A COMPARATIVE ANALYSIS BETWEEN IPV4 & IPV6

BY

JEWEL MIAH
ID: 151-15-298

MD. ASIF HOSSAIN
ID: 151-15-361

LALON MIAH
ID: 151-15-303

This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Arif Mahmud
Assistant Professor
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY

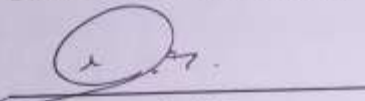**DHAKA, BANGLADESH**

DECEMBER 8, 2018

APPROVAL

This Project titled "**A Comparative Analysis between IPV4 & IPV6**", submitted by Jewel Miah ID No: 151-15-298, Md. Asif Hossain ID No: 151-15-361, Lalon Miah ID No: 151-15-303 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 8th December, 2018.

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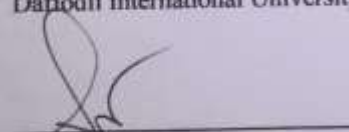Faculty of Science & Information Technology
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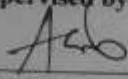Daffodil International University

Dr. Mohammad Shorif Uddin   **External Examiner**
Professor
Department of Computer Science and Engineering
Jahangirnagar University

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Arif Mahmud, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.
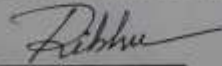
Supervised by:

8/12/18

Arif Mahmud
Assistant Professor
Department of CSE
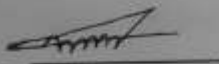Daffodil International University

Submitted by:

Jewel Miah
ID: -151-15-298
Department of CSE
Daffodil International University

Md. Asif Hossain
ID: -151-15-361
Department of CSE
Daffodil International University

Lalon Miah
ID: -151-15-303
Department of CSE
Daffodil International University

ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project/internship successfully.

We really grateful and wish our profound our indebtedness to **Arif Mahmud**, **Assistant Professor**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of Network Security to carry out this project. His endless patience ,scholarly guidance ,continual encouragement , constant and energetic supervision, constructive criticism , valuable advice ,reading many inferior draft and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to **Dr. Syed Akhter Hossain**, **professor and Head,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

This document offers an analysis and quotation of IPv4 not to mention IPv6 under a number of circumstances. It is most certainly understood that IPv6 happens to be designed to restore IPv4. We have done a feature-by-feature quotation and contrast from IPv6 versus IPv4 not to mention found that IPv6 offers you many unique options available for increasing some network architectures functionality and agility. Utilizing some sense, there can be described as competition going concerning between these standards, as they commonly are not directly compatible, and network firms and users have to consider whether to help one- or equal-time protocols for a number of internet services. And problems in later life that in three years or so the addresses from ipv4 will final. The new variety of IP, (e. IPv6), constitutes hard work to overcome typically the inborn limitations from IPv4, in order for one's new protocol have the ability respond to the ultra-modern needs as many shapes today in your Internet. All these problems in later life theoretically. This report is aimed to point out about comparison factors between ipv4 not to mention ipv6 practically.

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CHAPTER 1
INTRODUCTION

1.1 Indication

Network layer is third layer of open system interconnectivity (OSI) reference model and the single most important layers of any OSI. The network layer in TCP/Internet Protocol is responsible meant for moving datagram (packet) within the source (send) into the destination (receiver) by using an intermediate device (router, goes, bridge and gateway) to give us internetworking. The network layer handle logical addresses, each host on the network have a distinct address called IP address for identification purpose. Each node or host are usually trace by other computer on the network through IP address. Cause of the enormous number of web user and mobile device using web connection which lead to popular demand of IP addresses, consequently, the existing use and also the widely deploy internet process IP V4 address space nearly exhausted. In the year 1991 the actual International Engineering Task Pressure (IETF) notice that there's rapid depletion in the actual IP4 address space. So, they come to a decision to create a brand-latest version of internet process (IP) that was name as IPV six (IPv6) Alias following generation internet protocol (IPng). IPV6 was design to solve the problem of IP4 with the addition of some features and functions that is not in the IPv4. Though IP v4 and IP v6 can interoperate imply that IP v4 user can communicate and revel in the feature of IP v6 by using transition mechanism [1].

1.2 Background & problem Motivation

More recently for the blessing from the modern technology, communication devices are increasing in a large amount. To communicate between them we need IP address. We are now while using version of IP which is 4. From the start of the construction of IP addresses technologists gave us a details about how many unique IP addresses might be assigned for each big companies that will provide us internet facilities or communication devices. We recently have a little year left when the quantity of unique IP addresses may end for IP version 4. Also, day by day since the technology is progressive from its peak position, we now have found the problem from the IP version 4 (IP V4). That's why now we require a newer version of Internet Protocol address that will provide us a much better and profound facility compared to its previous version. Now as we are getting into a newer version which is sometimes called IP version six (IP V6) we have to know how it can help us better than IPV4. Which is our theme of project which we recently have shown practically why we ought to move on to IPV6.

1.3 Overall Aim

The over wall aim of our project is to show the distinguish between IP V4 & IP V6 and justify why we are accepting this IP V6 practically. Before taking this project, it was just a concept with limited resource that IP V6 is best than IPV4. But now we are representing to you practically by constructing routing scenario with different parameters. Overall performance estimation with different protocol to exhibit which version of Internet Protocol address is better.

1.4 Concrete & Verifiable Goal

As stated previously we will show the comparison with different parameters practically, so that by using GNS3 network simulator & Wireshark as a protocol analysis Tool lots of research work has done about the execution evaluation of various routing protocols within two of these different IP versions. Also using the latest models of in same environment which have shown us some unique performances of the two distinguish versions of IP addresses which includes us to verify our project. As stated previously we will show the comparison with different parameters practically, so that by using GNS3 network simulator & Wireshark as a protocol analysis tool, a plenty of research work done on the performance execute of different routing protocols within these two different IP versions. Also using different models in same environment which have shown us some unique performance of these two distinguish versions of IP addresses which has let us to verify our aim of this project.

1.5 Scope of the Project

In this project to understand the performance of IP V4 and IP V6 we have done simulation in GNS3 with four different protocols RIP, EIGRP, STATIC, OSPF uniquely. Then we've used Wireshark to analyze these each protocol to demonstrate how the performance factors operates by packet sending ratio, end to end delay, packet transformation rate, flow graph, I/O graph, captured file analysis. After that we need construct a new design with the combination of two protocols (RIP & EIGRP) which lead us to analysis about the redistribution performance comparison of the model between IP V4 & IP V6.

CHAPTER 2
IPV4 & IPV6

2.1 Definition of IPv4

In IPv4 address is Thirty-two- bit binary standard, which is a confirmed as four decimal digits. The IP V4 address area offers about 4. 3 thousand addresses. Only 3. 7 billion addresses can easily only be assigned away from 4300000 million address. One other addresses are conserved for specific purposes for instance multi casting, private address area, loop back testing, and study. IP version four makes use of Broadcasting for transferring packets from computer to all personal computers; this probably generates issues sometimes [2].

