

Performance Evaluation of Dynamic Routing Protocols for Real time application

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Abstract--In network communication, choosing the best path to send packets from source and destination is the first task to make sure the quality of communication. To do so the process called routing is held on the device router by following Routing algorithms. There are two categories of routing process: static routing, which is done manually by the administrator and dynamic routing, which is done automatically by using some routing protocols. The main target of this paper is to study the deep understanding of Interior Gateway routing protocols like RIP, EIGRP and OSPF and to compare their performance in real-time application VOIP, Video conferencing based on convergence, end to end packet delay, packet delay variation and queuing delay by using Cisco packet tracer and OPNET simulators. Our goal is to show which protocol performs better in real time application.

Keywords-- RIP, EIGRP, OSPF, VOIP, Video conferencing, Cisco packet tracer, OPNET.

I. INTRODUCTION

Routing is the process of finding the best path while sending a packet from source to destination based on routing algorithms. Routing algorithm uses metrics like cost, delay, bandwidth, reliability and hop count to find the best route and update routing tables on the router. Each router has information only about the networks directly attached to it and this information is shared with immediate neighbors, and then throughout the network through routing protocols. A routing protocol states the way routers interact with each other, select best routes between any two nodes by distributing information. [11] By this method, router's gain knowledge of the topology of the network. There are three major categories of routing protocols:

- Distance-vector Interior Gateway routing protocols (protocols like RIP, IGRP).
- Link State Interior Gateway routing protocols (protocols like OSPF, IS-IS).
- Exterior Gateway routing protocol (BGP).

Interior Gateway routing protocols both distance vector and link state routing protocols used within an autonomous system to exchange routing information, whereas Exterior Gateway routing protocols are used between different autonomous systems in order of exchanging routing information. Each dynamic routing protocol uses

its own metrics to find the best route for packet forwarding from source to destination.

RIP (Routing Information Protocol) is distance vector which uses hop count as a metric and Bellman ford algorithm to find the best route and it is used in small networks since it supports most 15 hops. RIP has two versions RIPV1 and RIPV2. RIPV2 is the advanced version of RIP which comes with some more features like it supports VLSM and uses multicast. And RIP uses Update Timer, Invalid Timer, Flush Timer and Hold-down Time timers as part of its operation.

An Interior Gateway Protocol EIGRP (Enhanced Interior Gateway Routing Protocol) is used with an autonomous and support up to 255 hops. EIGRP uses composite metrics mainly bandwidth and delay to choose the best route and follows Diffusing Update Algorithm (DUAL) to meet loop freedom at every instant all over route computation. And EIGRP uses Hello/Acknowledge, Updates, Queries, Replies and Requests packet types.

OSPF (Open Shortest Path First) is link state IGP routing protocol constructs map of the topology and database to calculate the metric for each route, and to choose shorter routing routes. Cost is the metric used by this protocol and OSPF is a routing protocol designed for networks with scalable and to handle a distributed routing table and fast propagation, among routers. There is no hop count limitation it can be used in large networks. OSPF uses the concept of Area for hierarchical network design. EIGRP is less complex to implement and it is also more efficient in route calculations than OSPF, but it is Cisco proprietary which is only configured in Cisco routers. The main focus of this paper is to select the best routing protocol by evaluating the performance of RIP, EIGRP and OSPF on real time application based on different metrics.

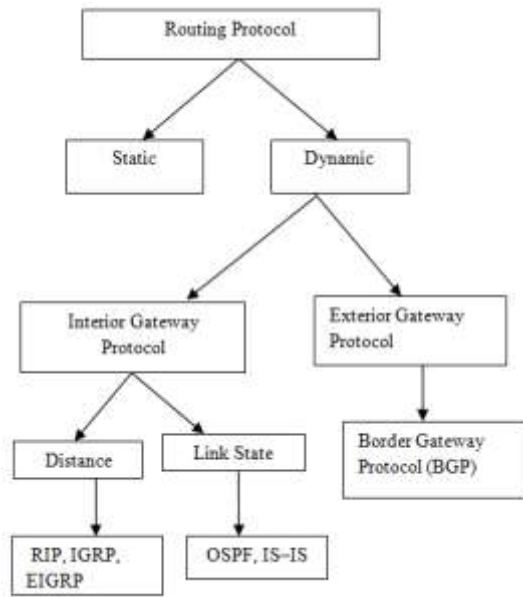


Fig.1. Types of Routing Protocols [12]

II. RELATED WORKS

[1] Selecting shortest path from source to destination is the necessary thing in the network and it is done using of routing. RIP (Routing Information Protocol), IGRP (Interior Gateway Routing Protocol), EIGRP (Enhanced Interior Gateway Routing Protocol), OSPF (Open Shortest Path First) and some other Dynamic routing protocols keep the flow paths by using routing algorithms for improved performance. [1]

The authors evaluate performance of RIP, OSPF, EIGRP and IGRP in real-time applications by designing different scenario. Simulation is used OPNET (Optimized Network Engineering Tool) for evaluating against different parameters that evaluate the performance of the network: convergence, queuing delay, packet delay variation, packet end-to-end delay, as well as video traffic, download response time, upload response time, page response time and object response time of E-mail, FTP, and HTTP. And from the analysis done EIGRP performs better than the other protocols. [1]

[2] IGP (Interior Gateway Protocol) is routing protocol within Autonomous Systems which helps to improve inter-network performance by assigning weights to the links between routers. [2] To each link, cost factors can be applied based on numerous metrics. These include distance to a router, maximum possible throughput of the link between routers, and the availability of a link. Using these metric weights is assigned to that link which is a single unit-less number. OSPF is one of the commonly used IGP routing protocols. [2]

5 different types of packets are used for OSPF communication:

- 1) **Hello packet:** a packet which establishes and brings up –to- date relationships.
- 2) **Database Description:** is sent when a new neighbor relationship is initialized.
- 3) **Link State Request:** this packet used to request information about specific portions of the neighbour’s database.
- 4) **Link State Update:** a packet is sent as a response to link state request and as a link state advertisement (LSA).
- 5) **Link State Acknowledgement:** a packet sent to acknowledge the link state update.

