Performance Evaluation of Routing Protocols for Real Time Applications in IPV6

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Abstract— The development of internet networks and increasing demand of various real time applications e.g. voice, video conferencing and email plays an important role in the real network. Routing Algorithm plays a vital role to handle such applications. Choosing which one is the best routing algorithm to show the best performance depends upon the various factors such as Delay, Bandwidth Utilization, Network Convergence and Throughput. The present work employs three routing protocols (OSPFv3, IS-IS and RIPng) for better performance for real time applications. OSPFv3 and IS-IS are link state routing protocol that are designed to operate in complete networking topologies and communicate within an autonomous system. On the other hand RIPng is the latest version of RIP that exchanges routing information used to compute routes for Ipv6 Networks. In the present work three routing protocols are combined to show the better results rather than the single protocol implementation. OPNET simulator is used to design and implement the proposed work. Firstly network model with OSPFv3 protocol is implemented. Secondly same network with IS-IS and RIPng is implemented. Finally the results of three protocols are collected and then analysis the performance to check which one is better protocols with different performance metrics. In HTTP Page Response Time IS-IS protocol gives us Better Response Time. In briefly combination of all protocols provides us best performance in Email Upload Response Time, Download Response Time, VOICE End to End Delay, MOS Value only in Http Page Response Time. IS-IS performance is best among others. In Video performance IS-IS, OSPFV3 and combination of all there protocols End to End Delay time is equal. RIPng provide us worst performance in all the performance metrics. Finally combined routing network model gives the best results.

Keywords—HTTP; IS-IS; IPV6, Routing Protocols; OSPV3; RIPng;

I. INTRODUCTION TO IPV6

Every computer system has a unique IP address which is referred for identification and location definition. Every packet has header format at both sides (source and destination) for addresses. Blueprint for that header is called internet protocol. Internet today relies on the Internet Protocols. First time Internet Protocol was designed in the beginning of 1980s. In the beginning developers of the IPv4 knew that the address space of IPv4 were not sufficient for the future. To remove the limitations of IPv4 a recommendation of a new Internet protocol IPv6 was developed and later on approved in 1994 by the IETF (The Internet Engineering Task Force). IPv6 is a new Internet protocol which replaced the IPv4 protocol. IPv6 contains number of many new features which are not in IPv4. The prime difference between IPv6 and IPv4 is that IPv6 has more number of addresses than IPv4, means that IPv6 has 128 bit addresses and IPv4 has 32 bit address. IPv4 has a 4,294,967,296 IP addresses but IPv6 has 18,446,744,073,709,551,616 IP addresses. IPv6 has been used on high scale throughout the world for 20 years. In 1981 IPv4 was defined properly. Durability, ability to work together and to implement easily is the main features of IPv4. IPv6 128-bit address structure defines large and sufficient address space. 128 bits means there are different no. of addresses which is useful for internet trends in future. Hierarchical network architecture of IPv6 improves the routing efficiency. IPv6 is a neighbour discovery routing protocol. This protocol provides (auto configuration of nodes, finding other nodes, discovery of other links in the nodes). IPv6 and Ipv4 are almost same but there are two new functions added in IPv6 which are router discovery and stateless address auto-configuration. IPv6 provides a group of address spaces when it needs to connect with new devices over a network.

1.1 IPv6 Features and Benefit

There are number of features listed:

1. Different Header and Packet Format
2. Larger Address Space
3. IPv6 address configuration (Statefull and Stateless)
4. Expanded Addressing
5. Secure Protocol

6. Multicasting and Enhancements for Mobile Network

7. Neighbour Discovery

1.2 Routing Process

Routing is the process in which packets are transferred to different destinations in connected areas. In Connected network areas routing has data forwarding capabilities between different hosts. IPv6 routing done two processes; one is data sorting and second is packet delivery. Packets which send and receive the data in IPv6 are called IPv6 packets. IPv6 packet consists of address of sending and receiving hosts. Ipv6 performs many functions but routing is aim of the IPv6. IPv6 packets are sent, received and processed on each node by using IPv6 protocol at IPv6 layer of OSI model. TCP and UDP packets are sent by the transport layer in OSI model. Then these packets are sent to IP layer. IPv6 layer creates the source and destination address information. This information is placed in routing table for future route information. Then IPv6 layer sends the packets to link layer in OSI model which further are forwarded to physical layer for fragmentation. On receiver side the process occur in reverse order. IPv6 layer examine the address of destination and then compare it with routing table .After examine the routing table IPv6 layer finds what additional forwarding of message is required. More than two IPv6 network segments are connected to multiple routers that are used to forward packets between hosts. The routing table of IPv6 is built automatically. Routing table created on the bases of configuration of your computer. Firstly host start to forward the IPv6 packets then system check the database addresses entries that is the most suitable to the destination IPv6 address. IPv6 routers are used for joining together IPv6 network segments which are separated physically.Computer works on one of three things:

1. It forwards the packet to a protocol layer which is placed next to IPv6 layer on the local host.
2. It passes the packet by using network interfaces.
3. It may discard the packet.

II. LITERATURE REVIEW

The available literature has been reviewed in this context.

Wijaya (2011) introduced two routing protocols OSPF and EIGRP. These two protocols comes under IGP (Interior Gateway Protocol) category. OSPF and EIGRP distribute routing information to routers in the autonomous systems. Research described how routing protocol defines and compares the different protocol of IPv4 and IPv6. Protocols may be static and dynamic. They explained the different network topologies. Finally research concluded that EIGRP is better than OSPF.

Dubey et al. (2012) presented the working of two protocols RIP & OSPF. These two protocols are explained by simulating on Opnet simulator. They also defined about the different versions of OPNET like Opnet educational version works on first three layers physical, data link and network layer of OSI model. They also defined the protocols and how these protocols exchanged data between the nodes. RIP and OSPF protocols are used in autonomous system. Result is compared in terms of different parameters like efficiency, throughput, delay and failure etc. and also improved other performance metrics. For checking all other parameters there is need to practical implement the network layer protocol which is inefficient and very expensive. Easy way to solve this problem is choose Opnet network simulator which is easily available. By choosing OPNET the performance and efficiency checked by simulating these protocols and it provides ease to study the behaviour of the network.

Farhangi et al. (2012) defined different internet routing protocols in real-time applications. Real time applications are like video conferencing, email, voice etc. Routing plays a vital role in any network. Routing protocols are used to transfer the information within connected network. For checking the performance and getting best results, they select the best protocols according to their function in internet. Interior Gateway Routing Protocol and Open Shortest Path First protocols have been chosen. Routing algorithms are used in routing process. These protocols are based on dynamic routing algorithms. For large networks they choose the IS-IS protocol. IS-IS comes under the category of interior gateway routing protocol. Research work implements new protocol which is combination of three protocols and works as one protocol. Results showed that combined OSPFv3/IS-IS/RIPng protocol is better than individuals. There are different parameters in terms of performance can be measured are end-to-end delay, packet delay variation, Voice Jitter and throughput etc. OPNET simulator tool is used to implement these network models.

Kaur et al. (2012) proposed Open Shortest Path First (OSPF) protocol is an Interior Gateway Routing Protocol category. It is a link state protocol. They defined the Open Shortest Path OSPFv3 is next generation protocol. OSPFv3 is updated version of OSPF which is used in IPv4. The work of Protocol is to provide routes to routers in connected networks. Routes are defined in database means in routing tables. OSPF router has routing table (database) which consists of routes or links between the nodes. This process shows that it is a link-state routing protocol. The simulator used in this research work is OPNET 14.5 version. OPNET is GUI based simulator. It provides a map like environment for creation of network models of protocols. Hierarchal structure of OPNET provides three types of different domain which helps to understand the tool. The purpose of this work is to discover shortest and

optimal path. Networks are created in wireless and LAN technology. In this way these protocols are evaluated. Performance of protocols is analyzed on the basis of parameters. The performance is measured in terms of traffic sent and received (bits/sec), traffic sent and received (bytes/sec), packet delay variation, jitter, throughput (packets/sec) and throughput (bits/sec) by simulation. Graphs showed the performance of an OSPF. Due to network congestion parameters some delays are observed. Other protocols also designed and compared using simulation.

Alangar and Swaminathan (2013) presented IPv6 protocol which is the new version. It is the updated version of IPv4. IPv6 is now preferred these day because of its larger address space. It handles large amount of data on the internet. IPv6 changes network components, the security field shifts and some other components. They observed the limitations of IPv4 and discovered new features of IPv6. The reason for designing IPv6 protocol is because of security problems in IPv4. IPv4 is less secure. IPv6 network is more secure because of NAT. NAT replaced many techniques that were used in IPv4.The documented methods of mapping. They also discussed the concept of firewall. This paper concentrated on security which is less in IPv4. Additional features of IPv6 are also discussed.