2.2 Header & data formation of ipv4
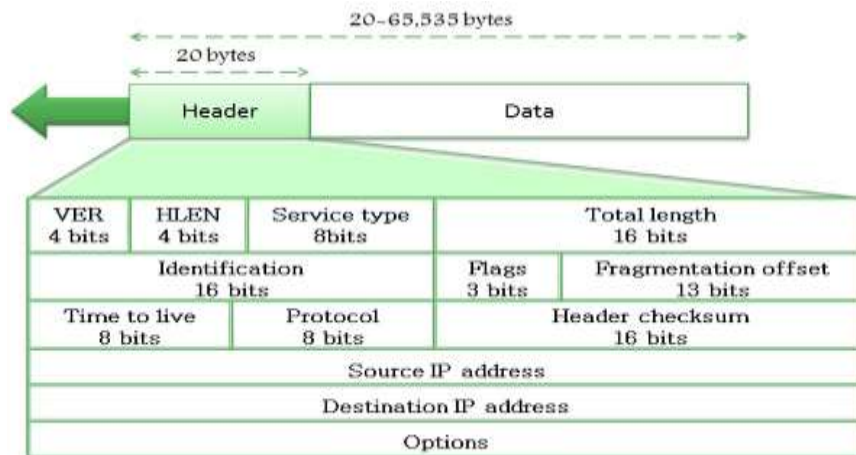
Fig. 2.2: Header & data format of ipv4 [3]

Dotted-decimal piece associated with IPv4 is actually 128. 11. 3.thirty-one & packet formation of the ipv4 datagram is really a variable-length box made up of the header (20 bytes) along with information (as much as 65, 536 together with header). The actual header consists of info necessary to redirecting along with sending. This identifies the actual edition quantity of IP, in this instance, it's four having a binary value associated with 0100. This signifies along the actual header within several associated with 4 bytes.

This decides exactly how datagram ought to be dealt with along with consists of person pieces for example degree of throughput, dependability, along with hold off. This indicates the whole period of the actual IP datagram. This particular area be used within fragmentation. The datagram is actually split whenever this goes by via various systems to complement the actual system body dimension. In those days every fragment is decided having a series quantity with this area. The actual pieces within the red flags area deals with fragmentation along with recognizes the very first, center or even final fragment, and so on. It's the tip which signifies the actual counteract from the process data within the unique datagram. This identifies the volume of hops the datagram may journey prior to it's declined. Within easy phrases, this specifies the actual length that the datagram continues to be on the Internet. The actual process area specifies that top coating process information tend to be exemplified within the datagram (TCP, UDP, ICMP, and so on). This can be a 16-bit area verify the actual ethics from the header ideals, not really all of those other box. It's the four-byte web tackle that recognizes the origin from the datagram. This can be a thirty two bit area that recognizes the ultimate location. This gives much more performance towards the IP datagram. In addition may have areas such as manage redirecting, timing, administration, along with position. IPv4 is really a two-level tackle framework (internet identity as well as web host identity) categorized in to 5 groups ((A, B, C, D, and E) [3].

2.3 Definition of IPv6
In IPv6 address is often a one twenty-bit binary standard that is showed as 32 hexadecimal numbers. Colons isolate entries in a very sequence of 16-bit Hexadecimal areas. It provides $3*10^{38}$ IP details. This version of Internet Protocol addressing is built to fulfill the needs involving exhausting IP's and delivering sufficient addresses for potential Internet growth requirements. As IPv4 uses two-level address structure where the application of address space is too little. That was the cause of proposing the IPv6, for you to overthrow the deficiencies IPv4. The format and the duration to the Internet Protocol addresses were changed with the packet size and standards were also modified [3].

2.4 Header & data formation of ipv6

IPv6 datagram
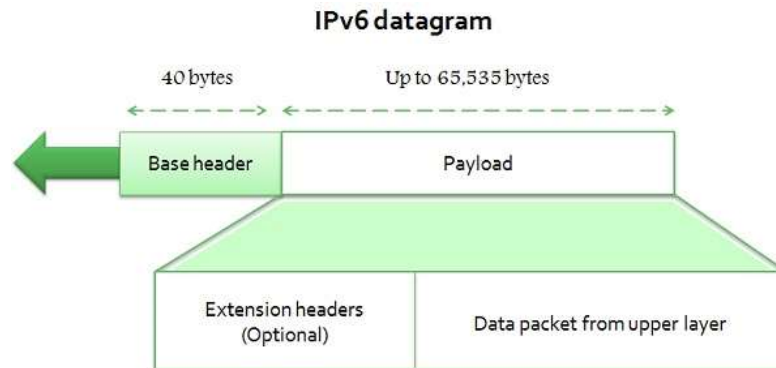
Fig. 2.4.1: Header & data format of ipv6 [3]

Hexadecimal intestinal tract notation of ipv6 is actually FDEC: BA98: 7654: 3210: ADBF: BBFF: 2922: FFFF & IP V6 packet format every packet is containing an obvious base header succeeded through the payload. The payload composes of both parts namely optionally available addons headers and information from a topper coating. The main header uses 40 bytes, opposite the addons headers and data in the up layer usually endure to 65, 535 bytes associated with information. This four-bit field specifies the version from the IP, i. e., 6 in this instance. It defines the priority to the packet concerning traffic blockage. The argument for creating this protocol would be to simplify with special controlling for any given flow of information. It defines the total period of the IP datagram excepting the bottom header [3].

Format of an IPv6 datagram
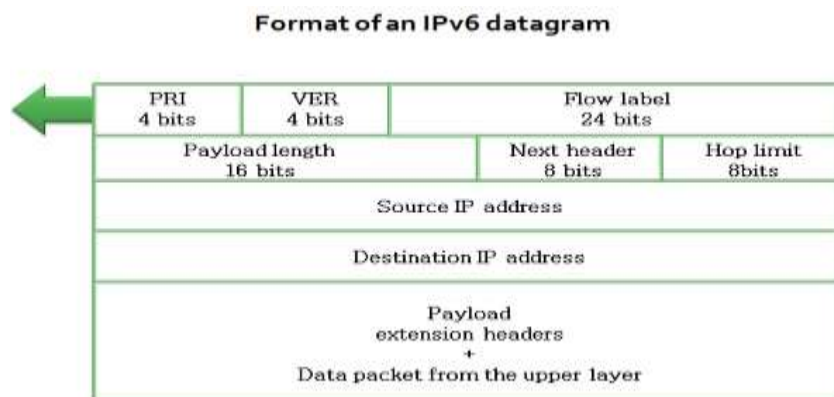
Fig. 2.4.2: Header & data format of ipv6 [3]

It is an 8-bit field explain the header that trails the bottom header in the datagram. The following header is among the optional addons headers that IP uses or the header to have a topper layer protocol for example UDP or TCP. This eight-bit hop limit field help with the equal functions in the TTL field in IPv4. It's a 16 bytes internet address shows the origin of the datagram. This really is 16-byte internet address that generally describes the ultimate destination to the datagram [3].

