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RESEARCHARTICLE

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PERFORMANCE ENHANCEMENT OF 'OSPF' FOR VIDEO CONFERENCING AND 'VOIP'

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ABSTRACT

In network communication, choosing the best path to send packets from source and destination is the first task to ensure 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 applications, VOIP and Video conferencing based on convergence duration, packet end to end delay, packet delay variation, Jitter, MOS and traffic sent and received by using OPNET simulators. Our goal is to identify which protocol performs better in real time application and enhance the performance of OSPF routing protocol. EIGRP routing protocol performs better than OSPF and RIP but changing the timer values of OSPF improves the performance of OSPF over EIGRP.

Key Words--RIP, EIGRP, OSPF, VOIP, Email, FTP, HTTP, Telnet, Cisco packet tracer, OPNET.

1. 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 hope 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 will be shared with immediate neighbors, and then throughout the network through routing protocols. A routing protocol states that how routers communicate with each other, distributing information that lets them to select routes between any two nodes. By this method, routers 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 for exchanging routing information within an autonomous system, whereas Exterior Gateway routing protocols are for exchanging routing information between different autonomous systems. 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 hop count as a metric and Bellman ford algorithm to determine the best route and it is used in the small size network since it supports maximum 15 hops. RIP has two versions RIPV1 and RIPV2. RIPV2 is the advanced version of RIP which comes with some additional 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.

EIGRP (Enhanced Interior Gateway Routing Protocol) is an Interior Gateway Protocol 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 achieve 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 configure 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 parameters and enhancing the performance of OSPF routing protocol.

2. OVERVIEW OF DYNAMIC ROUTING PROTOCOLS

A combination of networks connected by routers is called an internet. When a packet is sent from source to destination there will be so many pass through many routers until it reaches the router attached to the destination network.An autonomous system (AS) which is a collection of routers under a common administration is also known as routing domain.

Depending on the Autonomous System there are two types of routing protocols:

- Interior Gateway Protocols (IGP): It is also referred to as intra-AS routing as it is Used for routing within an AS. RIP, EIGRP, OSPF, and IS-IS are some of the examples of IGPs.
- Exterior Gateway Protocols (EGP): It is also referred to as inter-AS routing which is Used for routing between autonomous systems. The Border Gateway Protocol (BGP) is the only currently available EGP and is used by the Internet officially.

Interior Gateway Protocols (IGP) can be classified in two groups:

A. Distance Vector protocols

Distance vector means that routes are advertised using two characteristics: [11]

- Distance: a characteristic which identifies how far it is to the destination network from the source based on a metric such as the hop count, cost, bandwidth, delay, and more.
- Vector: characteristic that specifies the direction of the next-hop router or exit interface to reach the destination.

Distance Vector Protocols determine the best route adding the metric value which is received as the routing information happens from router to another one and the updates for the change of topology consist of periodic updates of the tables. This makes them to be slower in convergence.

RIP and EIGRP are some of the examples of distance vector routing protocols.

B. Link State Routing Protocols

The second category Link-state routing protocol creates a complete view or topology of the network by gathering information from all of the other routers and all link-state routers are using an identical map of the network. The link-state information is used by link-state router to create a topology map and to select the best path to all destination networks in the topology. This protocol does not use periodic updates but the network has converged, a link-state update is only sent if there is a change in the topology.

Link-state protocols work best in situations where:

- The network is large and hierarchical design is needed
- Fast convergence of the network is essential
- The administrators have good knowledge of the implemented link-state routing protocol

OSPF, IS-IS are examples of link state routing protocol.

2.1 ROUTING INFORMATION PROTOCOL (RIP)

The Routing Information Protocol (RIP) is one of the intra-domain (interior) routing protocols used within an autonomous system. It is one of the distance vector routing protocols which is very simple protocol. RIP implements distance vector routing directly with some considerations. RIP uses hop count as a metrics and bellman ford as routing algorithm. Updates in RIP are premedical which is in every 30 seconds.There are two versions of RIP, namely RIPv1 and RIPv2. [11]

2.2 EIGRP ROUTING PROTOCOL (EIGRP)

Enhanced Interior Routing protocol (EIGRP) incorporates features of distance vector protocols and link state advertisements and is known as a hybrid protocol. It is a Cisco proprietary routing protocol utilizing the Diffusing Update Algorithm (DUAL).EIGRP is IGP which uses the concept of autonomous systems to group routers which perform the same tasks. It gets information about the routes from updates of other routers but unlike other Distance vector protocols it maintains a partial topology of the network. There are 3 tables to make routing decisions in EIGRP. Those are; The Routing table, the Neighbor table and the Topology table. EIGRP uses bandwidth and delay as the metrics to determine best route from the source to destination. And it can also use bandwidth MTU, Reliability, load as metrics. [8] EIGRP is known as advanced distance vector used in large networks with 2555 maximum hop limit. It uses bandwidth, delay, MTU, Reliability and load as metrics but mainly both bandwidth and delay. And it is faster in convergence.

2.3 OPEN SHORTEST PATH FIRST (OSPF)

Open Shortest Path First (OSPF) is one of link state routing protocols which is an example of interior routing protocols, operating within an autonomous system (AS). OSPF detects link breakdowns, and converges in the topology within seconds. And it uses Dijkstra's algorithm, a shortest path first algorithm to compute the shortest path tree for each route. The OSPF routing uses link cost factors as a metric to construct a route table which is associated with each routing interface. The distance of a router (round-trip time), data throughput of a link, or link availability and reliability, expressed as simple unit less numbers can be considered as Cost factors. This provides traffic load balancing between routes of equal cost in dynamic process.It processes by using hello packet, database description packet, link state request packet, link state update packet and link state acknowledgement packet. [11] Link-State Advertisement (LSA) is used over all its adjacencies of OSPF router. OSPF used for very large network by configuring the topology hierarchal using the concept of area. It uses five types of area based upon the way the routing has to happen. [8]

OSPF supports multiple routes for a single destination network but they must be equal in cost unlike EIGRP, OSPF does not maintain unequal cost. In this protocol updates happened automatically if any change occurs on the topology. OSPF uses cost as its metrics and is good in bandwidth utilization.

