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Threat Analysis with Comparison of IPv4 and IPv6 in Cloud Computing

Muhammad Waqas Anwar, Moazzam Ali Baig, Haris Shabbir, Rohail Ayaz, Babar Saeed and Ammar Rafique

Abstract – **Cloud computing is a modern technology which provides its users the remote access to centralized and remotely located servers through internet to get many services like, storage and sharing of data and applications over the servers and cloud. The main focus of this research is on the performance measurement of IPv4 and IPv6 on the basis of convergence time, memory consumption, CPU consumption, bandwidth usage and quality of services over the cloud computing. To conclude the results, Opnet modeler 14.5 will be used.**

Keywords – **Cloud Computing, IPv4, IPv6, OPNET.**

I. INTRODUCTION

Cloud computing is a modern technology which provides its users the remote access to centralized and remotely located servers through internet to get many services like, storage and sharing of data and applications over the servers and cloud. Simply the cloud gives us opportunity to store our data on the remote servers same like as we store on our own hard drives. From this definition provided by Cisco we get three categories or properties of cloud computing:-

On-Demand services are activated for a user when he/she order for it. Whenever a service is ordered by user it is provided to him/her.

On-Scale services mean that the level of services requested by the user, the more the user pays the more scale he/she can get.

Multi-tenant Environment describes that every part of cloud services and resources can be allocated to more than one user. Cloud computing is also classified considering its service types. Three main classes of cloud are narrated as,

Software as a Service (SaaS): The real meaning of software as a service is to provide the software over the World Wide Web as a web service. So the user can utilize the software in its web browser without the downloading and installing it. The most common examples of SaaS (Software as a Service) providers are Microsoft and Google

Platform as a Service (PaaS): architecture brings forth the concept of allocating the users an environment/platform to build their own desired applications. The users don't need to panic about the hardware investment and maintenance expenditures. The most common PaaS providers are, Windows Azure, Heroku and Force.com.

Infrastructure as a Service (IaaS): In Infrastructure as a service model the users have more privileges than the SaaS and PaaS architectures. A user can select and manage the hardware specifications of his virtual machine provided by the cloud service provider. The mostly used IaaS are Go Grid and Amazon EC2.

A Protocol (communication protocol) is Pattern of rules that are applied; so that a machine (e.g. computer) can perform different functions i.e. especially communicate with one another. Internet protocol (IP) is the ruler of the internet. When hosts (computers) establish their connection to the internet, an IP address is assigned to them individually. These hosts exchange data packet with each other to communicate with each other. These data packets contain the IP addresses of the source and destination hosts. When a host communicates with the other host, it transmits its packet with source and destination IP addresses.

Internet Protocol version 4 address is of 32 bit .It contain 4 octets or unique four parts of strings, the total number of address of IPv4 are (2^{32}) = 4294967296. Each octet in IPv4 comprise of 8 bits the bits are either 0 or 1. Octet is divided with the dots.

In 1990 decade, the Internet Engineering Task Force felt that new version of Internet Protocol IP would be required. Internet Protocol Next Generation (IPng) was developed, which was later named Internet Protocol version 6. IPv6 is Layer 2 standard protocol (w.r.t TCP/IP Model) that follows IPv4 for communication across Internet and other networks. IPv6 address size is 128 bits; address can be noted in hexadecimal or binary notations. So the total number of IP addresses IPv6 can provide are 2^{128}=3.402823669209384634633746074317 7e+38. It's a huge amount of addresses. IPv6 provides many functions and is an evolution in Internet Protocol.

II. LITERATURE REVIEW

G. Bhatia, A. Lala and A. Chaurasia (2012) abstracted that the cloud computing is somewhat the mixture of virtualization, distributed computing and utility computing. New addition of networking and internet makes it more useful for end users. In these days a user has no need to purchase expensive computing hardware or software. What he has to do is only to hire a cloud service to store its data online or whichever service he hires. Indian Railways (the world's fourth biggest train system) that transports 30 million humans and 2.8 million tons of luggages daily is running in loss. The reasons for this loss are black marketing of tickets by staff, passengers without tickets and overloading of trains. This research will discuss how to implement cloud computing to solve all these problems as well as the internet facility in the trains.