2.5 Individualize between IP V4 and IP V6

Table 2.5: Distinguish between IP V4 & IP V6 [4]

Basis Of Comparison	IPV4	IPV6
Address Configuration	Facilitates Manual and DHCP settings.	Helps Auto-configuration and renumbering.
End-to-end connection integrity	Unattainable	Attainable
Security features	Security relies on application.	IPSEC is already given in the IPv6 protocol
Address length	32 bits (4 bytes)	128 bits (16 bytes)
Address Representation	In decimal	In hexadecimal
Fragmentation performed by	Routers are Sender and forwarding	Sender
Packet flow identification	Unattainable	Attainable and flow label field is being used in the header
Checksum Field	Attainable	Unattainable

Message Transmission Scheme	Broadcasting	Multicasting along with any type of casting
Encryption and Authentication	Given	Not being given
Ports	TCP as well as UDP have individual port spaces, each identified through port numbers within the range 1-65535.	With regard to IPv6, ports work just like IPv4. Because they are in a brand new address family, nowadays there are four separate interface spaces. For instance, there are 2 TCP port eighty spaces to which a credit card application can bind, one in AF_INET and something in AF_INET6.
Packet filtering	Packet filtering could be the basic firewall functions incorporated into TCP/IP. It is configured through the use of IBM Navigator.	Not supported.
NAT	Essential firewall functions built-into TCP/IP, configured	At present, NAT does not necessarily support IPv6. A lot more generally, IPv6 will not require NAT. The particular

	applying IBM Navigator.	expanded address area of IPv6 gets rid of the address absence problem and permits easier renumbering.
IP header	Variable length of 20-60 bytes. It relay on current IP option	Fixed length of 40 bytes.
Internet Control Message Protocol (ICMP)	Utilized by IPv4 to converse network information.	Applied similarly by IPv6; on the other hand, Internet Control Communication Protocol version 6 (ICMPv6) supplies some new qualities. Basic error varieties remain, such while destination unreachable, reveal request and answer. New types along with codes are combined with support neighbor breakthrough discovery and related characteristics.
Address Resolution Protocol (ARP)	ARP is needed by IPv4 to get a physical address, such as MAC or web page link address, associated with the IPv4 address. .	IPv6 embeds these kind of functions within IP itself contained in the algorithms for stateless vehicle configuration and friend discovery using Net Control Message Standard protocol version 6 (ICMPv6). For this reason, there is zero such thing while ARP6.

[5]

CHAPTER 3
LTERATURE REVIEW

This chapter is made to give an obvious idea about the argument why our project is exclusive. As we noticed, the difference in between IP V4 and IP V6 has happen a most well-liked topic in computer networking. We know the truth that after few many years from now the actual addresses of IPV4 is going to be end. That's why we want a newer edition of IP version IP V6. But why we pull to move ahead to newer edition? What kind of facilities it'll provide? Moreover, why IPV6 is preferable to IPV4?

We have studied a big deal about finding the reality on which IPV6 is preferable to IP V4. We analyzed and analyzed through some research papers about this topic. Currently, numerous research works is being conducted this topic.

We read the paper with title "Transformation from IP V4 to IP V6". They've shown the tunneling, kinds of IPV6 tunnels that is their strong factors and except individuals all discussions may be done theoretically [6].

We read the paper with title "Comparing TCP-IPV4/TCP-IPV6 Network Performance". IP V4 versus. IP V6 Latency Measurement may be the powerful point right here. In this measurement they've tried to show the amount of times needed in order to packet transfer from end to finish network both with regard to Internet Protocol V4 and IP V6 that is the powerful point to the paper. But we did the same method but 5 times more to obtain a stable result upon Wireshark packet analyzer device and calculate the typical value of these phones show in that IP version box travels averagely quicker than other. And we currently have found some peculiar results which will prove which IP version is much better [7].

Another paper we read with title "The Next Generation Internet Protocol". In which the next creation protocol can be described in quite simple way to start the study in future. However practical work hasn't already been done here sufficient [8]

Within another we read paper with title "Implementation of IPV6".Where through Wireshark analyzer device by capture document how packet continues IPV6 is being shown that is the strong stage but rest of are theoretical description of IPV6 [9].

Additionally, in another document with title "A Design distinguish between IP V4 & IP V6". Where the futuristic function or facilities of IP V6 has described theoretically [10].

A paper with title "Evaluating an IP v4 and IP v6 Network". Where they show the comparison TCP as per as UDP performance in IP v4 and IP v6 they started using a program called pcattcp. This is actually the Windows version associated with ttcp, which is really a UNIX benchmarking device. The command interface towards the program and it's options are proven below. #pcattcp -t transmitter -r recipient -6 IPv6 (default: IPv4) -u UDP (default: TCP) the setup contains two computers operating Windows 7 (behaving as transmitter as per as receiver) interconnected through an Ethernet change. they divided the actual test into 4 groups: IPv4 along with TCP, IPv4 along with UDP, IPv6 along with TCP, and IPv6 along with UDP, and ran every test-group 50 times (for any total of two hundred tests). We calculated the actual estimated expected value and also the honor deviation for every group. And this really is their strong stage. But without this particular we haven't discovered practical difference a lot. But in this project, we did the distinction between two of these IP versions within three different groups (Network in charge to network comparison about the Fact of Period for IPV4 & IPV6, Process distinguish between IPV4 & IPV6, router to Router Box Transformation through Redistribution) making our project much more practical [11].

CHAPTER 4
MODEL & IMPLEMENTATION

This chapter will cover all the network models that we designed to perform a practical distinguish between IP V4 and IP V6. For doing that we used tools like GNS3 platform and Wireshark for packet tracing and analyzing.