3. Related Works

A. 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]

B. 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. [2]

C. 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. [3]

D. PV4 andIPv6 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. [4] 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 isdone 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.[4]

E. The authors of this work presents a simulation based performance comparison of OSPF and EIGRP routing protocols by using OPNET and GN3 network simulators based on metrics like network convergence duration, packet end-to- end delay, throughput, delay, jitter and packet lost. And from the evaluation result they conclude that EIGRP provides better performance than OSPF. [5]

4. RESEARCH METHDOLOGY

Various methods are compared with each other and the justification of chosen method is given in this section. Three methods are available for performance evaluation of protocols in a network which include mathematical or analytical analysis, direct measurement and computer simulation. After taking all the constraints and parameters under consideration mathematical and computer simulation are suitable for our research.

There are various advantages of mathematical analysis like cost, time and the ability of providing best predictive results. The direct measurement as a choice of method could be expensive but can be an option to simulation. The other measurement which is direct measurement the analysis is to be done on an operational network which can lead to disruptive situation and an operation network could be very expensive in terms of configuration complexity. The advantage of direct measurement is fairly accurate results.

There are various simulators like NS-2, NS-3, Qualnet, Telnet, Omnet++, OPNET, Packet Tracer etc. In order to do simulation work, the simulator was to be chosen suitably. The suitable choice after keeping many considerations was OPNET simulator. OPNET is a powerful protocol simulator and dynamic tool that demonstrates the various protocols used in networking in Simulation mode. The discrete event system is a widely used efficient simulation tool and well known for its efficient performance and reliability.

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

4.1 Simulation Methodology for Network

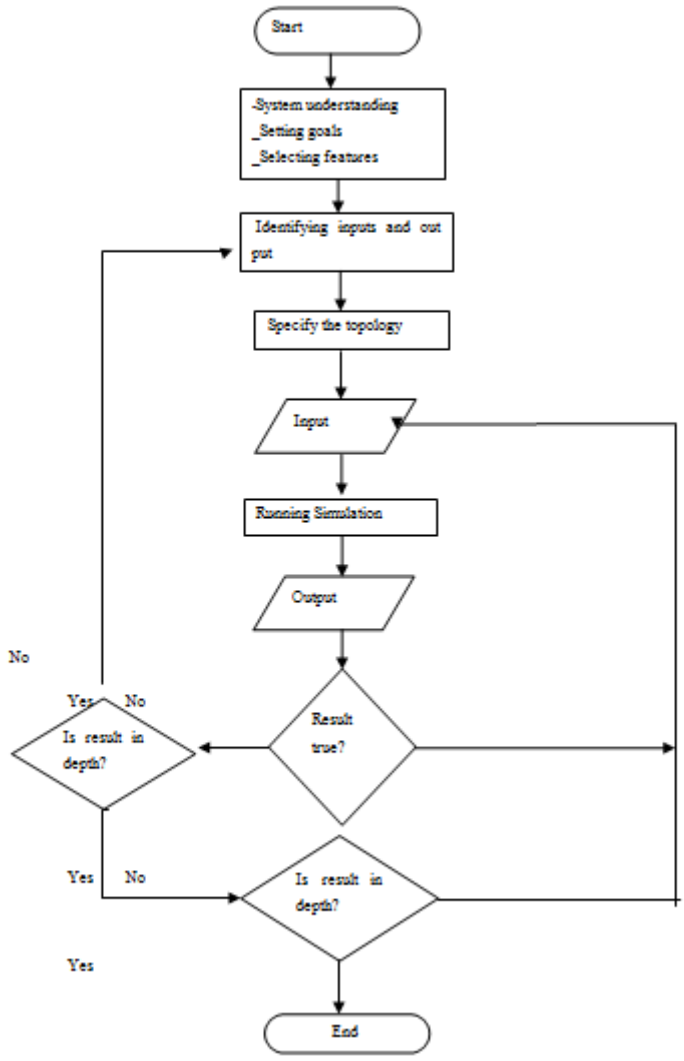


Fig1. Flow chart of simulation

4.2 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 delay variation, jitter and traffic sent and received while running real time applications like VOIP and video conferencing. We use 9 ethernet_tr_slip8_gtwy routers, 2ethernet_tr_slip8_gtwy_25_upgrade routers, 2 ethernet_16_switches, cyber_ethernet_wkstn_adv_11_upgrade and

mipv6_ppp_server_ adv.server to design the network topology while configuring it by using OPNET simulator. Every router is connected by ppp_DS3 connector and every workstation is connected with switch by 10BaseT connector. 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.