O'Halloran, C, the author of this paper [2] targeted on the establishing an algorithm and control method to modify OSPF interface costs mechanically and animatedly on routers based upon the amount of traffic on the path, not the complete shortest path. The inspiration for this work is OSPF costs are placed statically depending of the speed of the interface.

[3] In this research comparison of RIP and OSPF is done, in which RIP is distance vector routing protocol and OSPF is link state routing protocol. The comparison between these protocols is done based on different metrics like packet loss, throughput, convergence time and latency by using a GNS-3 simulator. From the analysis OSPF is the best one since it has lower administrative distance value than RIP, suitable for huge networks and least cost of communication when compared to RIP.

[4] IPV4 and IPV6 are the two types of internet protocol. IPV4 is mostly used one of the current network communication and IPV6 is protocol of next generation internet which will ultimately replace IPV4, but until then both protocols need to coexist for a long time. The main issue is both protocols are not compatible with each other. To configure a scenario with IPV4 and IPV6 different types of routing protocols are required which have different performances. Routing is not an easy task, especially in case of wireless networks. This paper presents a performance evaluation of some dynamic routing protocols like Routing Information Protocol (RIP), IPv6 Routing Information Protocol (RIPng), Open Shortest Path First (OSPFv2), and IPv6 Open Shortest Path First (OSPFv3) over Mobile Ad-hoc Networks is done using Exata Cyber 1.1 simulators. The performance of networks is measured based on the packet delivery ratio, jitter, end-to-end delay and throughput that is done on 100 nodes using four CBR applications with varying packet sizes of 256, 512, 1024 and 2058 bytes. And from the evaluation held, performance of RIPng is best among all the protocols as it has maximum throughput and packet delivery ratio with minimum delay and jitter.

[6] In this paper comparison of OSPF and EIGRP is done in the schema of IPV4 and IPV6. These

two protocols are mostly used dynamic routing protocols for application in latest years. OSPF is an IETF protocol, which is suitable for different types of router, and EIGRP is proprietary of Cisco, but both of the protocols are IGP protocols and have been widely used currently. The core objective of this work is that which one is more suitable for network. Comparable methods are chosen to discuss their advantage and disadvantage. Simulation of two topologies is done by using Packet tracer software in which three routers are used in each topology which are connected to various personal computers via network switches. In the first topology which is called point-to-point network, the three routers are connected to each other via serial interface which are connected to various computers via switches. And in multi-access network topology, the three routers are connected to each other through the switches which are further connected to the personal computers via network switches. The point-to-point topology is described in both IPV4 and IPV6 schema, whereas the second topology multi-access is described in IPV4.

Based on Administrative Distance, Round-trip Success Rate, Metrics/cost, Load Balancing, Start up Times and Link Recovery, Average time and Packet loss analysis of those two protocols is done on and from the analysis performance of EIGRP is well than OSPF according of Packet delay variation, Packet loss, Convergence activity end - to -end delay and round trip success rate.

[7] 3G wireless technology, which is called UMTS (Universal Mobile Telecommunication System) provides better speed, security and bandwidth utilization of resources. In this paper performance of UMTS network is inspected under different protocols like EIGRP, IGRP and RIP on the basis of efficiency and helpfulness of UMTS network under the protocols which provide better quality for different types of services within a network.

This research gives brief description about the UMTS and compares the performance of RIP, IGRP, EIGRP according to bits sent per second, the number of bits received per second for transmission cost, router operating cost and throughput and EIGRP has the best performance.

[8] This paper presents the performance comparison of EIGRP over OSPF for this three network models are designed and the first one is configured with OSPF, the second with EIGRP and the third is configured using both EIGRP and OSPF. Convergence time, packet delay difference, Loss packet, jitter, end-to-end delay and throughput are used for the comparison and evaluation of the protocols. These protocols are used to get better performance with each other in real time traffic, specially voice conferencing and video streaming

find in the entire network. And the result shows better in performance is by EIGRP routing protocol than OSPF routing protocol in real-time applications.

III. STUDY METHODOLOGY

More than a few ways are compared with each and every other and the justification of chosen method is given in this section. Three ways are on hand for efficient analysis of protocols in a network which incorporate mathematical or analytical evaluation, direct measurement and computer simulation. After taking all of the constraints and parameters into account mathematical and computer simulation are compatible for our research.

There are more than a few benefits of mathematical analysis like cost, time and the capability of supplying great predictive outcome. The direct dimension as an option of approach could be higherpriced, but can also be an option to simulate. The opposite size, which is direct size the analysis is to be carried out on an operational network which can result in disruptive situation and an operation community might be very expensive in terms of configuration complexity. The expertise of direct measurement is really correct results.

There are various simulators like NS-2, NS-3, Qualnet, Telnet, Omnet++, OPNET, and Packet Tracer. With a purpose to do simulation work, the simulator used to be to be chosen suitably. The suitable choice after keeping many concerns was Packet tracer simulator developed by Dennis Frezzo with his team at Cisco methods and OPNET. Packet Tracer (PT) is a strong protocol simulator and dynamic tool that demonstrates the quite a lot of protocols used in networking, in either real Time or Simulation mode. The discrete event procedure is a largely used effective simulation tool and good identified for its effective performance and reliability. OPNET (Optimized Network Engineering Tool) is a business network simulator.