4.1 Network to Network Distinguish between IP V4 & IP V6

In GNS3 platform we have designed a model where we have used 10 routers, then we have pinged several routers form one network to another network both for IP V4 and IP V6 and calculate the packet transformation time in average from end to end network.
 In next chapter we shall see the outcome of pinging and then we can understand which IP version is better.
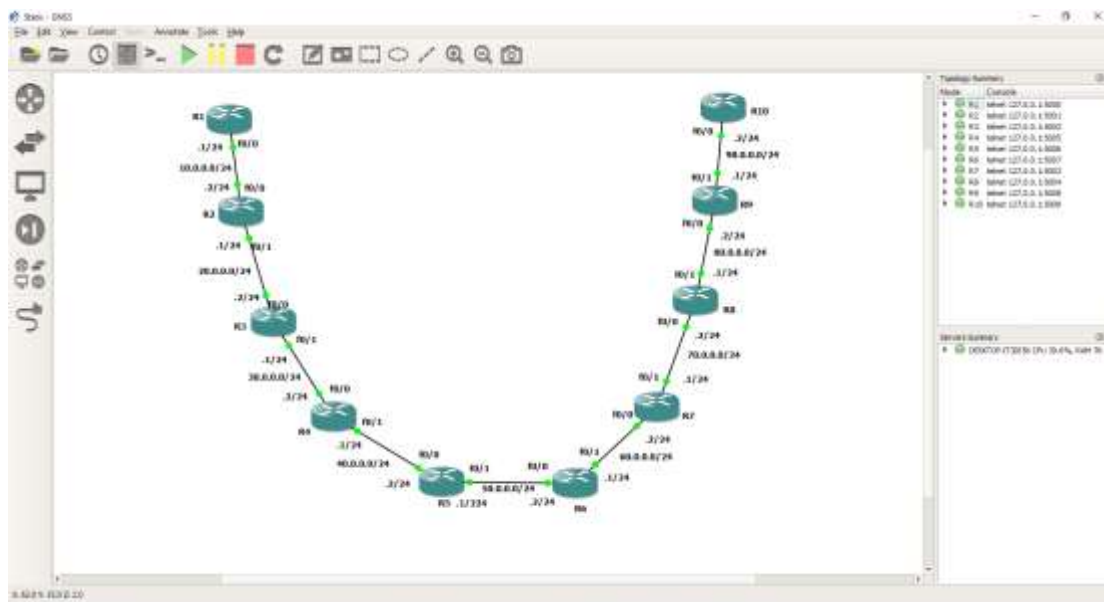
Fig 4.1.1: Network to network comparison on the Fact of Time for IPV4

In this model we used 10 routers & 9 networks. We also used OSPF protocol & ipv4 IP configuration. In this model we compare one network to all others networks to compare

networks we used averaged ping time. We ping address from one network to other network & take ping time which refer the time that need one network to reach other networks. By this ping time we made a graph & compare it with ipv6 & find out which one is best ipv4 or ipv6 according to network to network comparison.
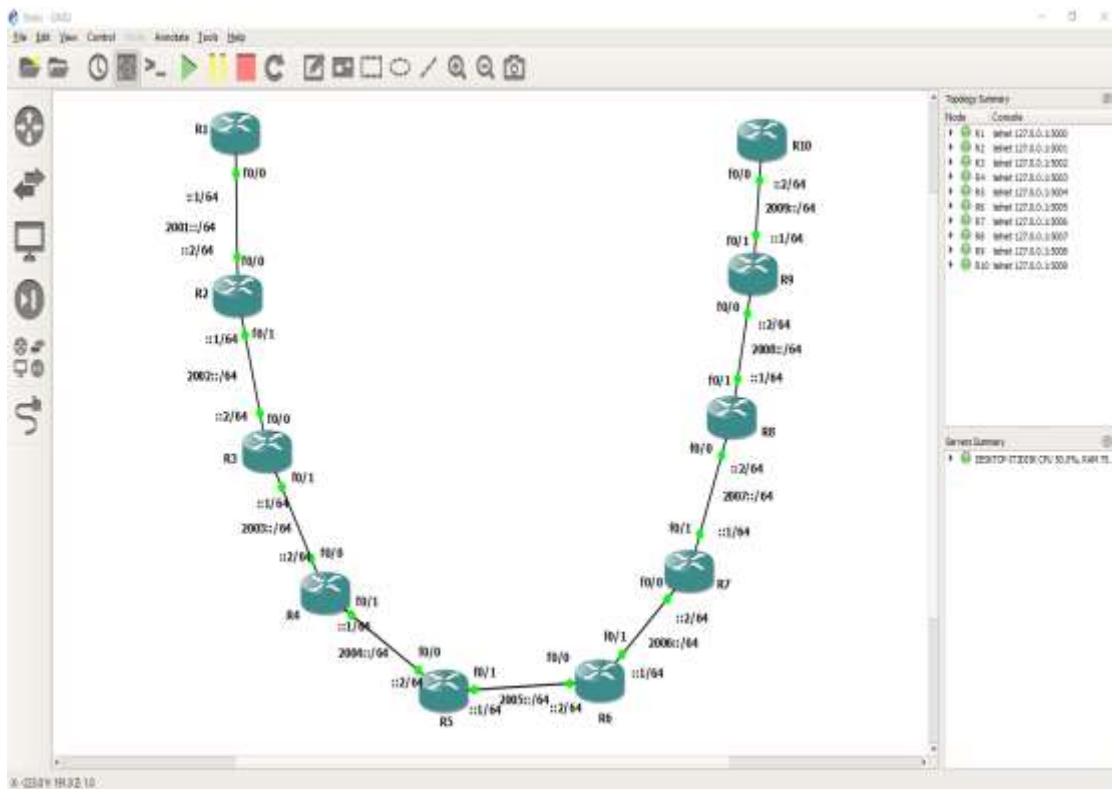
Fig 4.1.2: Network to network comparison on the fact of time for IPV6

In this model we used 10 routers & 9 networks. We also used OSPF protocol & ipv6 IP configuration. In this model we compare one network to all others networks to compare networks we used averaged ping time. We ping address from one network to other network & take ping time which refer the time that need one network to reach other networks. By this ping time we made a graph & compare it with ipv4 & find out which one is best ipv4 or ipv6 according to network to network comparison.