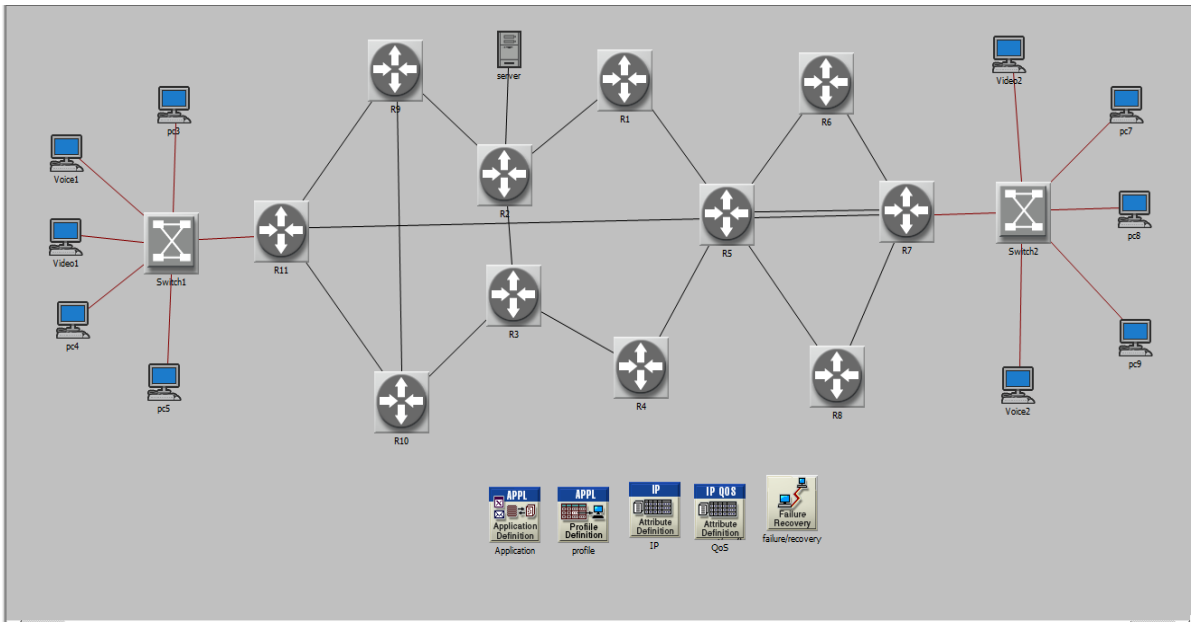


Fig.2 Network topology using OPNET

Table1. Failure Recovery

First Case	
Status	Time (Second)
Fail	270
Recovery	420
Fail	440
Recovery	500
Fail	575
Recovery	600
Fail	700
Recovery	750
Fail	800
Recovery	900

Second Case	
Status	Time (Second)
Fail	25
Recovery	30
Fail	50
Recovery	75
Fail	100
Recovery	125
Fail	175
Recovery	200
Fail	225
Recovery	250
Fail	275
Recovery	300

Third Case	
Status	Time (Second)
Fail	150
Recovery	300
Fail	450
Recovery	900
Fail	1200
Recovery	1500

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

1. Simulation Result and Analysis

In this work we are going to implement RIP, EIGRP and OSPF routing protocols to compare their performance in Video conferencing and VOIP real time applications. And somemodification is done on OSPF routing protocol to enhance the performance over other protocols by changing some parameter values. Some of the statics considered on this work:

1. Video conferencing Convergence duration: The time taken that all routers to be in the same routing table or same state. As we can see from the following figures EIGRP has better performance than RIP and OSPF in three situations as it has less value of convergence duration.But after changing Hello interval, Router Dead Interval and retransmission interval interface timers of OSPF from the default value into 5, 20, 2.5 respectively, we get performance improvement of OSPF over EIGRP and RIP in case one and case three.

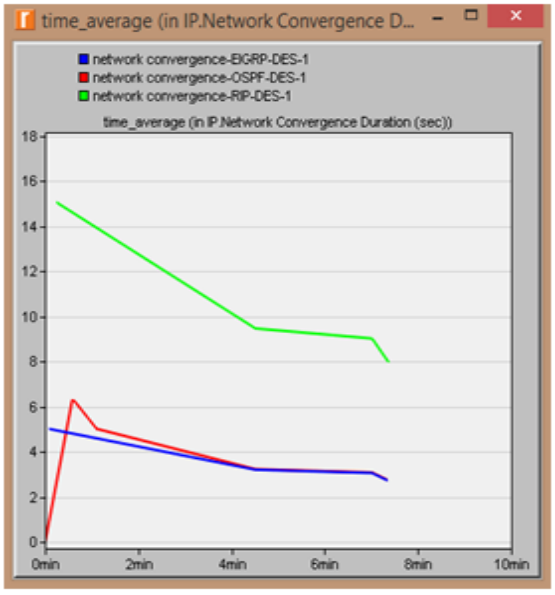
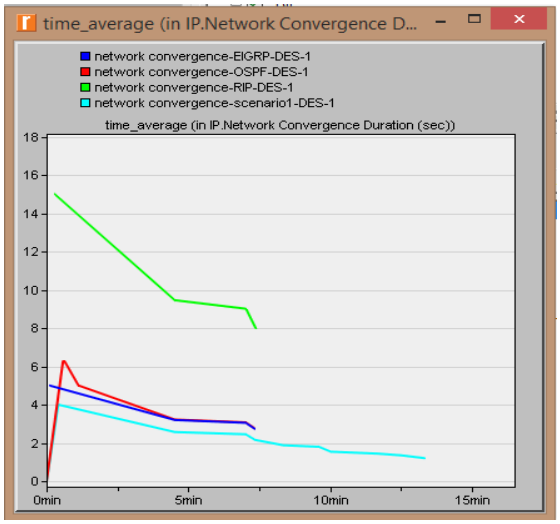


Fig .3 (a) 1st case network convergence



(b) 1st case network convergence (after change)