A. Network Simulator and Design

Network simulators used in this study are OPNET and packet tracer. OPNET is a business network simulator and analysis application and it involves some toasts. These tool sets have their own function:

- 1) **Node model:** Interface of network components is precise.
- 2) **Packet format:** Protocols are outlined
- 3) **Process model:** community component's behavior is summarized
- 4) **Operation window:** network topology and link relationships are designed
- 5) **Simulation window:** outcomes of the analysis are validated and taken as the output

OPNET simulator is a powerful simulator program which is quite often used in current days in designing and inspecting the network configuration.

The Cisco packet tracer is additionally a simulator program developed by Cisco to demonstrate at a basic level how networks work. It is a proprietary Cisco product. It has 2 totally different views:

- 1) **Logical workspace:** Network building and configuration are performed by drag and drop network elements. [11]

- 2) **Physical workspace:** geographical design is feasible by connecting, networking devices at different locations of the town. [11]

While operating in the Cisco packet tracer simulator, the operation is done in 2 modes:

- 1) **Real-time mode:** The device within the network behaves and appears like real device. [11]
- 2) **Simulation mode:** Network failure troubleshooting is performed. [11]

B. Simulation Methodology for Network

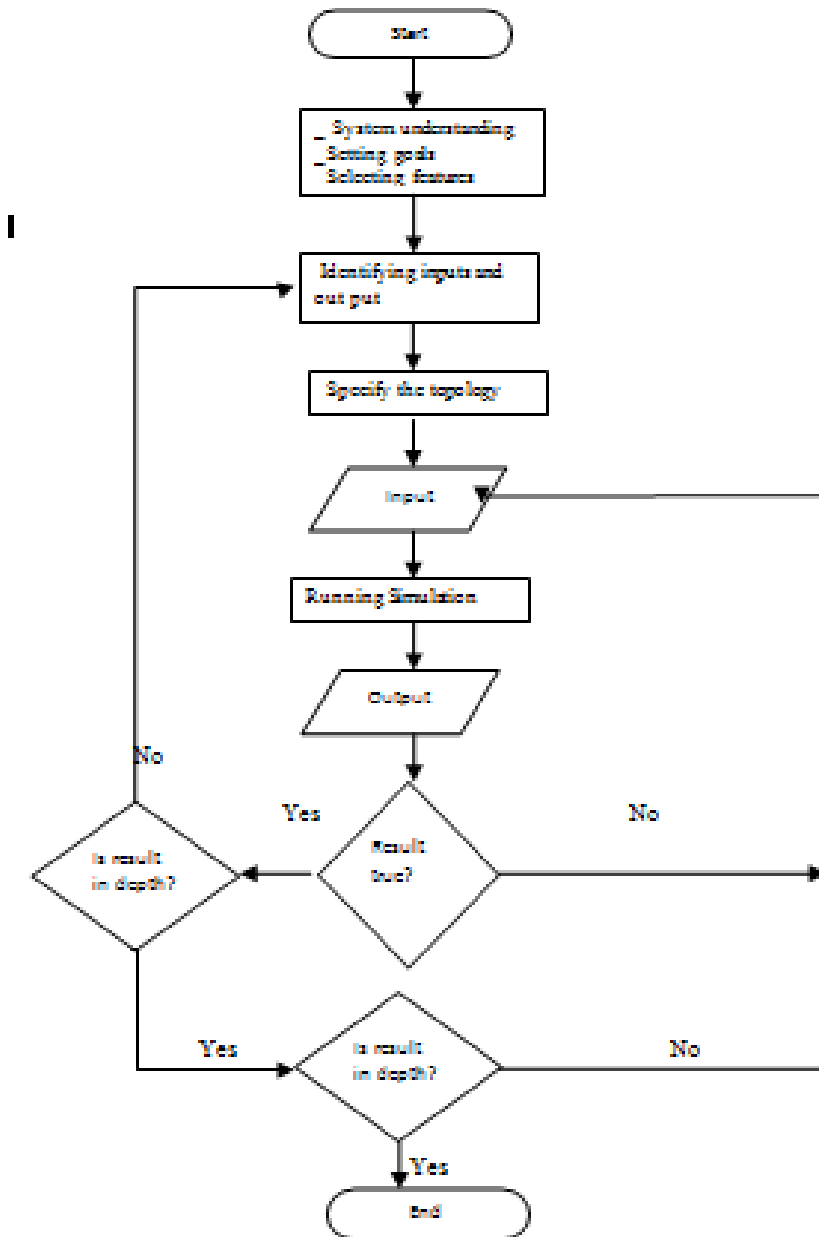


Fig. 2. Flow chart of Simulator Tool

C. Network Topology and Simulation

The proposed routing protocols (RIP, EIGRP and OSPF) are in comparison, based on convergence length, packet end to end delay, packet version, jitter and traffic sent and received while running real time applications like VOIP and video conferencing. We set application definition, profile

definition objects from the object palette to set and define the applications (VOIP and Video conferencing) and Failure recovery object to set the failure and restoration time.