4.2 I/O Graph Distinguish between IPV4 & IPV6

In GNS3 platform we have designed a model where we have used 11 routers, then we have pinged several routers form one network to another network both for IP V4 and IP V6 and have analyzed the packet transformation rate per minute through Wireshark packet analyzing tool. In next chapter we will see the outcome of analysis of network capture with the help of I/O graph and then we can understand which IP version is better.
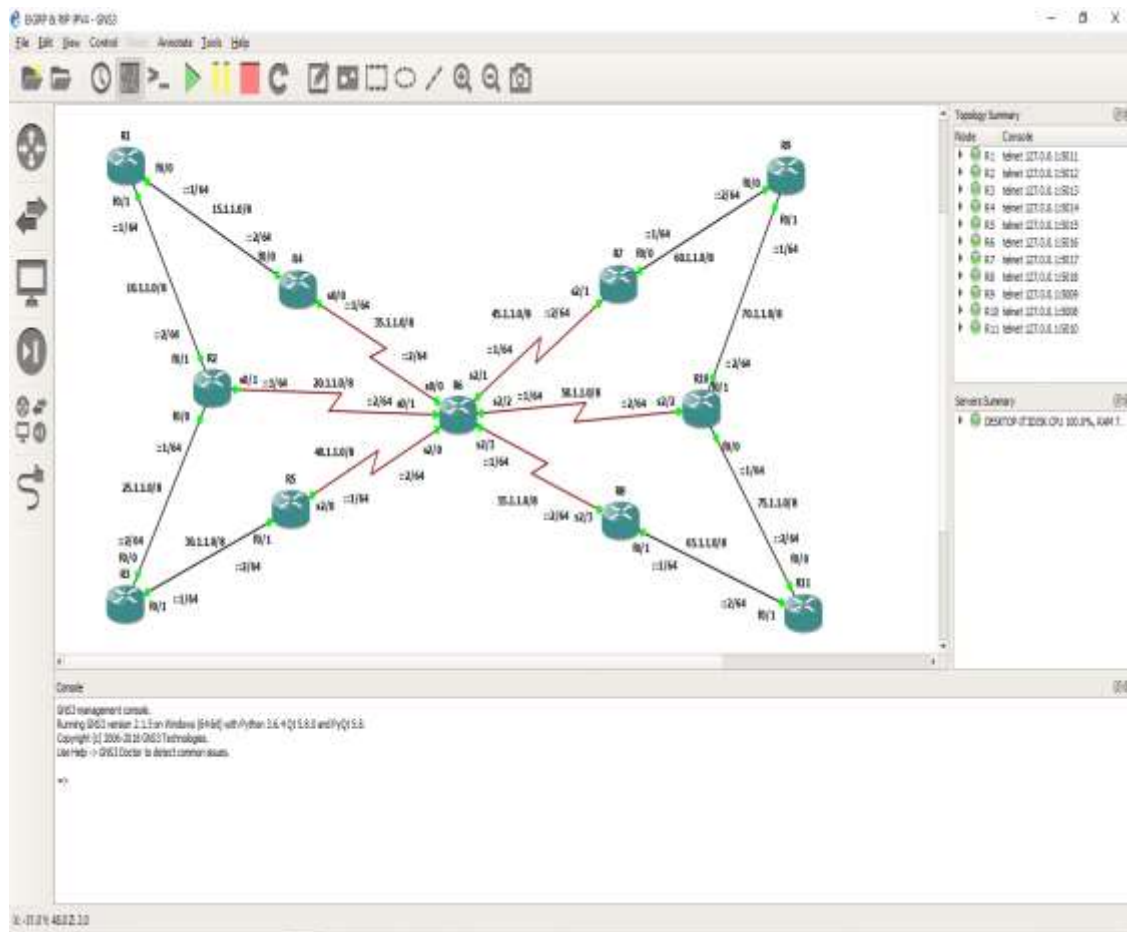
Fig 4.2.1: Router to Router Packet Transformation through redistribution for ipv4

Here in this design we used 11 routers, 14 network, EIGRP, RIP protocol. We also used here redistribution. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv4.we configure ipv4 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we

made a graph & compare with IP v6.After this we can see which one is best IP V4 or IP V6
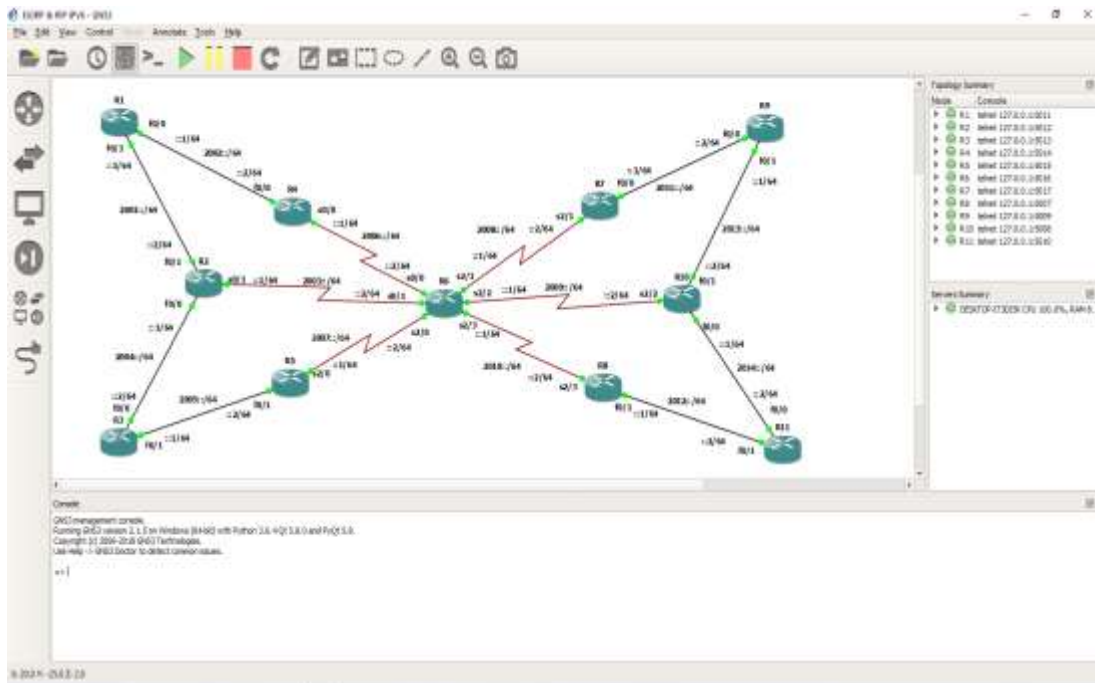
Fig 4.2.2: Router to router packet transformation through redistribution for ipv6

Here in this design we used 11 routers, 14 network, EIGRP, RIP protocol. We also used here redistribution. We collect here number of packets transfer from one router to another router in time interval in minutes for ipv6.we configure ipv6 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv4.After this we can find which one is best IP V4 or IP V6

4.3 Protocol Distinguish between IP V4 & IP V6

In GNS3 platform we have designed 8 models for protocol comparison portion. There are 4 protocols (EIGRP, OSPF, RIP, STATIC) that we used both for IP V4 and IP V6 then we have pinged several routers and have analyzed the packet transformation rate per minute for each unique protocol through Wireshark packet analyzing tool. In next

chapter we shall see the outcome of analyzing and then we can understand which IP version is better for each unique protocol.

Fig 4.3.1: Packet transformation for EIGRP in ipv4

Here in this design we used 6 routers, 6 network, and EIGRP protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv4.we configure ipv4 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv6.After this we can view which one is best ipv4 or ipv6.

Fig 4.3.2: Packet transformation for OSPF in ipv4

Here in this design we used 3 routers, 4 network, 2 switch, 2 pc and OSPF protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv4.we configure ipv4 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv6.After this we can view which one is best ipv4 or ipv6.