Awadi et al. (2013) described Mobile IP technology considered as one of the buzzwords in world of wireless technology. These days a lot of Internet applications depend on this technology to deploy their services like VOIP, VANET and so on. The main goal of this technology is to maintain high connectivity among the mobile nodes. The assumption here is that the Mobile Nodes (MN) should remain connected to its Home Agent (HA) during its mobility from one scope to another. The new scope is called Foreign Agent (FA) whereby the Mobile node can remain connected to the original scope (HA) by getting a new IP from FA which is called Care of Address (CoA). This paper addressed the certain aspects related to the Mobile IP technology such as Mobile IPV4 and its relationship to Mobile IPV6 and some advantages and disadvantages of using Mobile IP. Vi-Fi (Vehicle Wi-Fi) described as one of most advanced technology.

Khan et al. (2013) defined the importance of Routing; Routing process is the base of any WAN (Wide Area Network) in internet. Internet surfing speed totally based on routing. These days' internet users totally dependent on IPv6. IPv4 not much used by world. The proposed work focus on routing protocol's working in wireless areas. ICMP protocol is used to evaluate and compare results. Results are gathered on the basis of implementation of protocols on different simulation tools.

Singh et al. (2013) described that the internet users are increasing day by day. With new technology demands of user increases. IPv6 is also a new technology protocol. They defined that IPv6 is better than IPv4 because of larger address space. In this proposed work they have considered the protocol EIGRP to show better results. They evaluated and discussed the implementation of this protocol. OPNET simulator is used to show result in the graphical forms. They did not mention any limitation of EIGRP protocol and other options for future work.

Aggarwal (2014) presented the routing protocols in new version. Demand of internet is increasing day by day. The routing protocols plays important role in routing process. Routing protocols are used to transfer the information from one node in a connected network area. Routing process is used to forward data to proper destination through proper channels. Routers play vital roles in networking. Routers have their own routing tables to store data. Protocols are used to transfer routing information to other devices. Routing protocols have their own algorithms and design. Comparison and discussion done on IPv4 and on IPv6. Simulator OPNET is used to implement these protocols. With the help of OPNET tool evaluation is made for protocols. After this results are compared with IPv4. So basically this research work focused on IPV4 and IPv6.

Kaur and Singh (2014) described new techniques of the internet. They also defined the new version of routing protocol. They defined about IPv6 which is latest version of internet protocol. IPv6 has many additional features which eliminates the limitations of IPv4. The proposed work defines the performance of various protocols and chooses two protocols. OSPF and IS-IS are selected for evaluation. There are different parameters used to check the performance in real time applications. E-mail Download Response Time, E-mail Upload Response Time, Http Page Response Time etc. OPNET simulator is used to create different network models. Using this tool scenario is created. Three different scenarios are designed. OSPF and IS-IS are created with OPNET 14.5 tool. Then the combined protocol is implemented OSPF/IS-IS. After this results are compared and defined.

Kudtarkar et.al (2014) presented that routing protocols like OSPF, RIP, EIGRP and IGRP. Routing protocols are used to transfer the data from one node to other. These protocols come under the category of interior gateway routing protocols. They select the right protocol for real time application like Email, Voice, Video conferencing etc. Two protocols WFQ and IGP are selected. With the help of simulator OPNET 14.5 these two protocols are implemented. After this results are compared and defined. Graphs are created on the basis of results.

Narula and Aggarwal (2014) described the modern internet era, routing protocol plays an important role. They forward the packets form source to destination. There are many routing protocols used. In the proposed

work they checked the performance of different routing protocol like RIP and OSPF for IPv6. Simulator is used to compare the performance of RIP and OSPF in three network models in which two network models will perform on one routing protocol only while the third are used to simulate the performance of this routing protocol. The performance metrics used are download response time, end to end delay, traffic received, traffic sent, response time, jitter, page response time, object response time, throughput for IPv6 Etc. They designed three scenarios to compare their performance.

III. PRESENT WORK

3.1 Problem Formulation

Many routing protocols have been proposed. There are few analysis and research on OSPFv3, IS-IS and on RIPng in real time applications have been made. Researchers have published about the behaviour of these protocols. Behaviour of protocols is measured by some performance metrics like delay, packet response time, traffic sent and receive, jitter etc. So to compare and evaluate performance based on parameters is a need to implement all three protocols using OPNET simulator. After implementing and checking which one is better in terms of parameters. Some protocols are in some metrics like OSPFv3 give better response in download response time as such IS-IS is better in HTTP. Traffic (traffic send and received) is the main problem in all three protocols. There are some other problems in parameters.