H. Zahid, A. Arshad, M. Khalid, B. Saeed and A. Rafique (2013) described that the technology which provides us computing resources virtually via internet in all over the world is called cloud computing. This paper covers the security issues from DOS attacks on cloud servers by the hackers or zombies.

I. Gandotra, P. Abrol, P. Gupta, R. Uppal and S. Singh (2011) evoked that each author defined cloud computing in its own words, sometimes we feel confusion that which definition is correct. First of all cloud computing is not totally a new concept it is started when in 1998 grid computing was started and cloud computing is also tied up with cluster computing. In this paper the detail discussion will be done on grid computing, cluster computing and future technique cloud computing.

J. Touch (2013) wrote that the work of ID in IPv4 is to helping out the fragmentation and de-fragmentation process during the transmission. Another quality of this is that it should be different for each datagram of packet and it should retain its value for maximum time. If it does so then the speed of links or transmission will be limited to 6.4 Mbps. But the normal systems cross this limit. So, the purpose of this document is to update the RFC number 791, 2003 and 1122. This update is done to discuss with close view the current use of IPv4 ID field.

J. P. Sahlin, S. Sarkani and T. Mazzuchi (2012) stated that there are two types of cloud service providers, one are those who provide cloud services for the purpose of their business or to make money out of it, other are government organizations which don't want to make profit out of cloud services but they want to keep its cost as low as possible. So for both type of cloud service providers the efficient way to know that how the upgrade in system can benefit and keep the cost without affecting the QoS (Quality of service), is OPNET tool. This tool can provide thorough and deep analysis on each and every node in the system.

M. Cotton, L. Vegoda, R. Bonica & B. Haberman (2013) clarified that the purpose of their paper is to reassign the IPv4 block 192.0.0.0/24 to Internet Assigned Numbers Authority (IANA) and it is current best internet practice. This document will enforce IANA to rebuild its special-purpose address registries of IPv4 and IPv6. They stated that this paper is product of Internet Engineering Task Force (IETF). It reflects the IETF community and publishing is allowed by Internet Engineering Steering Group (IESG). In the result of this document publication the RFC (Request for Comments) number 4773, 5156, 5735 and 5736 are no more functional.

V. K. Muniyappa (2012) depicted that IPv4 and IPv6 were implemented on a campus network and FTP service was configured. Both versions were compared but in some aspects the IPv4 was better and in some cases IPv6 was preferable.

III. Research Work

OPNET is the best option to deal with the modeling of composite network structures. With the help of OPNET Modeler we can judge and check every possibility after making a change in network structure.

Our Research scenario is designed in the OPNET Modeler 14.5 simulator. On the same scenario structure both of the IP versions (IPv4 and IPv6) are configured to perform the comparison of both IP versions. Research scenario shown in fig. 1 contains three cloud servers which are providing Database, FTP and Video Conferencing services to four LAN networks connected to these servers via a cloud switch and mesh of thirteen routers. One cloud switch is connecting all three servers of cloud to this mesh of thirteen routers.

Each LAN contains 100 clients or end users. All users in these four LANs are using all three types of services which are Database, FTP and Video Conferencing services. Fig. 2 is representing the inventory summary of our research scenario designed in OPNET modeler 14.5.

We executed the simulation of our scenario for 119 simulation seconds for both Internet Protocol Versions IPv4 and IPv6.

The parameters we set to measure the performance of IPv4 and IPv6 on the same scenario were Query Response Time for Database service, Download Response time for FTP service, Upload Response Time for FTP service, End-to-End Packet Delay for video conferencing service, Routing Table Size, Routers CPU utilization queuing delay on cloud switch, Ethernet Delay and Packets Dropped on cloud switch.

What we analyzed and what were the results after the simulation execution was completed for both IPv4 and IPv6, all these questions are answered in the following sections.