Fig 4.3.3: Packet transformation for RIP in ipv4

Here in this design we used 2 routers, 3 network, 2 switch, 2 pc and RIP protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv4.we configure ipv4 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv6.After this we can view which one is best ipv4 or ipv6.
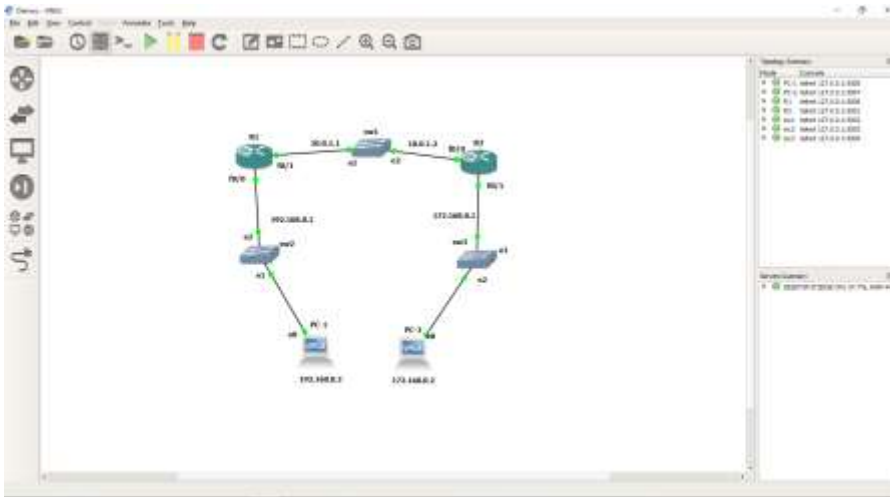
Fig 4.3.4: Packet transformation for STATIC in ipv4

Here in this design we used 2 routers, 3 network, 3 switch, 2 pc and STATIC protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv4.we configure ipv4 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv6.After this we can view which one is best ipv4 or ipv6.
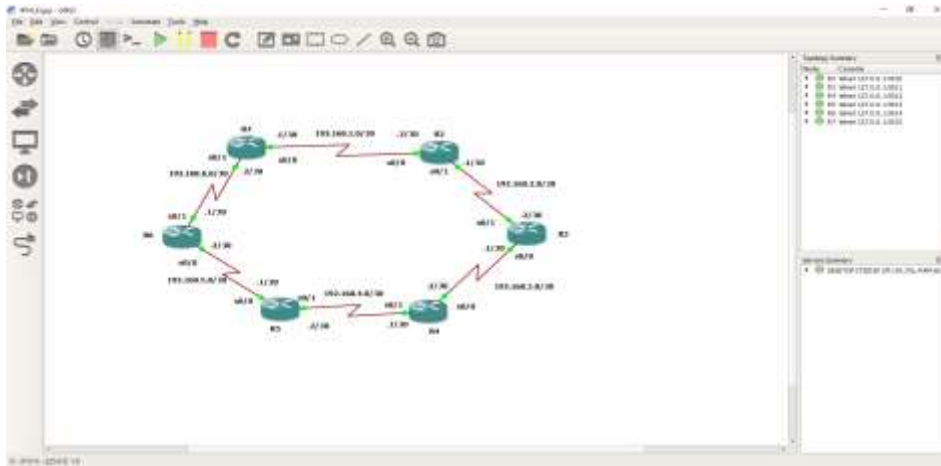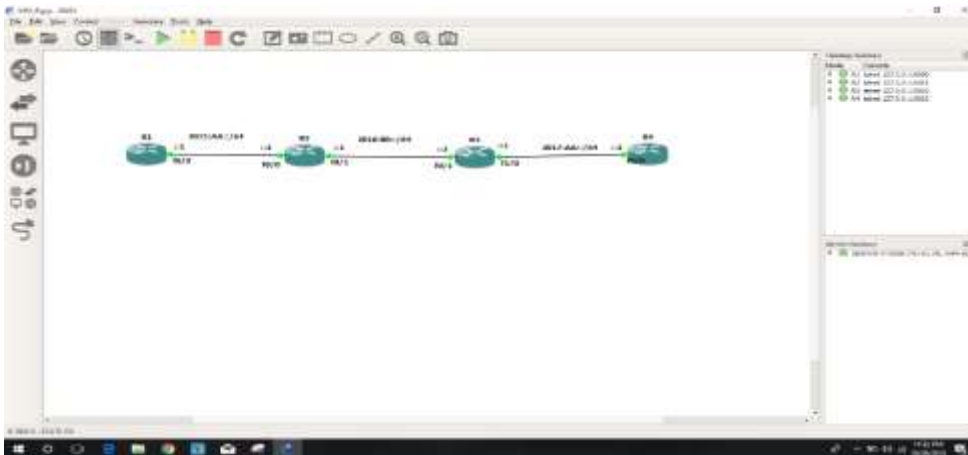

Fig 4.3.5: Packet transformation for EIGRP in ipv6

Here in this design we used 4 routers, 3 network, and EIGRP protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv6.we configure IP V6 addressing here. We capture network from this design by

Wireshark & collect data. Then by this data we made a graph & compare with ipv4.After this we can view which one is best ipv4 or ipv6.
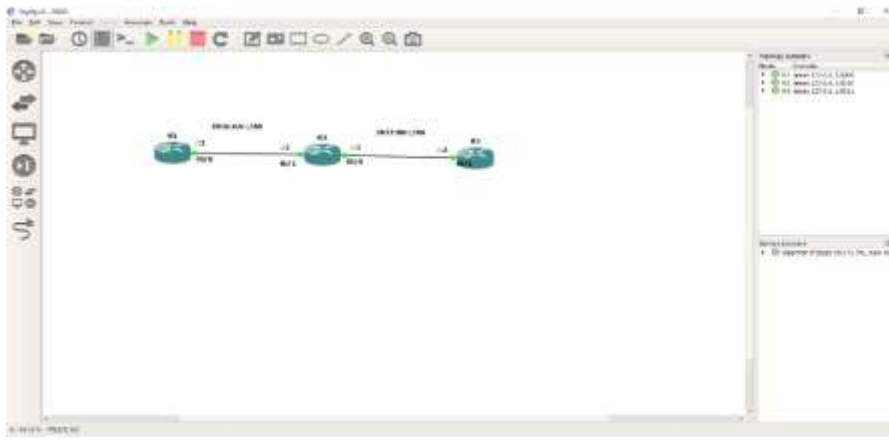
Fig 4.3.6: Packet transformation for OSPF in ipv6