1. OSPFv3 has poor object response time, as it received more traffic.
2. IS-IS has poor upload response time and page response time.
3. RIPng gives poor response in traffic sent (bytes/sec).

So the question is how these protocols well perform? To solve this problem there is a need to create one network by implementing a combination of three protocols OSPFv3, RIPng and IS-IS that is implemented to check the performance in real time applications.

3.2 Objectives of the Work

The main contributions of the present work are to obtain the better performance of routing protocols in real time applications.

1. To decrease the traffic in three protocols.
2. To get the better upload and download response time.
3. To analyze the protocol performance.
4. To create the better network design for real time applications.

3.3 Methodology

OPNET 14.5 tool selected for simulation by studying and learning tool environment. The work in OPNET has to stream through some steps. The work is executed step by step in OPNET. If the work is assigned to build a local area network with hundred nodes in OPNET, then the first step will be making and setting up a LAN using a project window of OPNET modeller. Once the LAN is set, place hundred nodes within that LAN and connect those nodes with each other and definitely with LAN also. For connecting nodes with each other, OPNET offers many attributes. In this proposed work network model is created. Firstly, Network model of OSPFv3 protocol is implemented. Secondly, same network with IS-IS and RIPng is implemented. Finally the results are collected with three protocols and then analysis the performance with the results which one is better protocols with different performance metrics.

1. To implement the proposed routing protocols (OSPFv3, IS -IS, RIPng) in IPv6 network.

2. To analyze the protocols performance theoretically and by simulation and select the performance metrics such as video conferencing, voice (traffic sent), packet response time, delay and email.

3. To check for better performance combine three protocols OSPFv3, IS-IS, RIPng in one network.

3.4 Performance Metrics

Performance of any routing protocol determines on its performance metrics. There are many performance metrics exist in networking term. But selection is based according to the needs of the proposed work and direction of the research. Some performance metrics are below.

1. End To End Delay: End to End delay is defined as the total time taken by the packet when it sends from source to destination over the network. As the delay is less data will transfer fastly to destination.

2. Ethernet Delay: Ethernet delay is defined as the delay between the times when packets are sent from source to destination. It also means that how long bits take from one node to other.

3. Email Upload Response Time: Upload response time is the time taken by web services to upload on server. Like in email any file attached, this is called uploading. It should be low as possible.

4. HTTP Page Response Time: This is defined as the total time taken by any web page to respond to server or to upload on server. It should be low as possible.

5. Throughput: It is defined as total number of packets sends by the total amount of time.

6. Email Download Response Time: Download Response Time is the time it takes to download data

from internet or from the server. It should be as low as possible.

IV. RESULTS AND DISCUSSIONS

4.1.1 OSPF-V3 Scenario:

This Scenario in figure 4.1 represents the layout of OSP-V3protocol. This defines the different modules used in layout. In this network model different router, servers, nodes and different types of links are defined. These modules are connected to each other by links. Names are given to routers and other nodes. Routing protocols send data from source to destination by using Dijkstra's Algorithm.

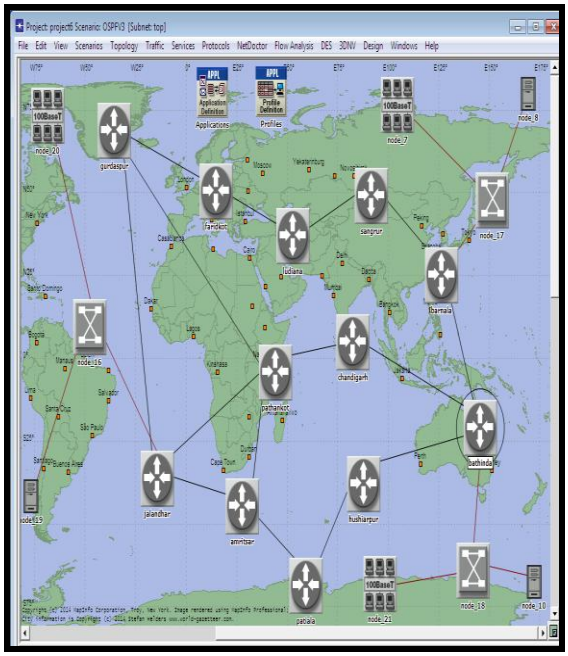

Figure 4.1: Scenario of OSPF-V3

4.1.2 RIPng Scenario:

The figure 4.2 displays the Scenario of RIPng protocol. This scenario represents the network model which consists of no. of different nodes, links, routers and servers. RIPng protocol based on Bellman Ford Algorithm. Hop limit of RIPng is 15. Different no. of nodes is connected to each other and passes data using this protocol. In this scenario there is one application node and profile node where no. of nodes are mentioned.