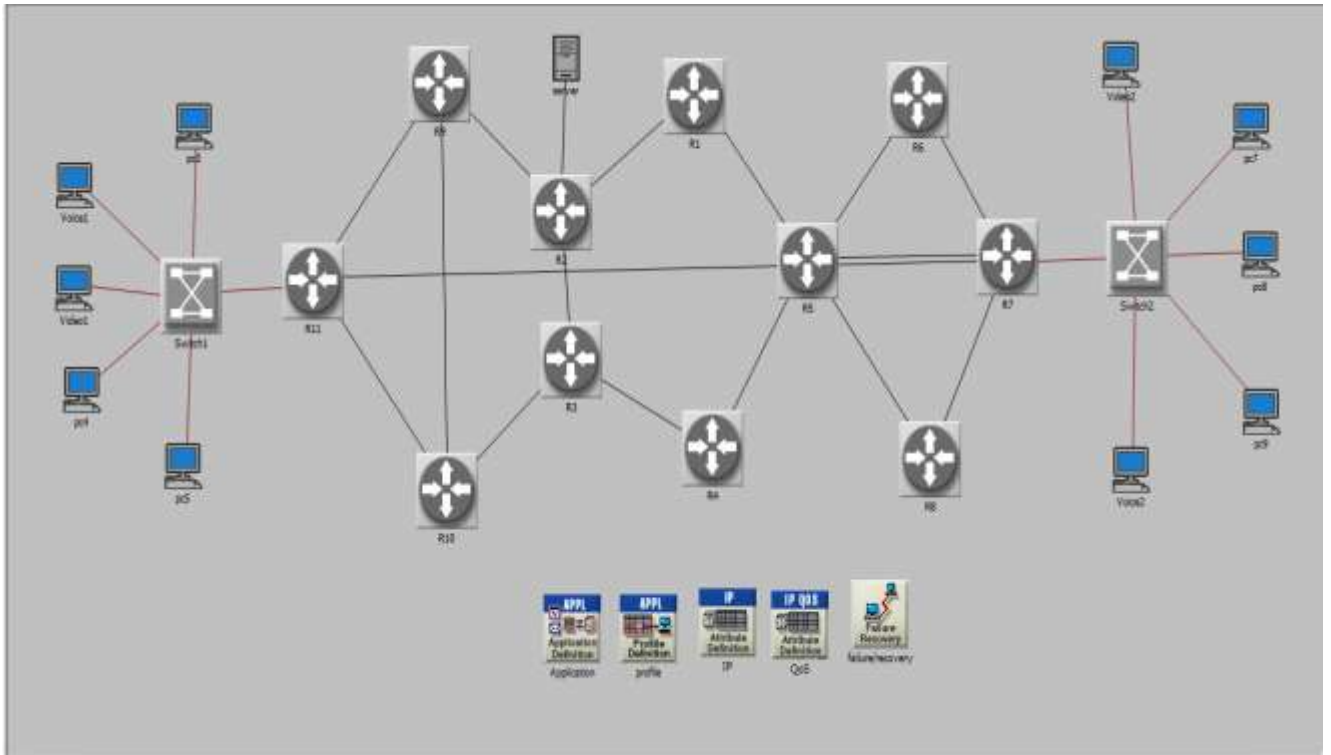


Fig 3. Network topology using OPNET

To compare the performance of RIP, EIGRP and OSPF on real time application Video conferencing and VOIP we use two situations in three scenarios configured with RIP, EIGRP and OSPF specifically. We set those two situations in failure/recovery object to show the performance of the protocols while some failure is happening on the link.

TABLE I. situation one

First situation	
Status	Time (Second)
100	Fail
150	Recovery
200	Fail
250	Recovery
300	Fail
350	Recover

TABLE II. simulation two

Second situation	
Status	Time (Second)
200	Fail
300	Recovery
400	Fail
500	Recovery
600	Fail
700	Recovery
800	Fail
900	Recovery
1000	Fail
1200	Recovery

A. Convergence duration of Video Conferencing

The time taken that all routers are in the same routing table or the same state. The simulation is

done in 350 seconds and 1200 seconds respectively to the above situations. And as we can see from fig. 1 EIGRP has fastest convergence duration than OSPF and RIP.

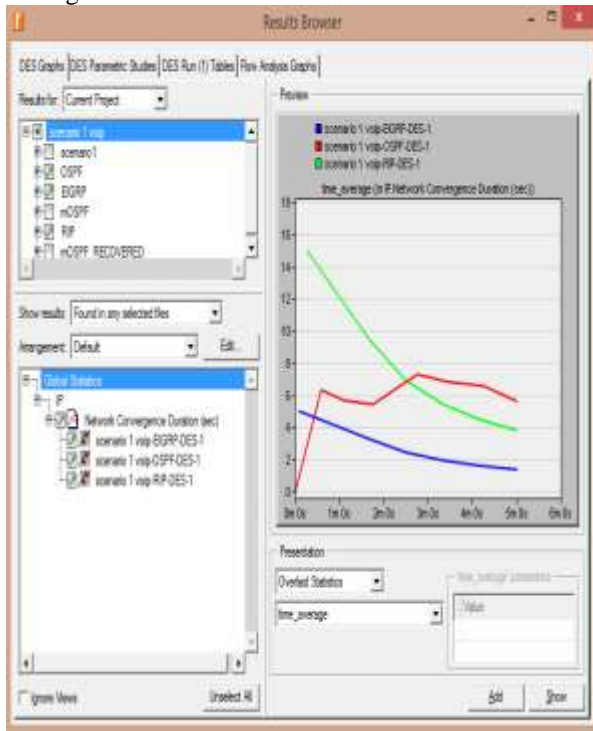


Fig .4.video Conferencing convergence duration(1st situation)

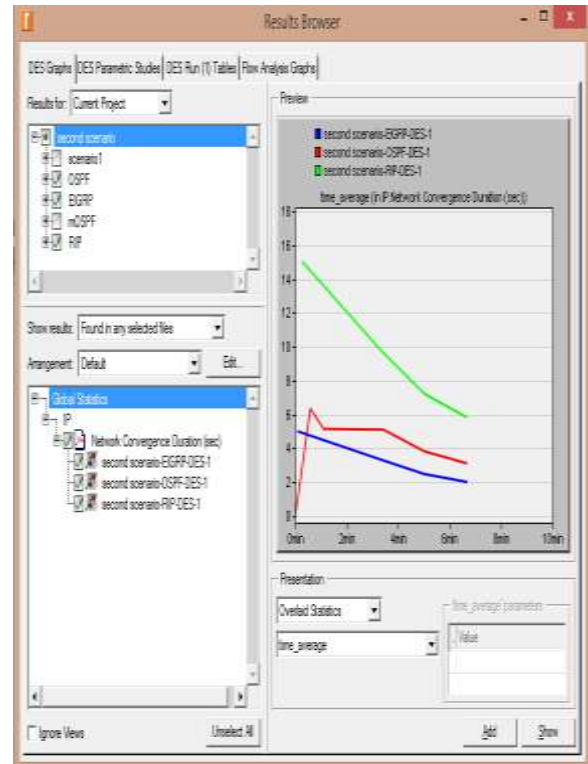


Fig.5. convergence duration (2nd situation)

A. Videoconferencing Packet end to end delay

Time taken that a packet to travel from source to destination.

