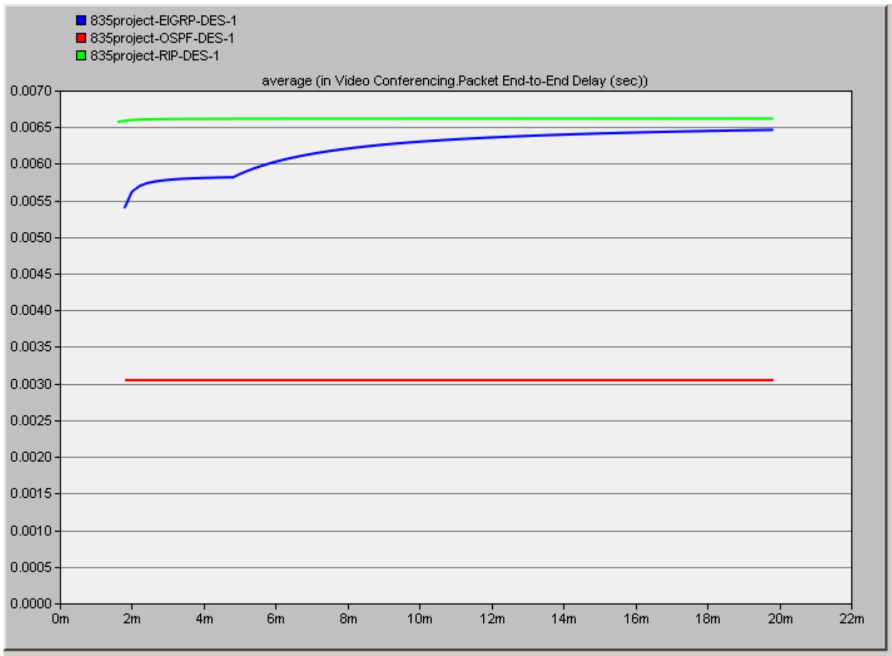

Fig 12: Average Video Conferencing Packet End-to-End Delay (sec) of RIP, OSPF, and EIGRP

Voice Packet Delay: RIP protocol provides the lowest delay and OSPF protocol provides the highest.

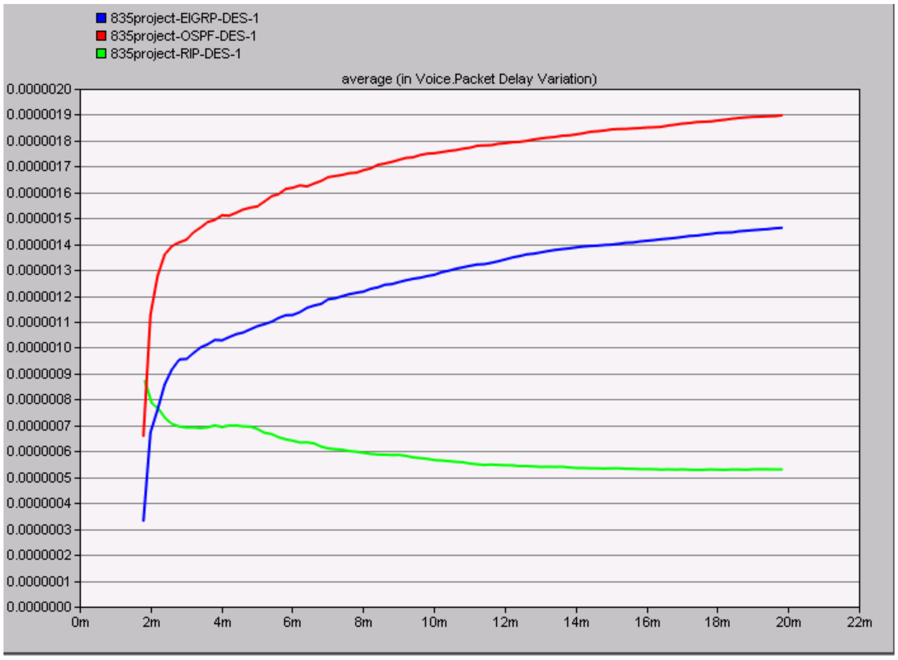

Fig 13: Average Voice Packet Delay Variation of RIP, OSPF, and EIGRP

V. CONCLUSIONS

It can be seen that EIGRP compared to RIP and OSPF performs better in terms of network convergence activity and Routing protocol traffic and Ethernet delay. OSPF performs better in terms of HTTP Page Response Time and Video Conferencing Packet End-to-End Delay. RIP performs better in terms of Voice Packet Delay.

VI. FUTURE WORKS

This project is only using Cisco products since EIGRP is Cisco proprietary routing protocol. Using multi-vendor, different network topology and applications should be considered in the future.

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