Here in this design we used 3 routers, 2 network, and OSPF protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv6.we configure IP V6 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv4.After this we can view which one is best ipv4 or ipv6.
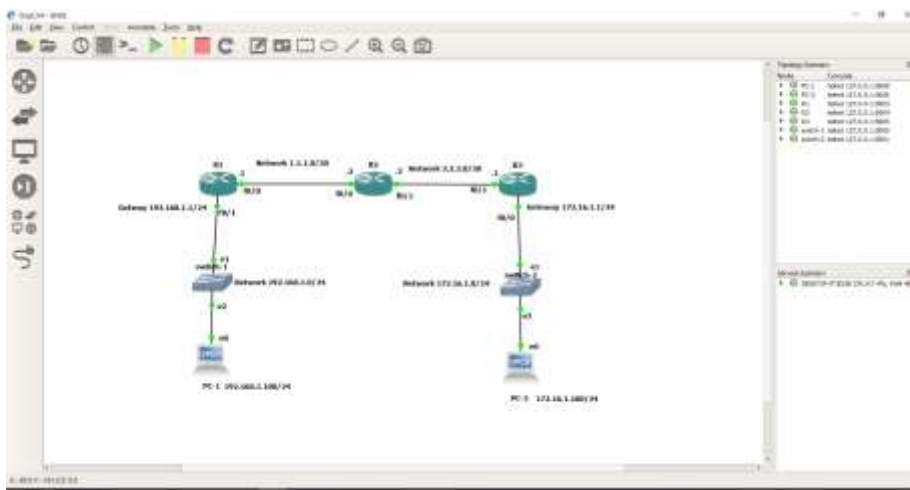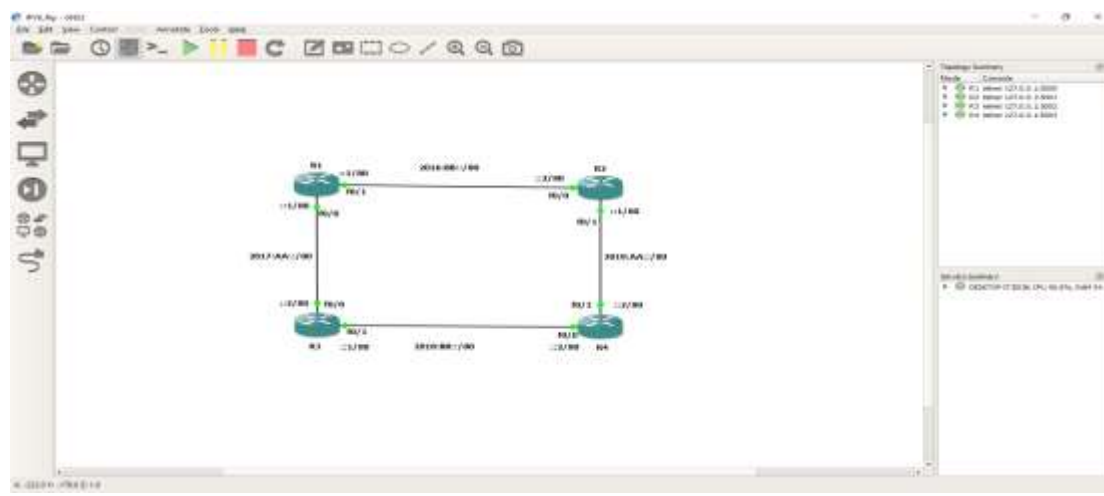

Fig 4.3.7: Packet transformation for RIP in ipv6

Here in this design we used 4 routers, 4 network, and RIP protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv6.we configure IP V6 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv4.After this we can view which one is best ipv4 or ipv6.
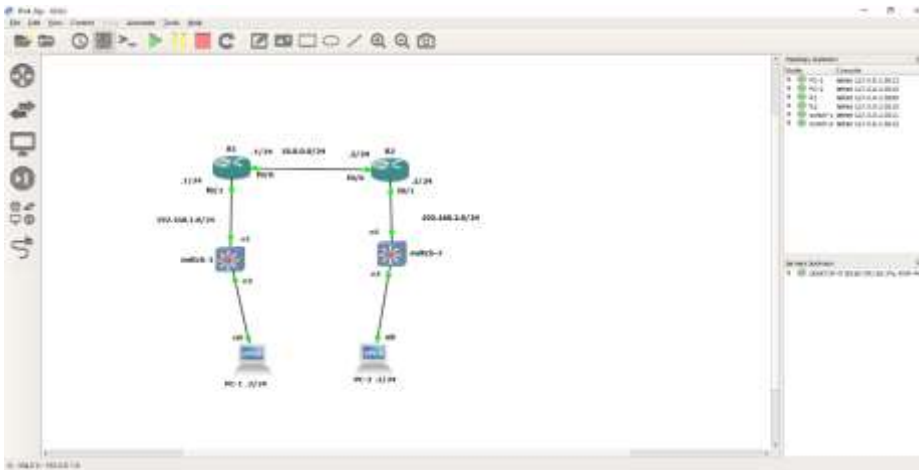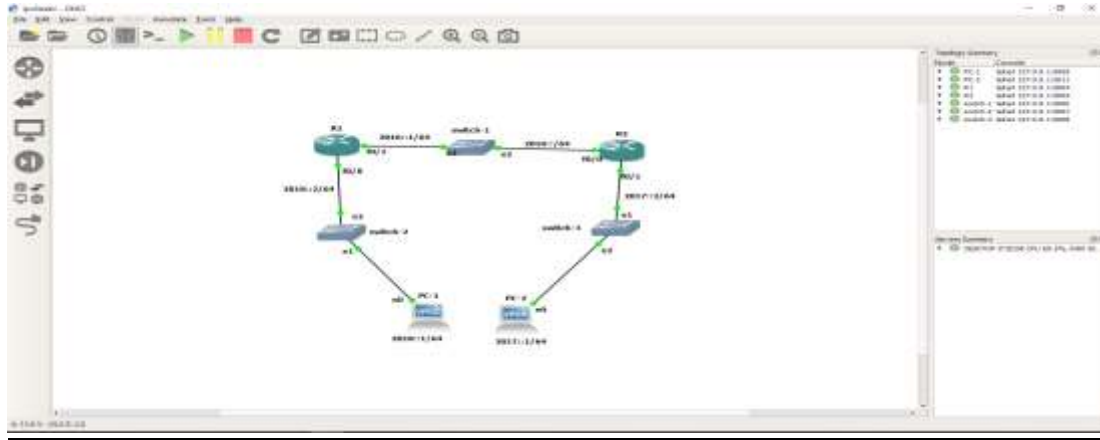

Fig 4.3.8: Packet transformation for STATIC in ipv6

Here in this design we used 2 routers, 3 network, and STATIC protocol. We collect here no. of packets transmit from one router to other router in time interval in minutes for ipv6.we configure IP V6 addressing here. We capture network from this design by Wireshark & collect data. Then by this data we made a graph & compare with ipv4.After this we can view which one is best ipv4 or ipv6.

CHAPTER 5

RESULT

In previous chapter 4, there were 12 network designs of three categories (I/O graph comparison for router to router packet transformation through re-distribution, Network to network time analysis, Protocol comparison) for analyzing the practical distinguish between Ip v4 and Ip v6. Now the chapter, we will show the possible outcome of our analysis from previous chapter in 3 different categories and also there shall be sub categories.