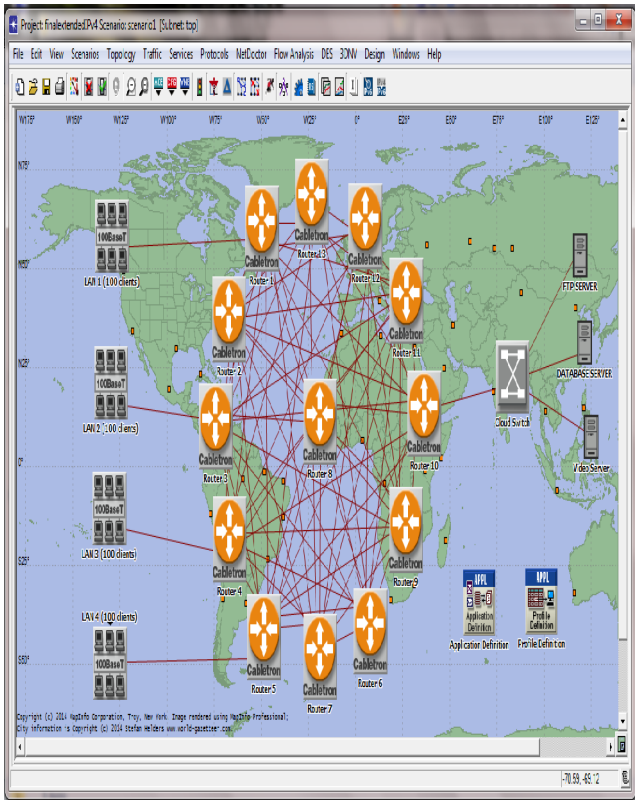

Fig.1. Research Scenario

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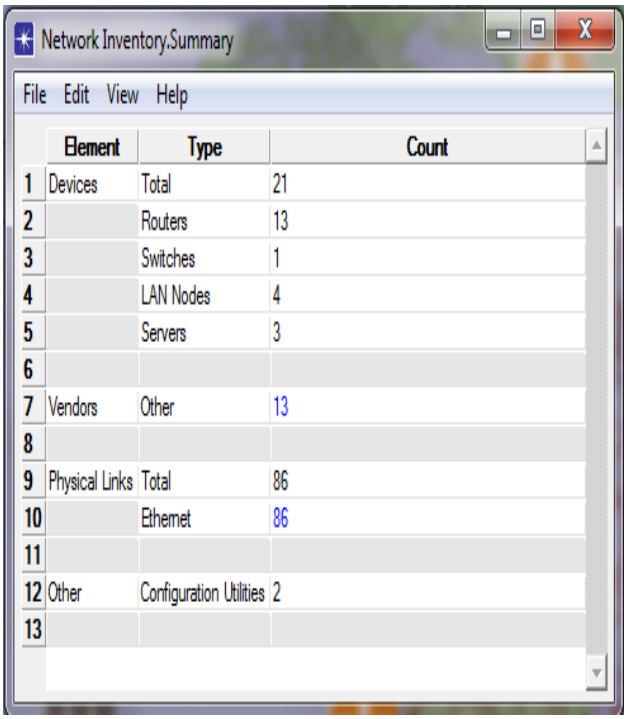

	Element	Type	Count
1	Devices	Total	21
2		Routers	13
3		Switches	1
4		LAN Nodes	4
5		Servers	3
6			
7	Vendors	Other	13
8			
9	Physical Links	Total	86
10		Ethernet	86
11			
12	Other	Configuration Utilities	2
13			

Fig.2. Network Invertory Summary

IV. RESULTS ANALYSIS

The results we analyzed from our research scenario are basically the graphs formed by the simulator having name OPNET. The following graphs are corresponding of the parameters which we defined in our scenario to perform a just comparison between IPv4 and IPv6 over the cloud services.