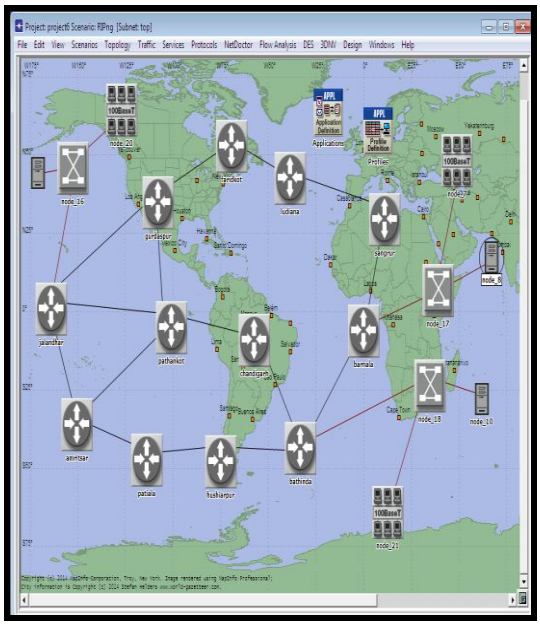

Figure 4.2: Scenario of RIPng

4.1.3 IS-IS Scenario:

This scenario in figure 4.3 represents the IS-IS routing protocol network model. IS-IS is based on Dijkstra Algorithm. This figure shows different modules used in network model. There is no limit of no. of nodes as in RIPng. Routers transferred the data from source to destination. Routers one by one sent the data to all the nodes and choose the best path for destination, best path means shortest path. IS-IS is the link state interior routing protocol.

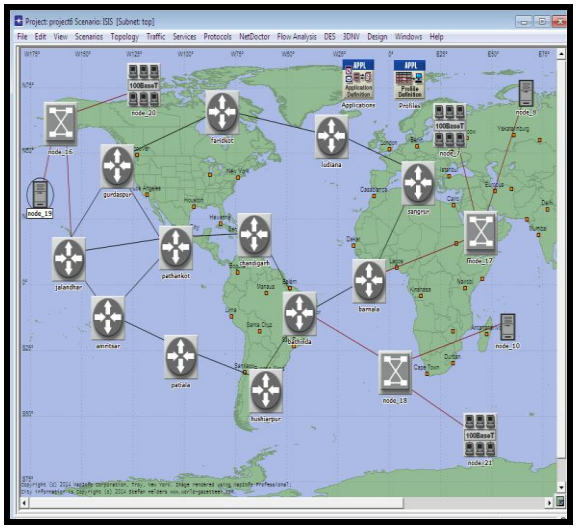

Figure 4.3: IS-IS Scenario

4.1.4 Combined Scenario of OSPFv3, RIPng and IS-IS: The figure 4.4 represents the combined scenario of three different protocols. This defines the different modules in network model. Different protocols worked on different nodes. According to different algorithms they worked on nodes. Then the performance calculated and compared with previous individual protocols scenarios.

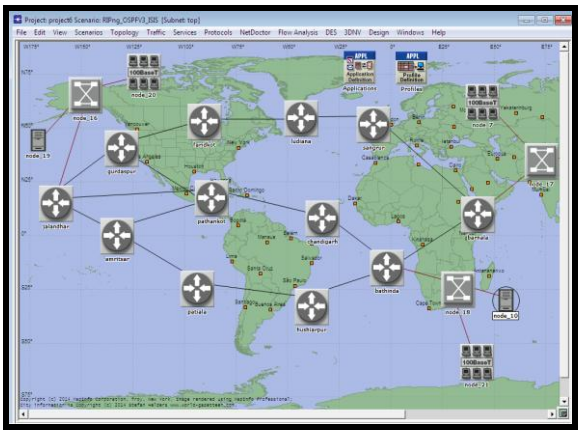

Figure 4.4: Combined Scenario of OSPFv3, RIPng and IS-IS

4.1.5 Comparison of 4 scenarios in terms of Download Response Time in Email:

Download Response Time is the time it takes to respond to the request for service. Figure 4.5 shows the download response time in email of RIPng is more than IS-IS and OSPV3 also with combined protocol it takes less time to download the data as compared to the individual implementation.