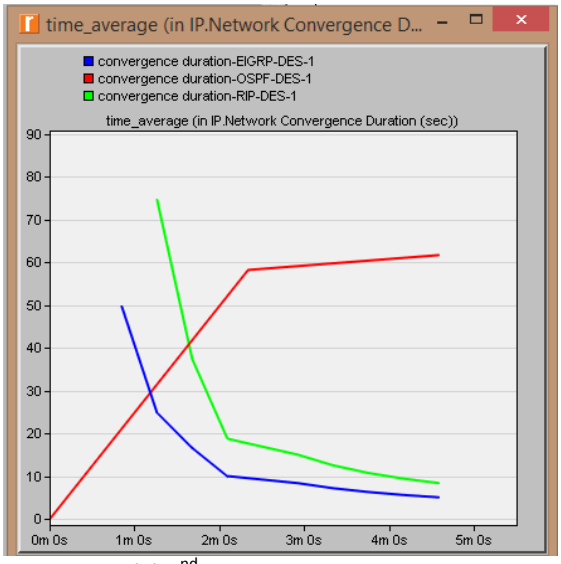
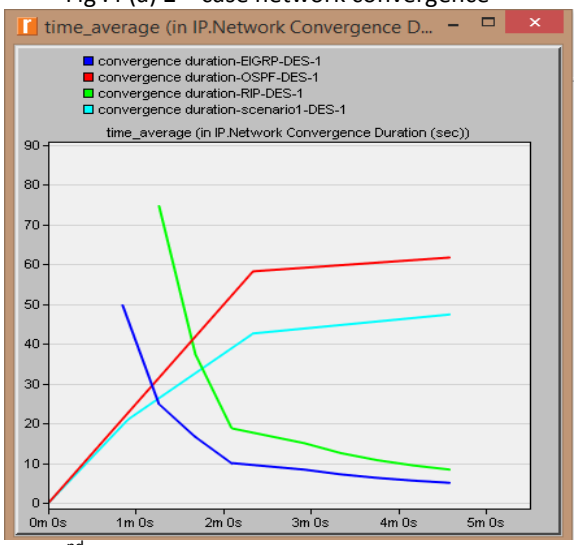


Fig .4 (a) 2nd case network convergence



(b) 2nd case network convergence (after change)

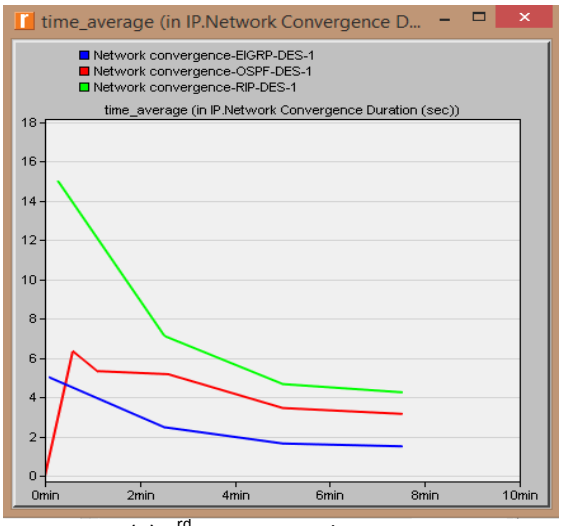
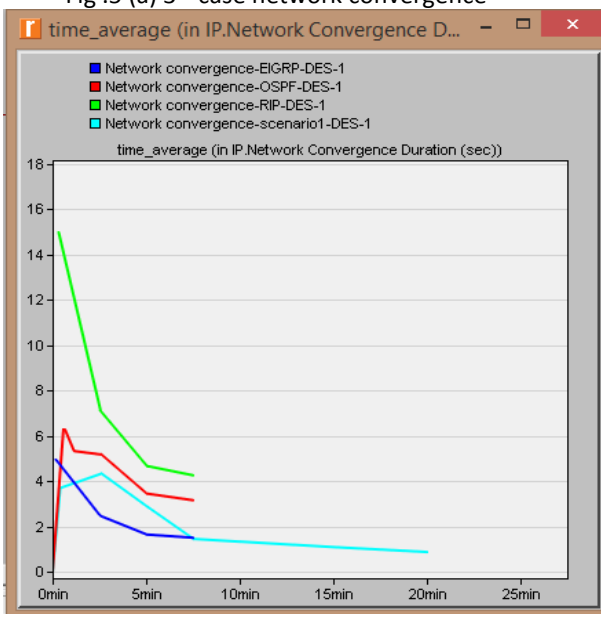


Fig .5 (a) 3rd case network convergence



(b) 3rd case network convergence (after change)

Table.2 Network convergence duration

protocol	First Case	Second Case	Third Case
RIP	15.03958	75	15.03958
OSPF	18.2092	218.6295	23.21149
EIGRP	5.016061	50.08671	5.025761
OSPF(Modified)	4.396269	199.3964	9.396467

Delay: It specifies how long it takes to transfer a bit of data from source to destination and it is measured in multiples or fraction of seconds. In this work we will consider packet end to end delay and packet delay variation.

2. Video conferencing Packet end to end delay: Time taken that a packet to travel from source to destination. As we can see from the following figures OSPF performs better on case the first and third cases but in the second case RIP performs better followed by EIGRP. Changing the minimum and maximum outcome value of OSPF into 10 and 15 improves the performance of OSPF over RIP and EIGRP.