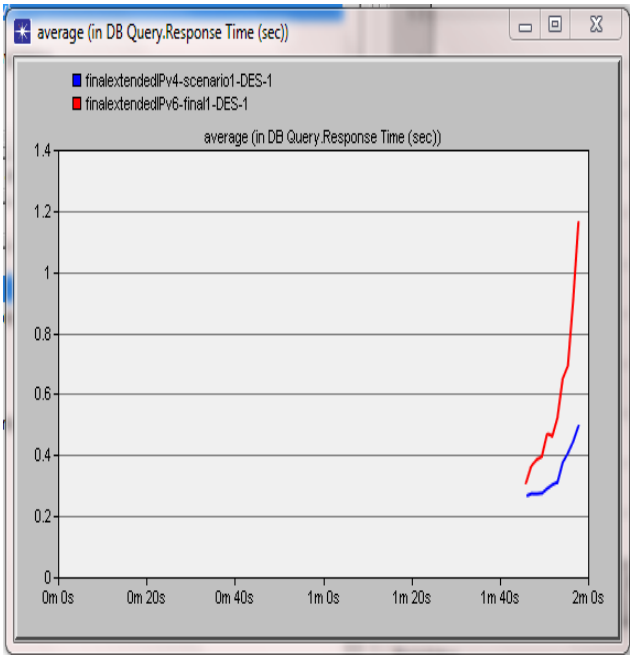

Fig.1. Database Query Response Time Graph

In Fig. 3 graph the Response Time for a database query with IPv4 is much less than the Response Time of IPv6. The reason of this higher value for IPv6 can be the bigger size of its header or it's due to more IP address bits of IPv6 in the header of the packets.

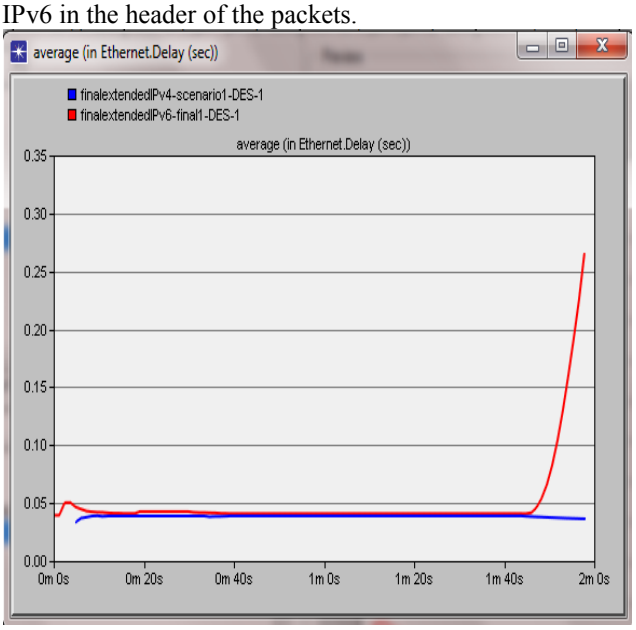

Fig.2. Ethernet Delay Graph

The Average Ethernet delay (shown in Fig. 4) for the IPv4 was less than the 0.1 seconds and for IPv6 this value was up to 1.6 seconds So, IPv4 gives better performance than IPv6 on Ethernet Channels of Clouds.

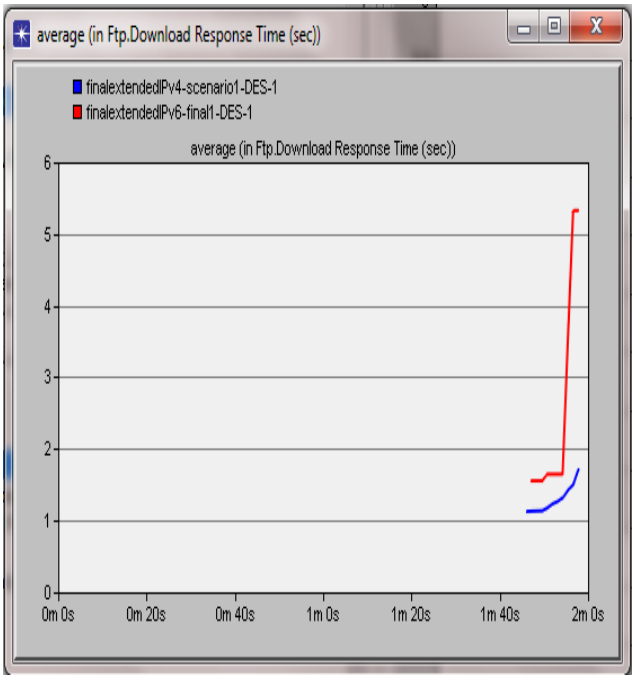

Fig.3. Graph for FTP Download Response Time

In Fig. 5 graph FTP Download Response Time is calculated for both versions of IP. The average of this response time for IPv4 is not more than 1.6 seconds overall the simulation time, but for IPv6 FTP Download Response Time is more than five (5) seconds. So the IPv4 is preferable for FTP Services over the cloud as compared to IPv6.