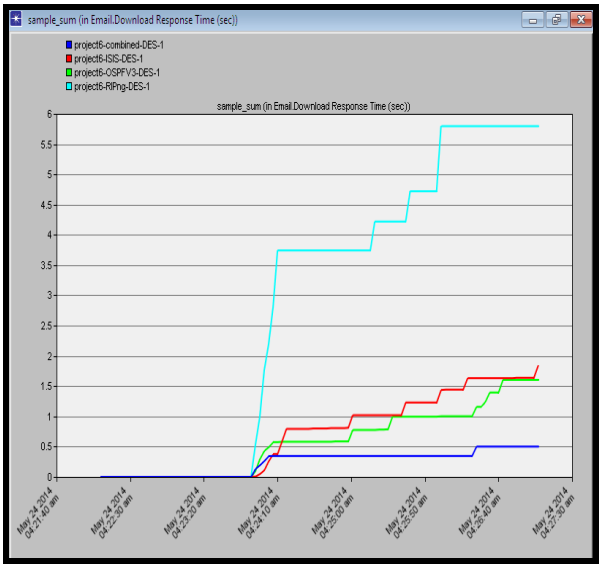

Figure 4.5: Download Response Time

4.1.6 Comparison of 4 scenarios in terms of Upload Response Time in Email:

Upload Response Time is defined as the total time any web page takes to upload on server. It should be minimum as possible. Figure 4.6 defined that OSPF/IS-IS/RIPng combined scenario shows better response, it takes less time to upload the data.

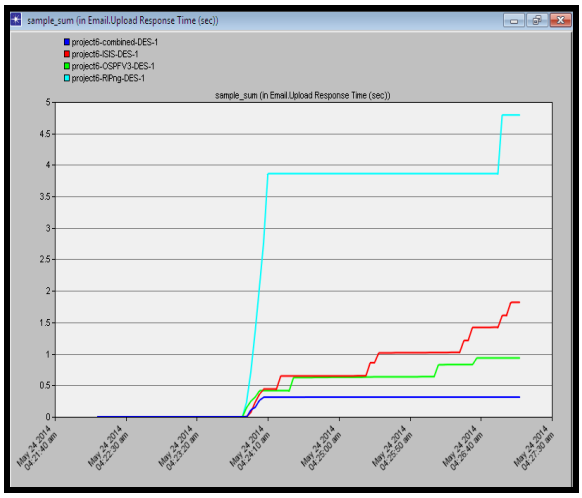

Figure 4.6: Upload Response Time

4.1.7 Performance Comparison in terms of Packet Delay Variation in Video Conferencing:

Packet Delay Variation is defined as difference between the packets means time from when the packets send at source side to be received at destination side. The delay should be low as possible. Figure 4.7 shows that there is zero delay for OSPFv3, IS-IS and OSPFv3/IS-IS/RIPng combined protocol. But the RIPng takes more time than all other protocols.

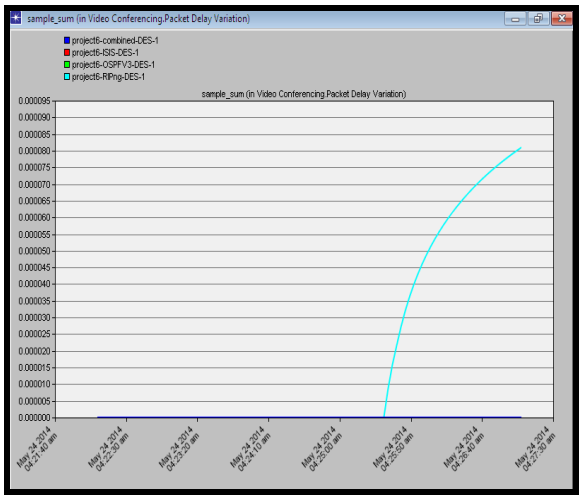

Figure 4.7: Packet Delay Variation in Video Conferencing

4.1.8 Performance comparison in terms of End to End Delay:

End to End Delay is defined as the total time taken by the packet when it sends from source to destination over the network. Figure 4.8 shows that combined protocol OSPFV3/IS-IS/RIPng has minimum end to end delay. RIPng takes more time to transfer the data form source to destination.