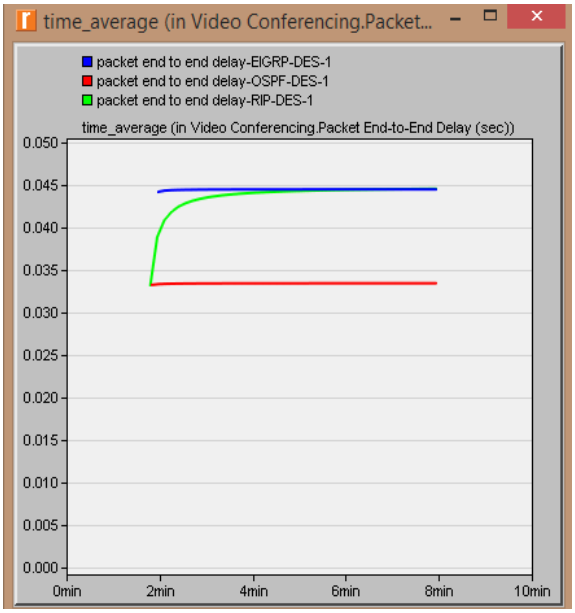
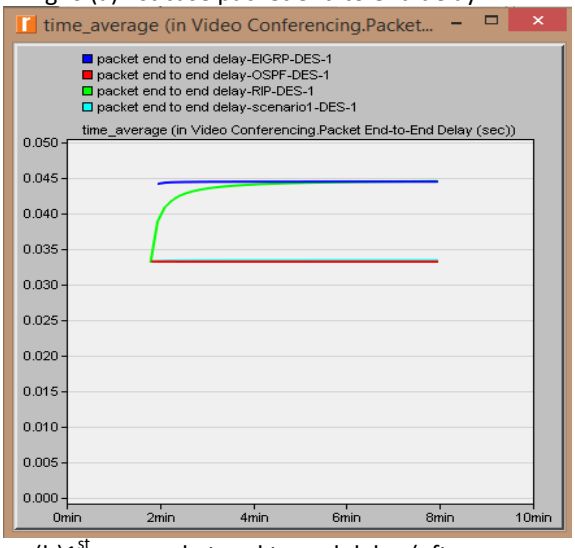


Fig .6 (a) 1st case packet end to end delay



(b)1st case packet end to end delay (after change)

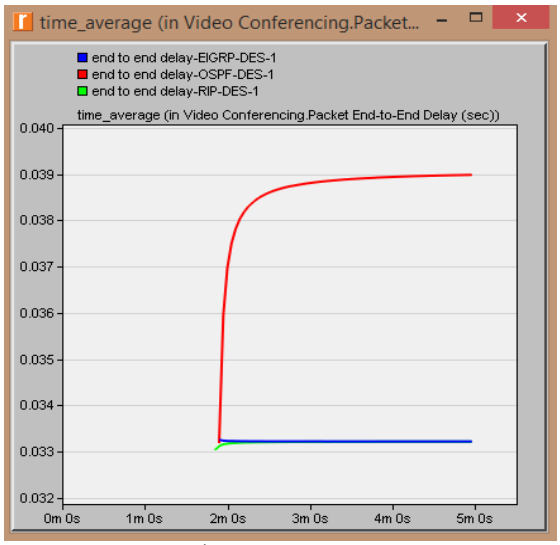
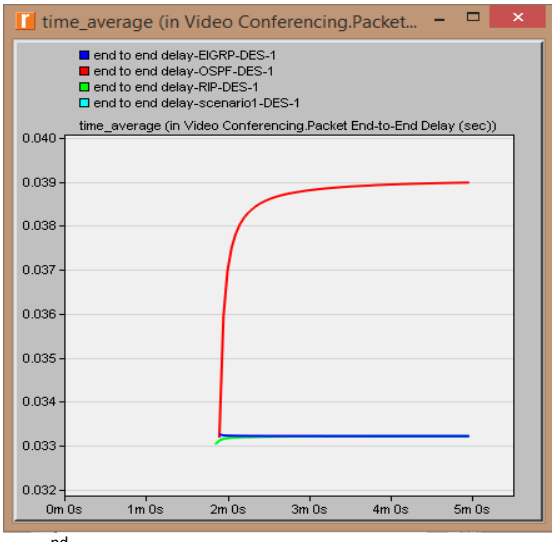


Fig.7 (a) 2nd case packet end to end delay



(b) 2nd case packet end to end delay (after change)

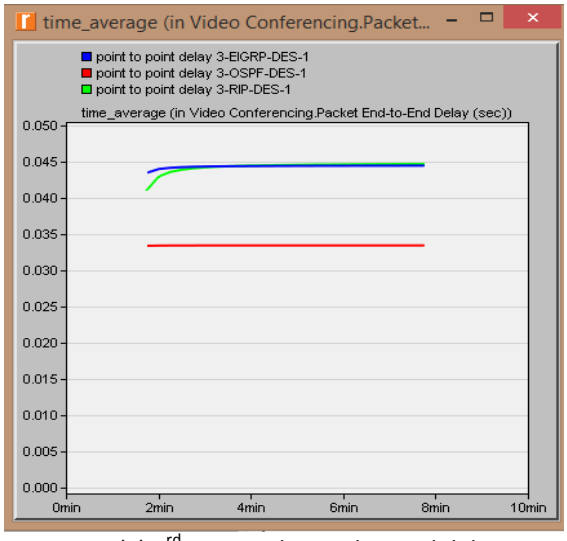
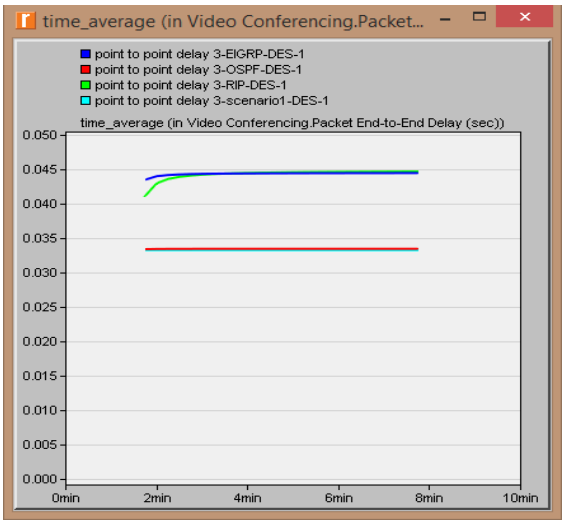