Performance of RIP is better followed by OSPF in the first situation and OSPF performs better in the second situation.

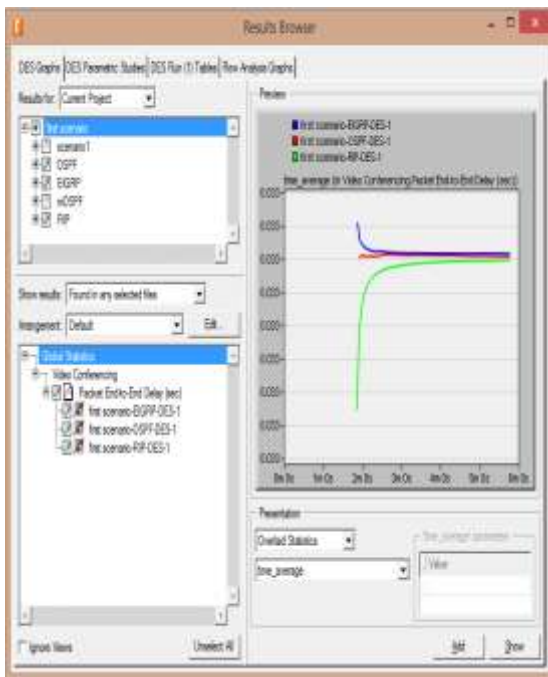


Fig.6. video Conferencing packet end to end(1st situation)

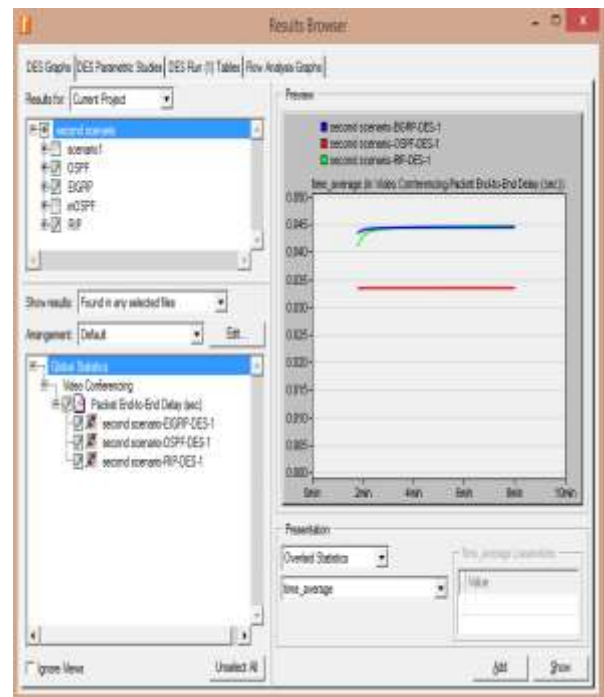


Fig.7. video Conferencing packet end to end(2nd situation)

C. Packet delay variation of Video Conferencing

Is the time between consecutive packets. Performance of OSPF is better than EIGRP and RIP in both situations.

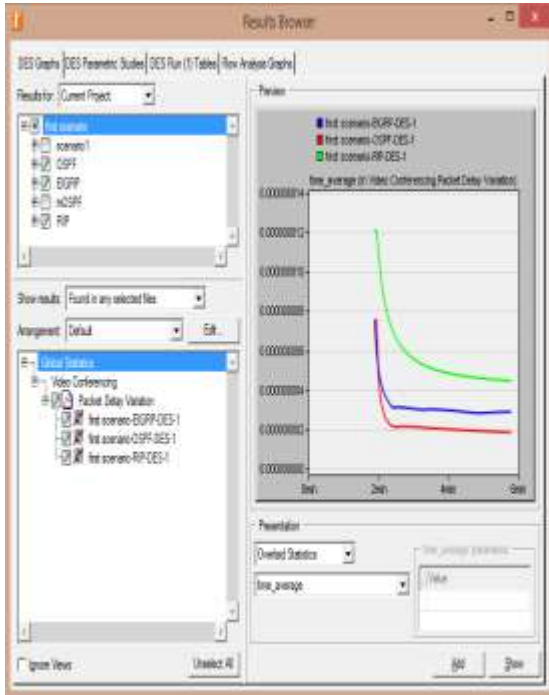


Fig.8.video Conferencing Packet delay variation (1st scenario)

D. Traffic sent and received of Video Conferencing

It indicates the amount of data sent and received during data transmission.