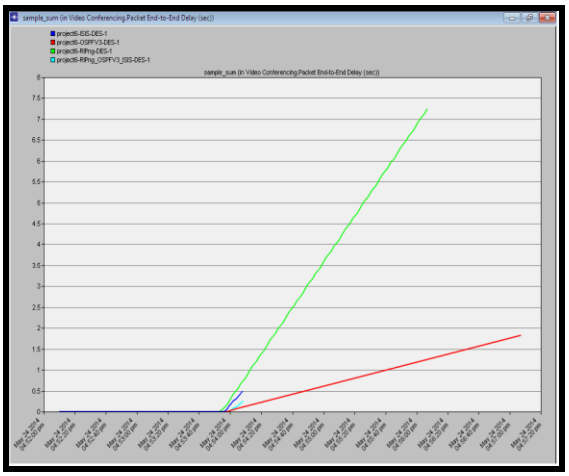

Figure 4.8: End To End Delay In Video Conferencing

4.1.9 Performance comparison in terms of Jitter In Voice Trasmission:

Jitter is defined as time variation in arriving packets at destination. Jitter occurs because of traffic between routing and any difference in time like changing the route of packets in between. Figure 4.9 shows that Jitter is minimum for OSPFv3/IS-IS/RIPng combined protocol. RIPng protocol has maximum Jitter.

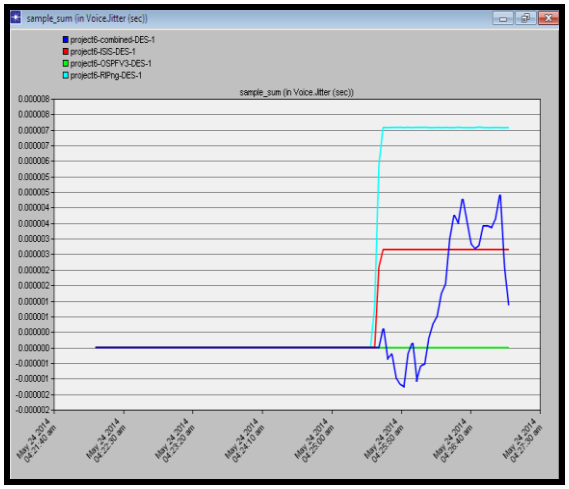

Figure 4.9: Jitter in Voice

4.1.10 Performance comparison in terms of Packet Dealy Variation in Voice:

Packet Delay Variation is defined as difference between the packets means time difference from when the packets send at source side to be received at destination side. The delay should be low as possible. Figure 4.10 shows best result for combined protocol OSPFv3/IS-IS/RIPng. For combined protocol packet delay variation is minimum.

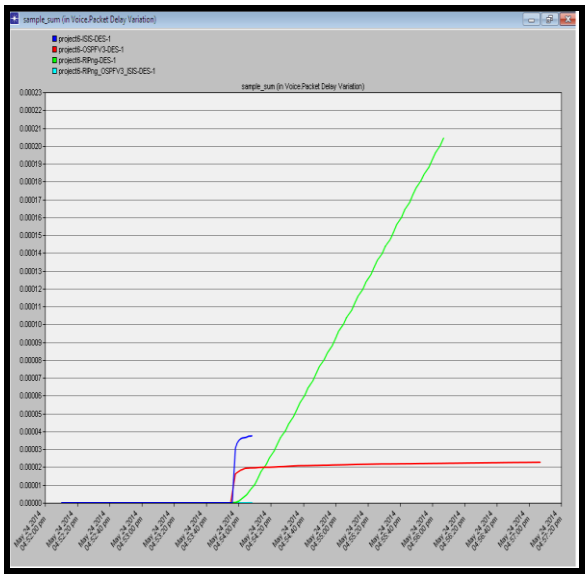

Figure 4.10: Packet Delay Variation in Voice

4.1.11 Performance comparison in terms of Object Response Time in HTTP

Object Response Time is the time taken by system to react for requested service. Object Response Time in real time applications is also defined as time between the systems starts to run and to complete the task. In figure 4.11 it is showed that Object Response Time of combined protocols OSPFv3/IS-IS/RIPng is less as compared to individual protocols.