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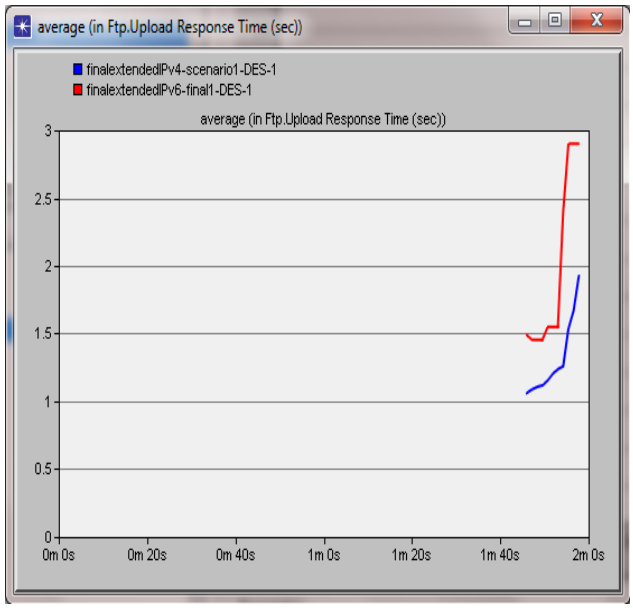

Fig.4. Graph for FTP Upload Response Time

As the graph in Fig. 6 describes that the average response time taken for FTP upload service by IPv4 is round about 1.9 seconds but the average value for IPv6 upload response time in this graph is nearly 2.9 seconds. So, for Uploading Service over the cloud computing IPv4 takes less time than IPv6.

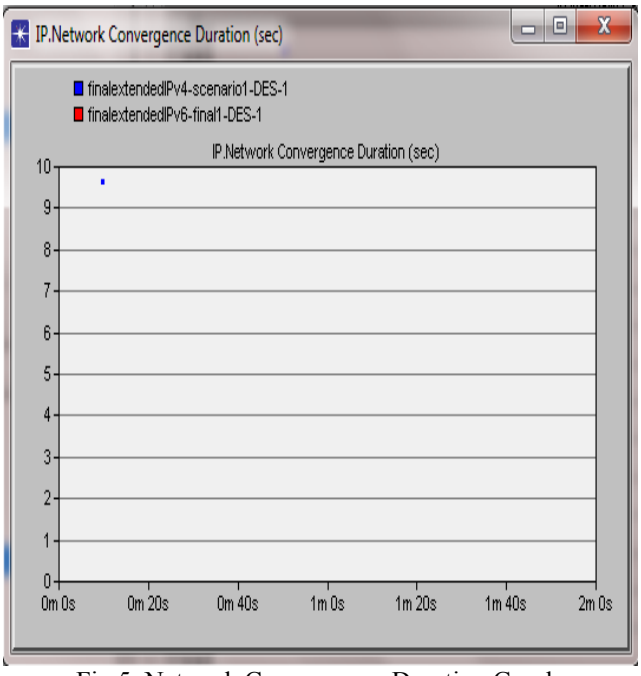

Fig.5. Network Convergence Duration Graph

Fig.7 graph is only showing one value for both of IP version So IPv6 convergence time is equal to the IPv4's in our cloud computing scenario.