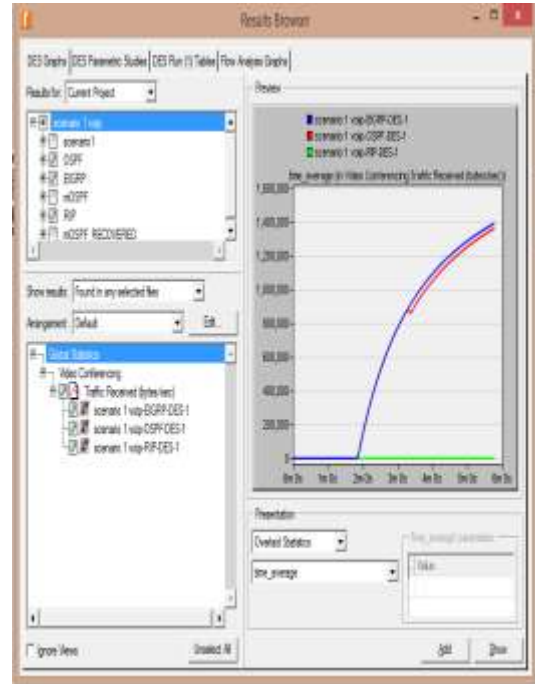


Fig.10. video Conferencing Traffic Received(1st situation)

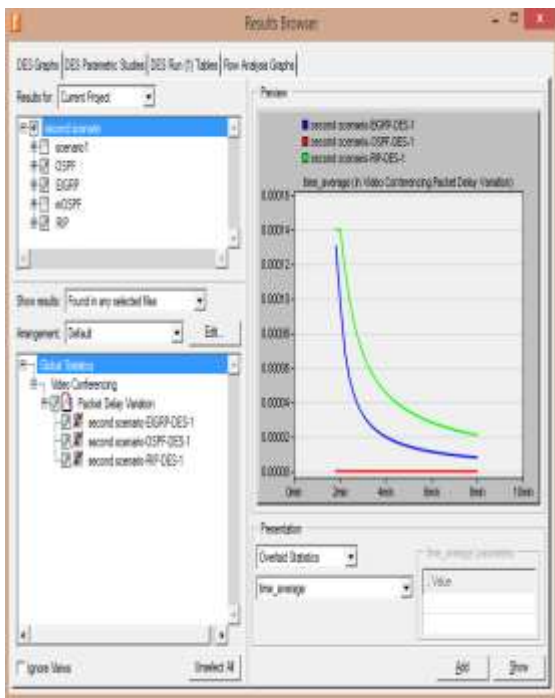


Fig.9. Packet delay variation (2nd scenario)

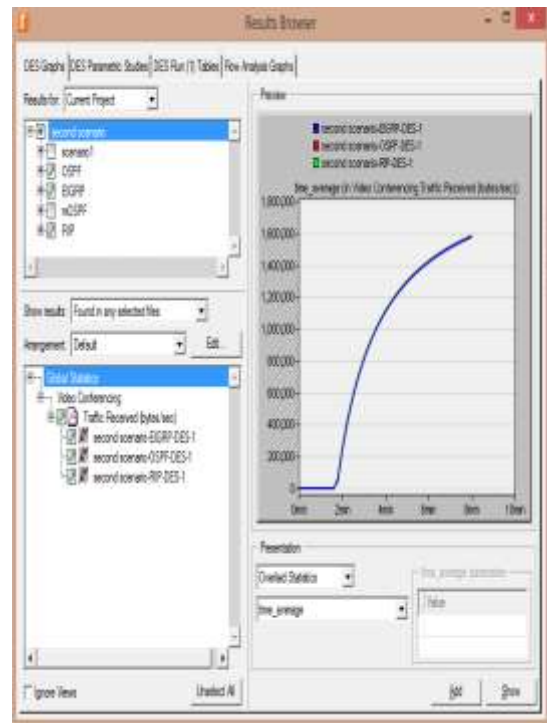


Fig.11. Traffic Received(2nd situation)

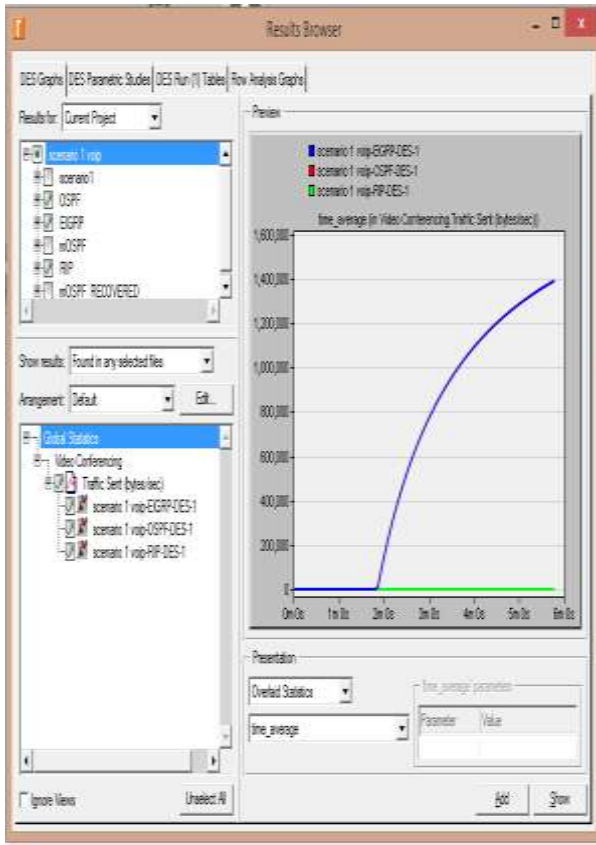


Fig.12. video Conferencing Traffic Sent (1st situation)

E. Jitter of VOIP

Jitter is the variation of delay time which indicates variation within the delay of received packets.