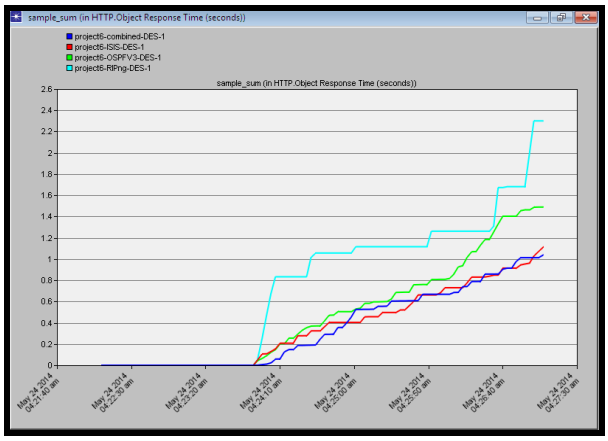

Figure 4.11: Object Response Time

4.1.12 Performance comparison in terms of Page Response Time in HTTP:

Page Response Time is defined as the total time taken by any functional unit to give response when service is requested. It should be low as possible.Figure 4.12 showed that combined scenario takes less time than other three scenarios.

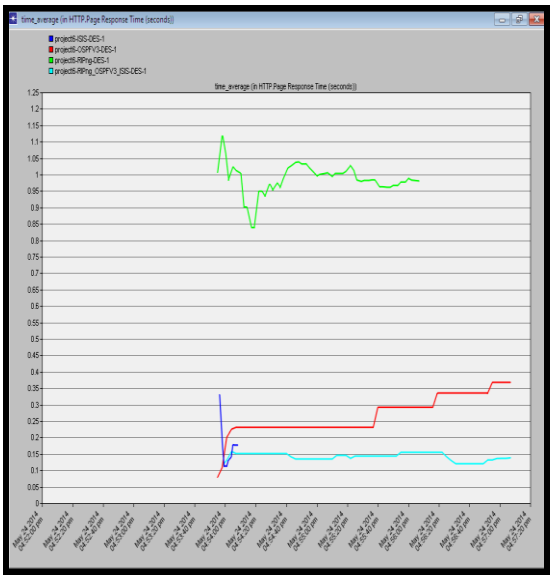

Figure 4.12: Page Response Time in HTTP

V. CONCLUSION AND FUTURE WORK

5.1Conclusions

In the proposed work performance analysis of selected routing protocols such as RIPng, IS-IS, OSPF v3 and the combination of RIPng, IS-IS and OSPF v3 calculated. The main aim of this work is to achieve better results in real time applications. The proposed work has analyzed in same network with three protocols for real time applications. Results are collected in term of some parameters. As the result show that combination of three protocols OSPFv3/IS-IS/RIPng for the real time application gives the better performance in terms of packet delay variation, end to end delay, jitter, traffic send/received, page response time and object response time. In HTTP page response time IS-IS protocol gives us better response time. In briefly combination of all protocols provides us best performance in real time applications like Email, Voice and Video conferencing. In Email there are two parameters like upload response time and download response time which gives better results in OSPFv3/IS-IS/RIPng. In Voice end to end delay and in MOS value in http page response time IS-IS performance is best among others .In video performance IS-IS, OSPFV3 and combination of all there protocols end to end delay time is equal. RIPng provide us worst performance in all the performance metrics and is shown in Table 5.1.

Table 5.1: Times taken by Different Protocols for different Applications

Application	Protocols			
	OSPFv3	RIPng	IS-IS	Combined
Email-Download Response Time(sec)	1.2	5.8	1.8	0.5
Email-Upload Response Time(sec)	0.9	4.8	1.8	0.3
Video Conferencing Packet Delay Variation (sec)	0	0.00081	0	0
Video Conferencing End to End Delay (sec)	1.4	7.3	0.5	0.3
Voice Jitter(sec)	0.0000	0.00007	0.00003	0.00002
Voice Packet Delay Variation (sec)	0.00002	0.00021	0.00004	0.000000
HTTP Page Response Time (sec)	1.5	2.3	1.1	1
HTTP Page Response Time (sec)	0.34	0.97	0.17	0.14

5.2 Future Scope

The proposed model work for the real time applications in IPV6. The future work could be done on Security Analysis for OSPF v3, RIPng and IS-IS for different applications in different scenario's. Further three protocols work on non-real applications on different parameters and servers.

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