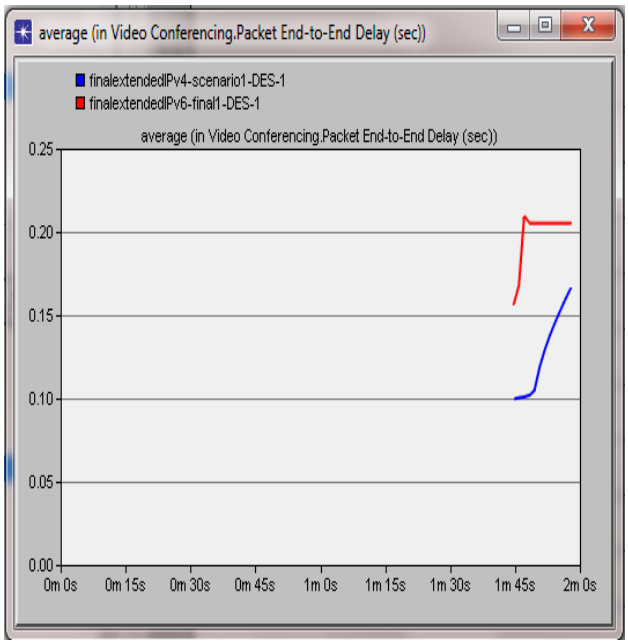

Fig.6. Video Conferencing Packets Delay Graph

The results in Fig. 8 are showing that the IPv6 packet delay for video conferencing was more than IPv4 packets delay time for video conferencing service of cloud. So, for video conferencing service over the cloud IPv4 is better than IPv6.

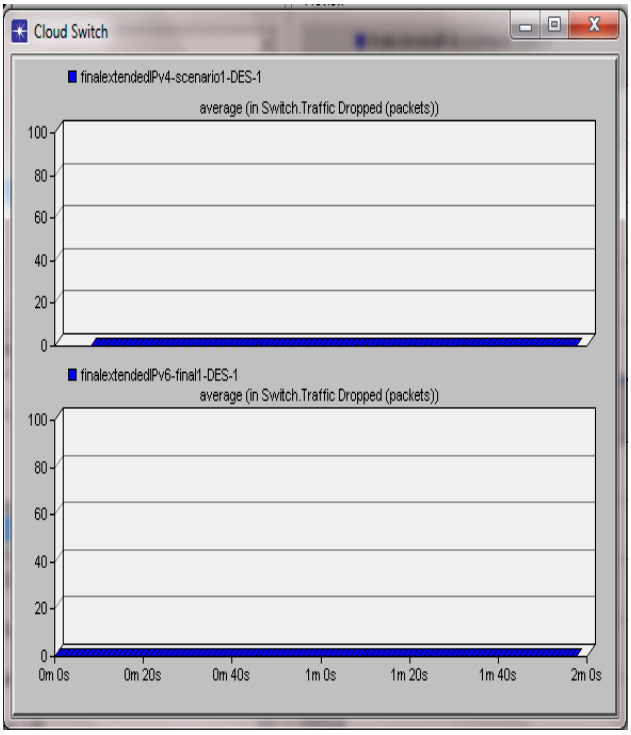

Fig.7. 3-D Graph for Packets dropped on Cloud Switch

As represented in Fig. 9 Graph that, for IPv4 the packet dropping on cloud switch starts approximately from 0 minute 10 seconds according to the simulation time but for IPv6 this process start from the start point of the simulation time. So for Cloud Computing IPv4 is more efficient than IPv6.

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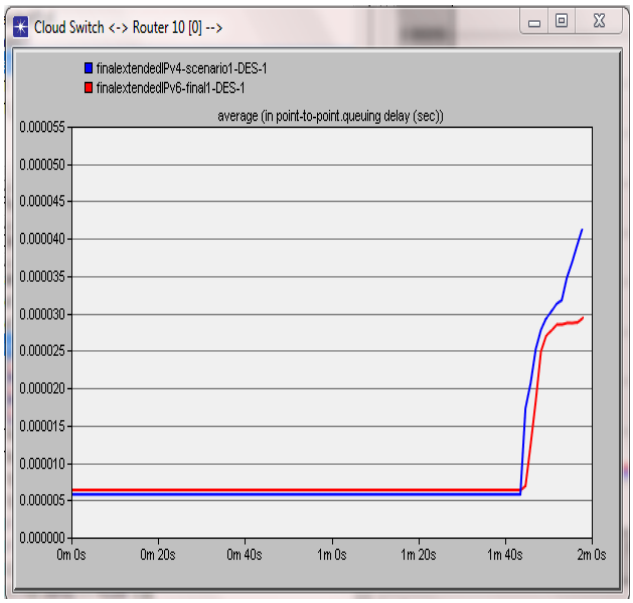

Fig.8. Average Queuing Delay Graph between Cloud Switch and Mesh Edge Router

From Fig. 10 graph it is observed that IPv4 queuing delay time between cloud switch and mesh edge router was lower at the start of simulation and IPv6 queuing delay time was slightly higher at the start of simulation but at the end IPv4 Delay time was greater than IPv6 delay time. So at this position IPv6 show slightly better performance than IPv4.