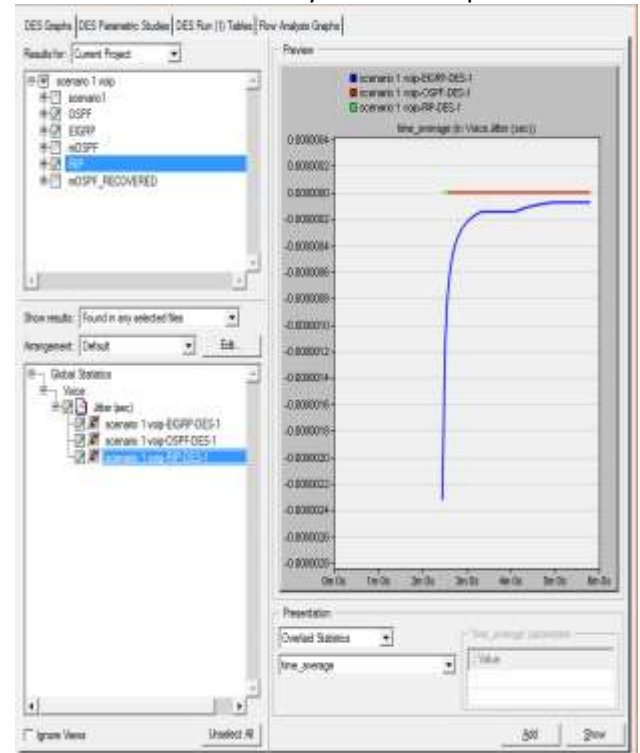


Fig.14. VOIP jitter (1st situation)

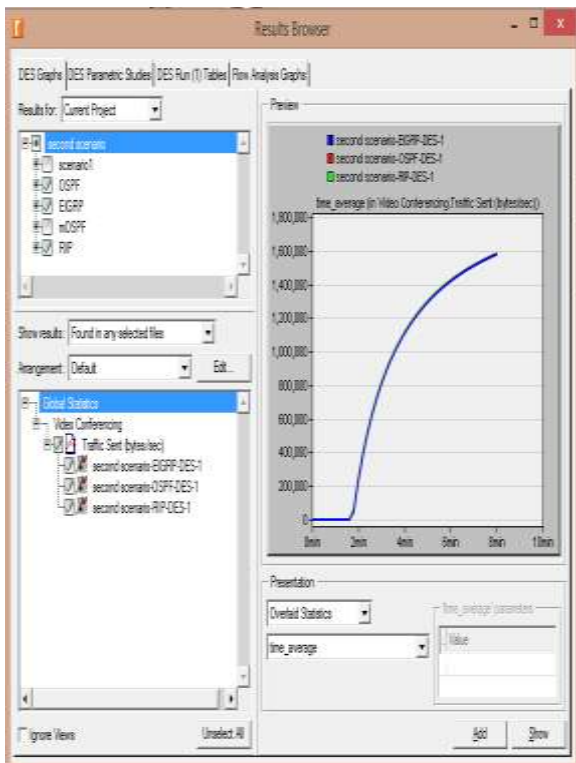


Fig.13. Traffic Sent(2nd situation)

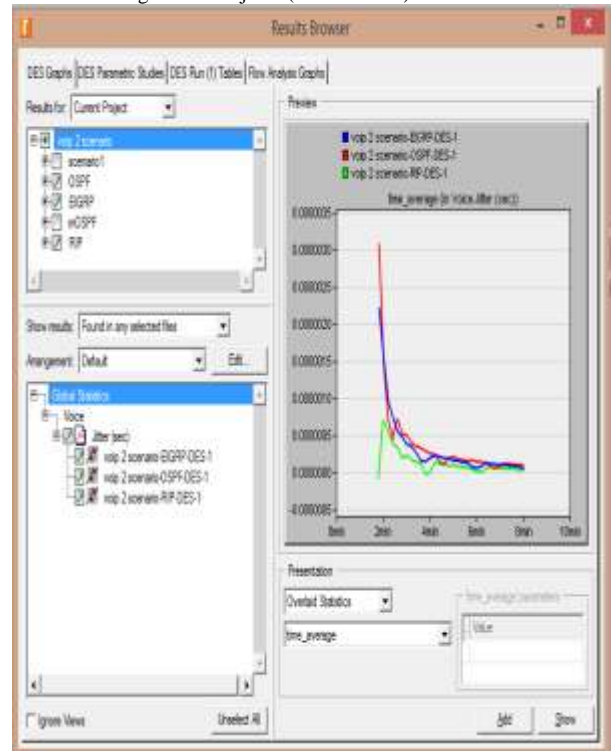


Fig.15. VOIP jitter (2nd situation)

F. MOS of VOIP

A number value for signifying the quality of VOIP.

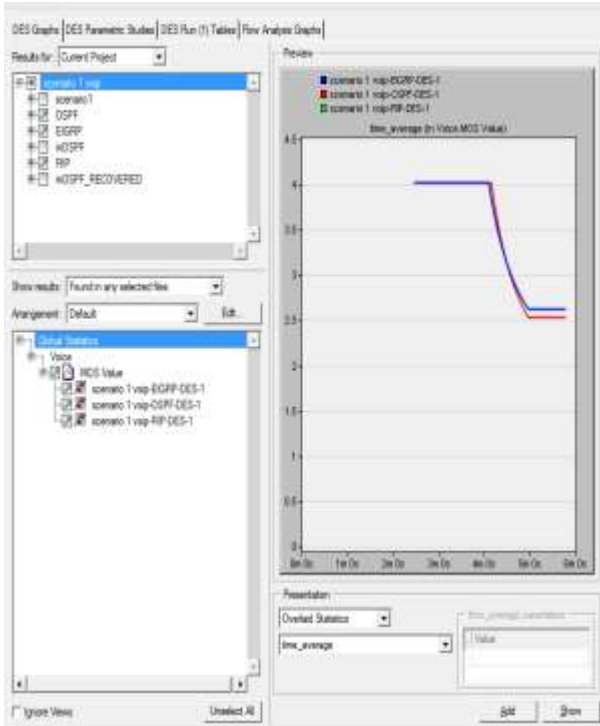


Fig.16. VOIP MOS (1st situation)