Fig.8 (a) 3rd case packet end to end delay



(b) 3rd case packet end to end delay (after change)

1. ***Packet delay variation:*** packet delay variationindicates the time between consecutive packets. In this work OSPF shows better performance in first and third case and EIGRP is better in the second case.

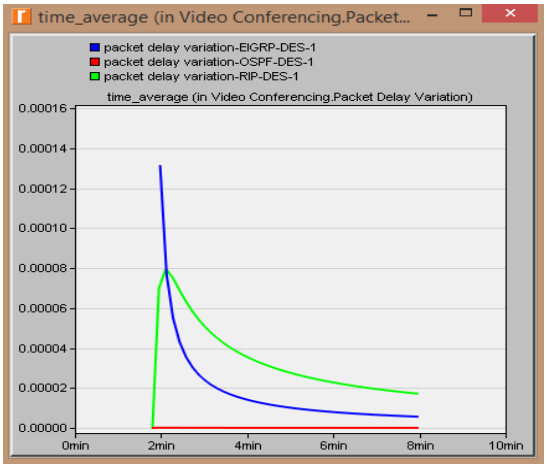
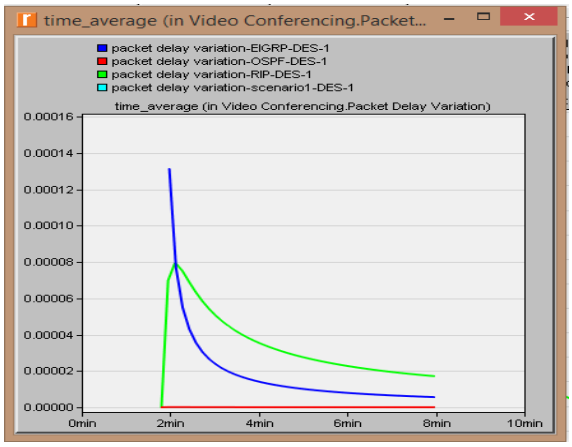


Fig.9 (a) 1st case Packet delay variation



(b) 1st case Packet delay variation (after change)

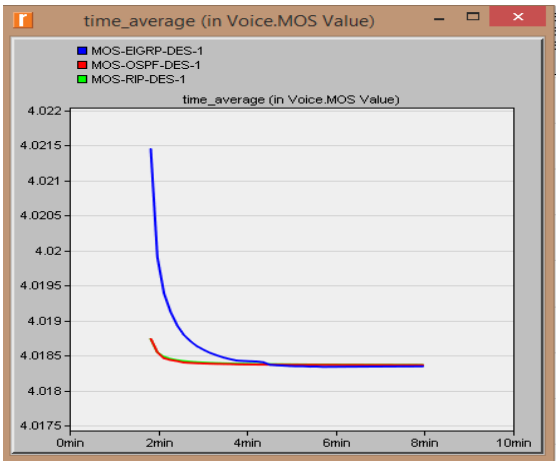
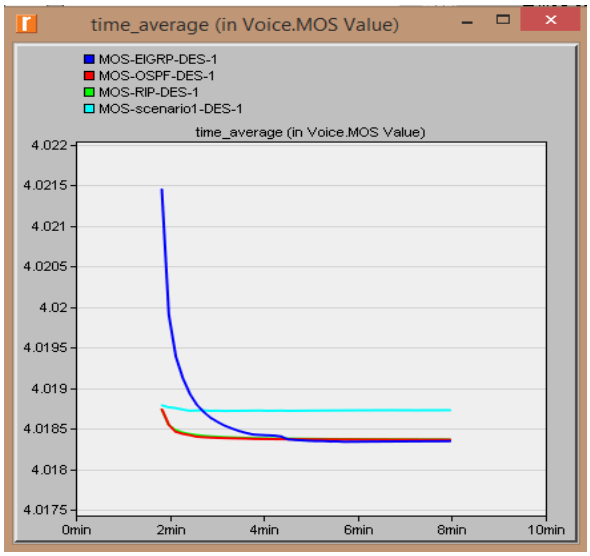


Fig.12 (a) 1st case MOS



(b) 1st case MOS (after change)