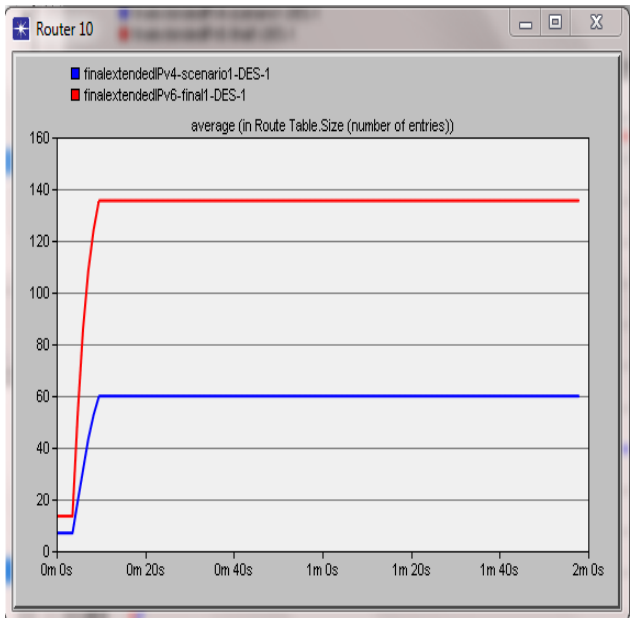

Fig.9. Graph for Average Router Table Size

Fig. 11 graph exhibits that the IPv6 routing table size is very much bigger than the routing table size for IPv4. The reason behind this higher memory consumption for IPv6 router table is that its IP address bits are 4 times more than the bits of IPv4 address so for large number of bits more space is required to make a routing table.

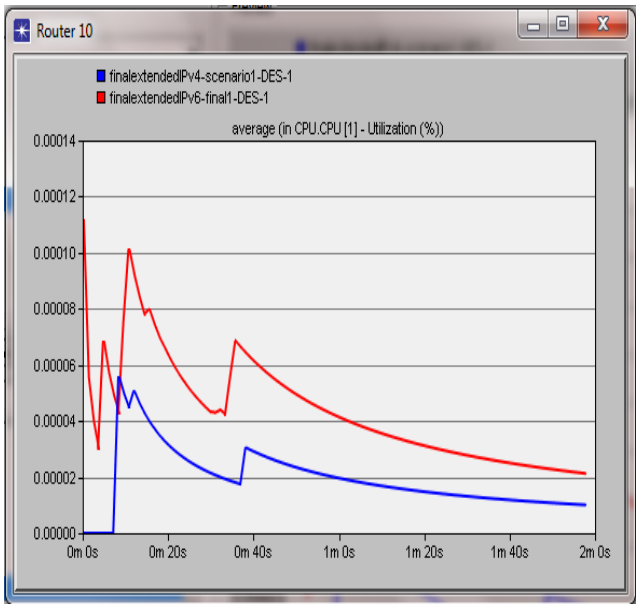

Fig.10. Average CPU Utilization Graph for Routers

Analysis of CPU utilization average graph in Fig. 12 told that the IPv6 consumes more CPU than IPv4. So, for Cloud computing and internet routers IPv4 is more suitable than IPv6.

V. Conclusion

From all above discussion on the result graphs it is concluded that although IPv6 is newer version of IPv4 and it has advance features than IPv4 but due to its bigger header size it affected the performance and QoS of cloud services. In simple words we can say that overall performance of IPv4 over the cloud was very much better than IPv6. So, the migration (in cloud computing) from IPv4 to IPv6 in our view is just because of the lack of IP addresses in IPv4. Otherwise no other benefit of IPv6 usage on cloud is analyzed in this conducted research.

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