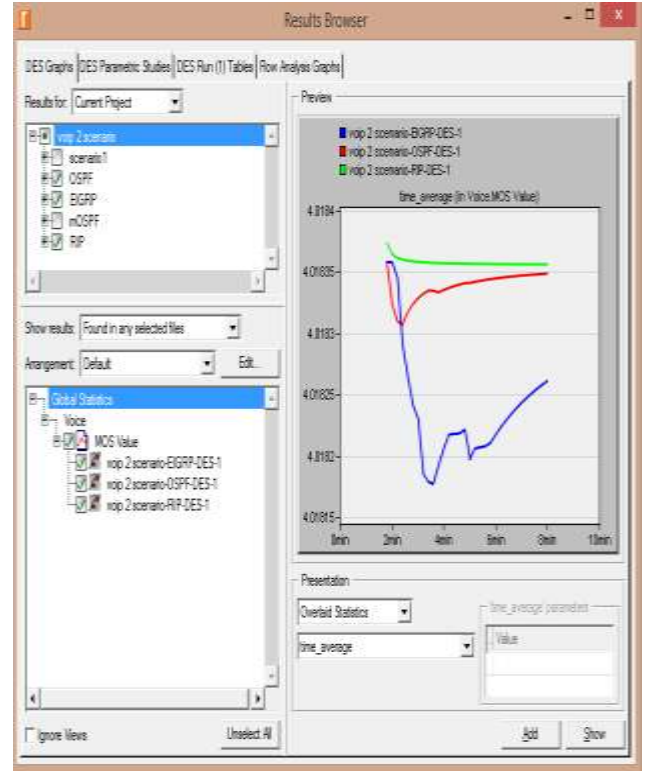


Fig.17. VOIP MoS(2nd situation)

We use CISCO packet tracers to show the work of VOIP within the protocols. We configure the

following topology using RIP, OSPF and EIGRP to analyze which protocol performs better in VOIP.

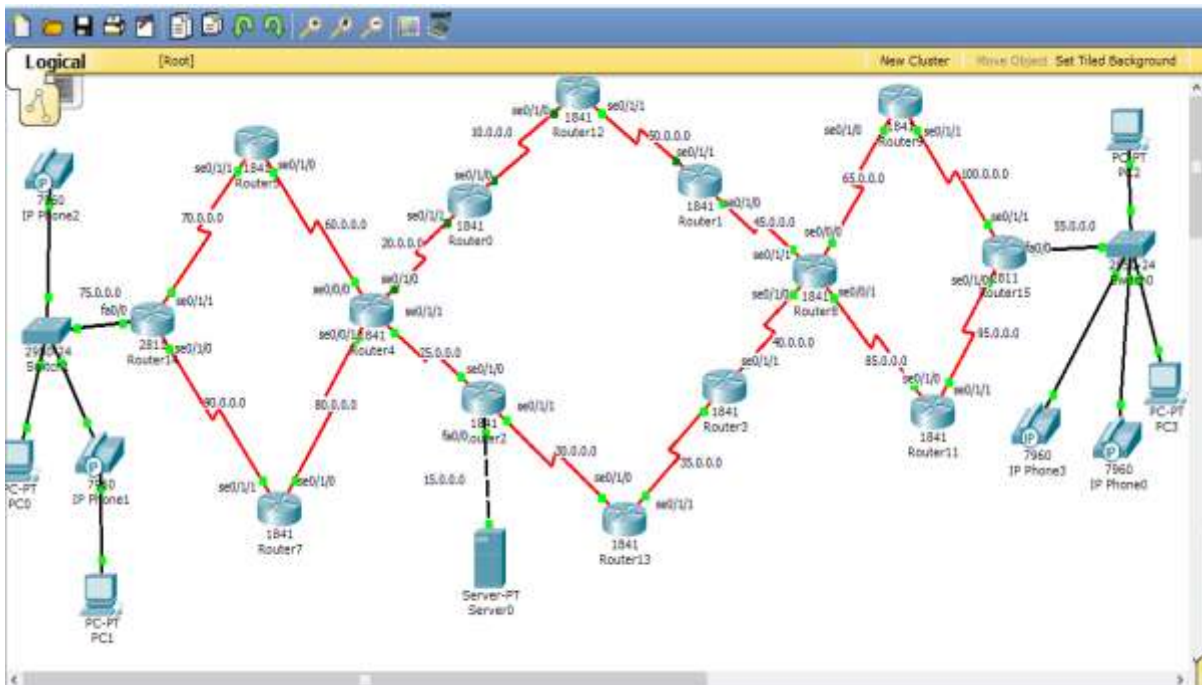


Fig.18. VOIP using packet tracer

IV. Comparison of Dynamic Routing

The comparison of RIP, EIGRP and OSPF is given in the following table.

TABLE I II. Comparison of Dynamic protocols

Features	RIP	EIGRP	OSPF
Protocol type	Distance vector	Hybrid	Link state
Routing Algorithm	Bellman ford	DUAL	Dijkstra
Maximum hop count	15	255	No limit
Classful/ Classless	classful	Classless	Classless
Authentication	No	Yes	MD5
Areas	-	-	5 area types
Update type	Periodic	Trigger when change is happening	Trigger when change is happening
Property	Open standard	Cisco proprietary	Open standard
Type of communication	Broadcast	Multicast	Multicast
Administrative distance	120	Internal: 90 External: 170	110
Network size	Small	Large	Very large
Convergence	Slow	Very fast	Fast
Metric	Hop count	Bandwidth/ delay	Cost

V. CONCLUSION

Routing protocols have a big role in network communication. Different protocols have different criteria and performance as we can see from the above comparison. RIPv2 protocol is suitable for small network and EIGRP is best for fast convergence, although it is a Cisco proprietary protocol. And OSPF is suitable for a very large network which does not have a maximum hop limit. It becomes with area concept which helps to hierarchaly organize the huge network. Even

though it is complex to configure it is a very popular protocol as it is an open standard protocol with fast convergence and with outstuck in problem like in EIGRP protocol.

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