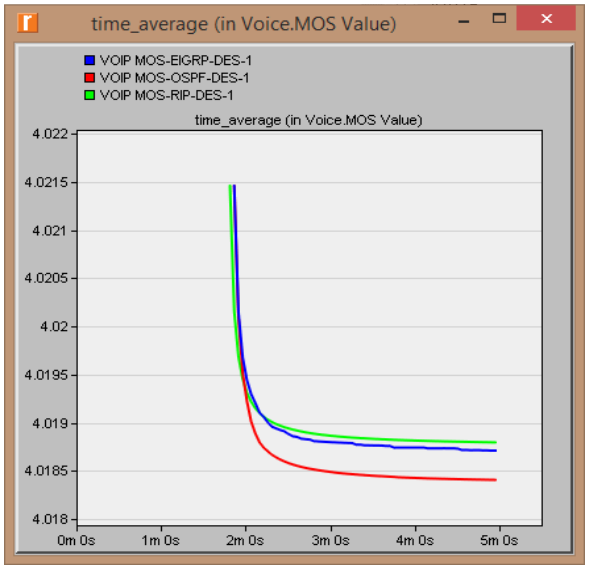
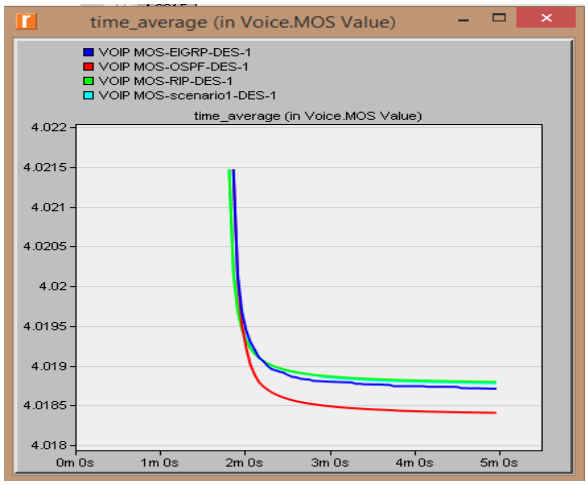


Fig.13 (a)2nd case MOS



(b) 2nd case MOS (after change)

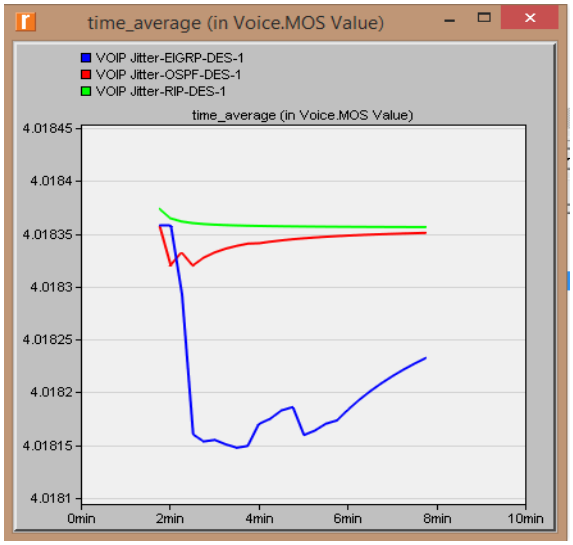
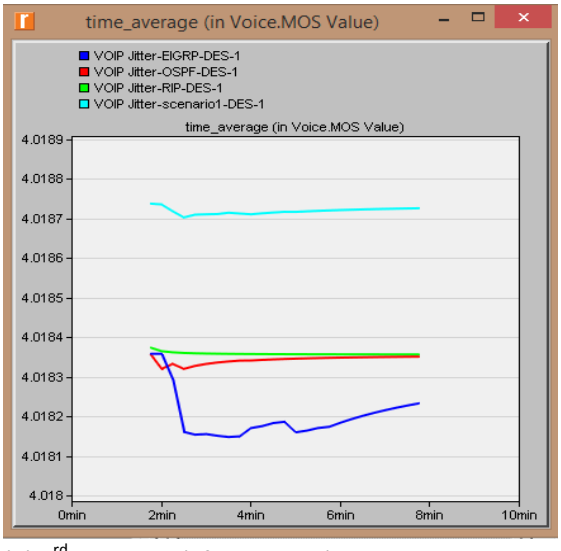


Fig.14 (a) 3rd case MOS



(b) 3rd caseMOS (after change)

2. ***VOIP Jitter:*** Jitter is variationin the delay time. Performance of RIP is better in all three cases followed by OSPF.

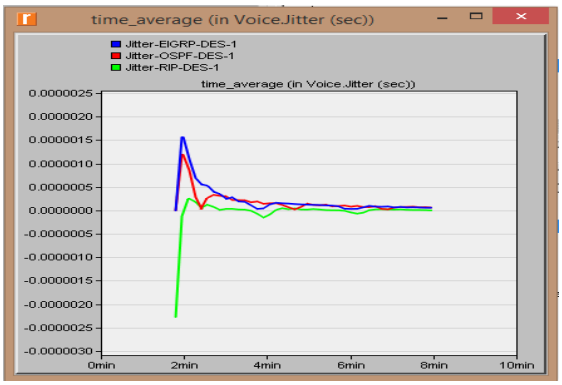
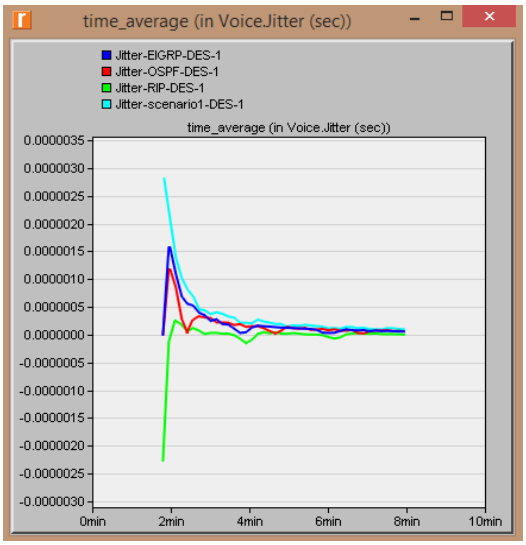


Fig.15 (a) 1st case jitter



(b)1st casejitter (after change)

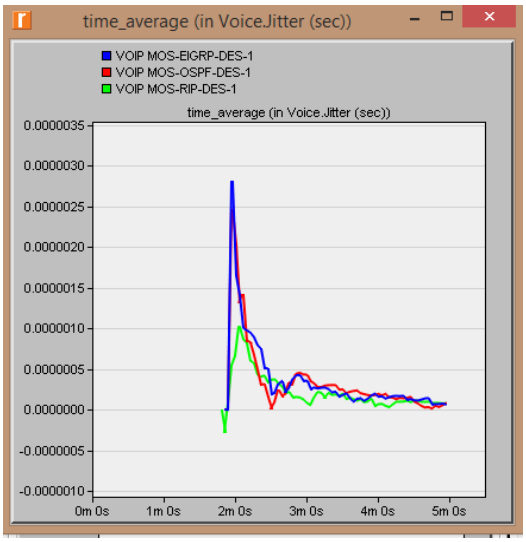
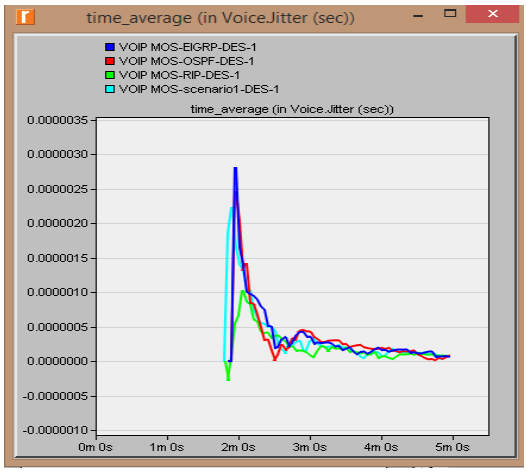


Fig.16 (a) 2nd case jitter



(b) 2nd casejitter (after change)

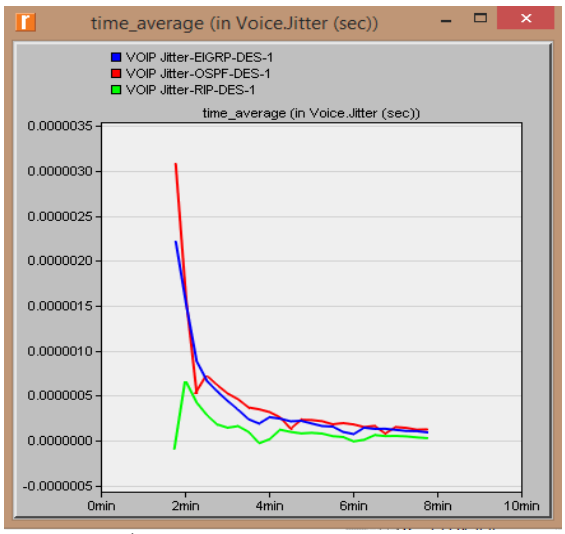
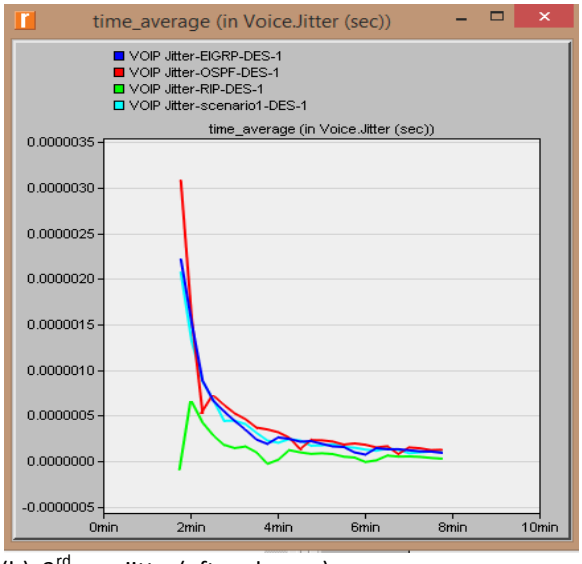


Fig.17 (a) 3rd casejitter



(b) 3rd casejitter(after change)

5.1 Comparison of Dynamic Routing protocols

Table.3Comparisons of Dynamic Routing Protocol

Features	RIPv1	RIPv2	EIGRP	OSPF
Protocol type	Distance vector	Distance vector	Hybrid	Link state
Routing Algorithm	Bellman ford	Bellman ford	DUAL	Dijkstra
Maximum hop count	15	15	255	No limit
Class full /classless	Class full	Class full	classless	Classless
Authentication	No	Yes	Yes	MD5
Areas	-	-	-	5 area types
Update type	Periodic	Periodic	Trigger when change is happened	Trigger when change is happened
Property	Open standard	Open standard	Cisco Proprietary	Open standard
Message type	Broadcast	Multicast	multicast	Multicast
Administrative distance	120	120	Internal: 90 External: 170	110
Network size	Small	Small	Large	Very large
Convergence	Slow	Slow	Very fast	Fast
Metric	Hop count	Hop count	Bandwidth/ delay	Cost

6. 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. RIPprotocol is suitable for small network and EIGRP is best for fast convergence although it is a Cisco proprietary protocol. And OSPF is suitable for very large network which does not have maximum hop limit. OSPF becomes with area concept which helpshierarchically organize the huge network and it is very popular protocol as it is an open standard protocol with fast convergence and without stuck in problem like in EIGRP protocol. In this work we compared the performance of those three protocols namely RIP, EIGRP and OSPF and EIGRP has better in network convergence than others but by changing the default values of OSPF Hello interval, Router Dead Interval and retransmission interval OSPF protocol performs well. OSPF is an open standard and most popular routing protocol modifying and enhancing the performance will be better for cost minimization and fast communication.

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