5.1 I/O Packet Transformation Distinguish Graph between IP V4 & IP V6

Like as previous chapter we have discussed about I/O graph comparison, in which IP version has performed better than other one through packet transformation on the fact of time measurement.

	0 m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m
IPV4 (Packets 241 = 12 min)	0	38	56	74	93	111	130	149	167	186	205	223	241
IPV6 (Packets 250 = 12 min)	0	40	58	76	96	116	135	153	173	191	210	231	250

Fig 5.1.1: I/O packet transformation comparison graph for R1 to R2

As view in figure 5.1.1 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 12th minute then we can see that in this time there are 241 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 250. As said that in this network IPV6 performs better than IPV4.

I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R2 TO R3

	0m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
IPV4 (Packets 259 = 13 min)	0	37	54	73	91	110	128	149	167	185	204	222	241	259
IPV6 (Packets 270 = 13 min)	0	39	58	78	97	115	137	155	173	191	212	230	249	270

Fig 5.1.2: I/O packet transformation comparison graph for R2 to R3

As view in figure 5.1.2 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 13th minute then we can see that in this time there are 259 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 270. As said that in this network IPV6 performs better than IPV4
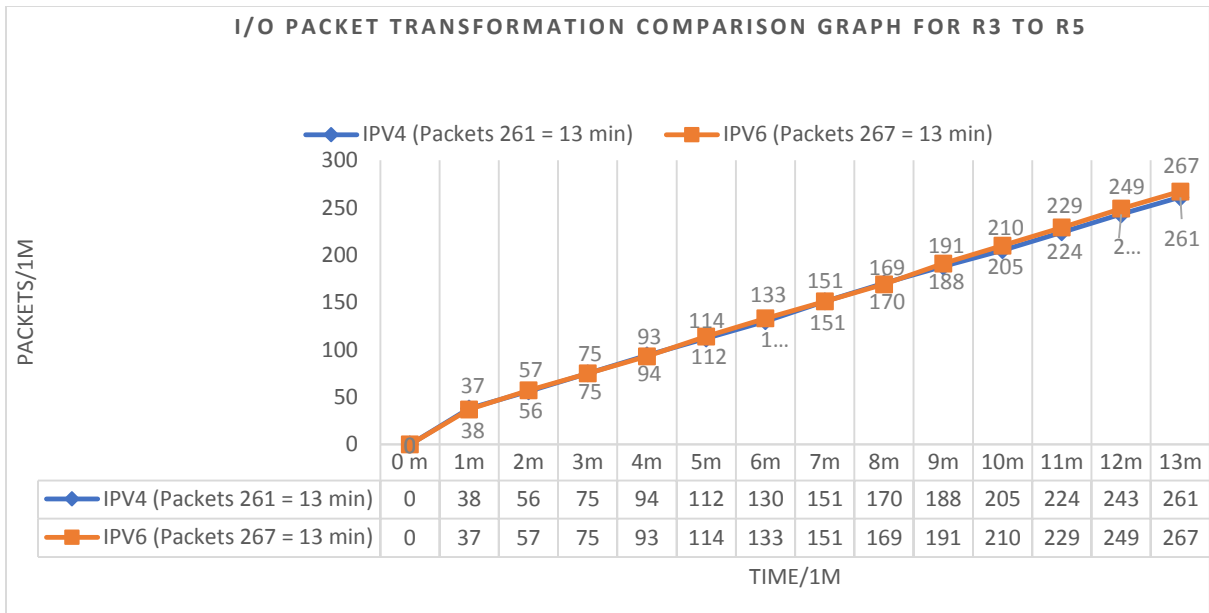
Fig 5.1.3: I/O packet transformation comparison graph for R3 to R5

As view in figure 5.1.3 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 13th minute then we can see that in this time there are 261 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 267. As said that in this network IPV6 performs better than IPV4

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Fig 5.1.4: I/O packet transformation comparison graph for R3 to R

As view in figure 5.1.4 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 10th minute then we can see that in this time there are 205 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 212. As said that in this network IPV6 performs better than IPV4

I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R4 TO R6

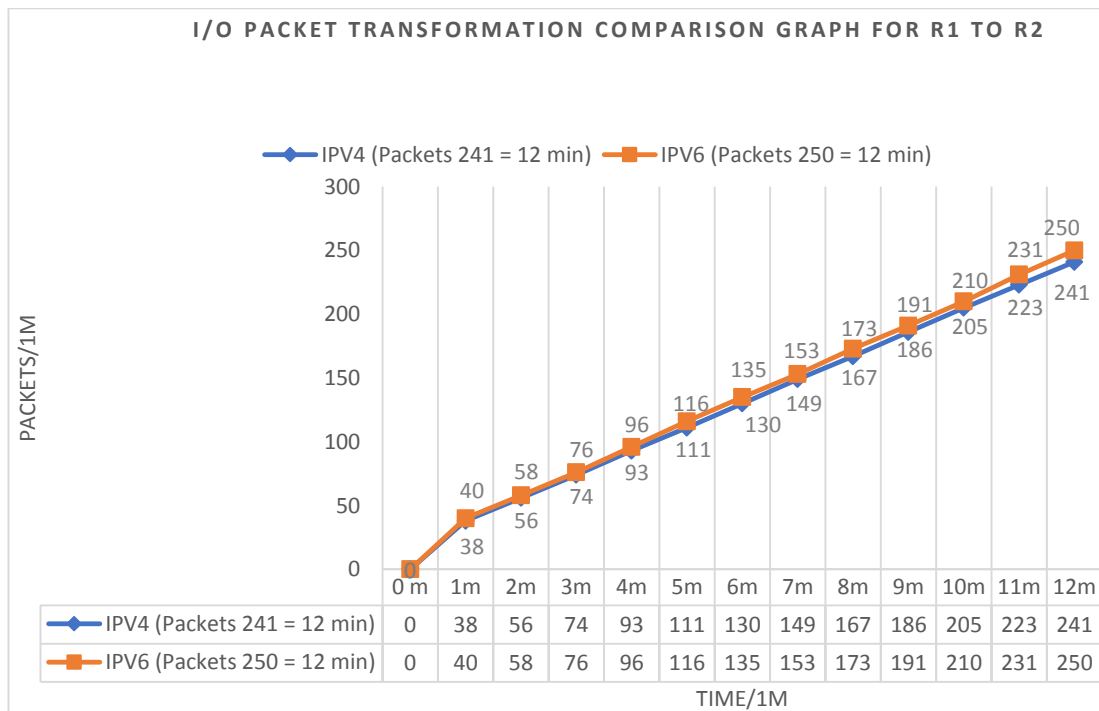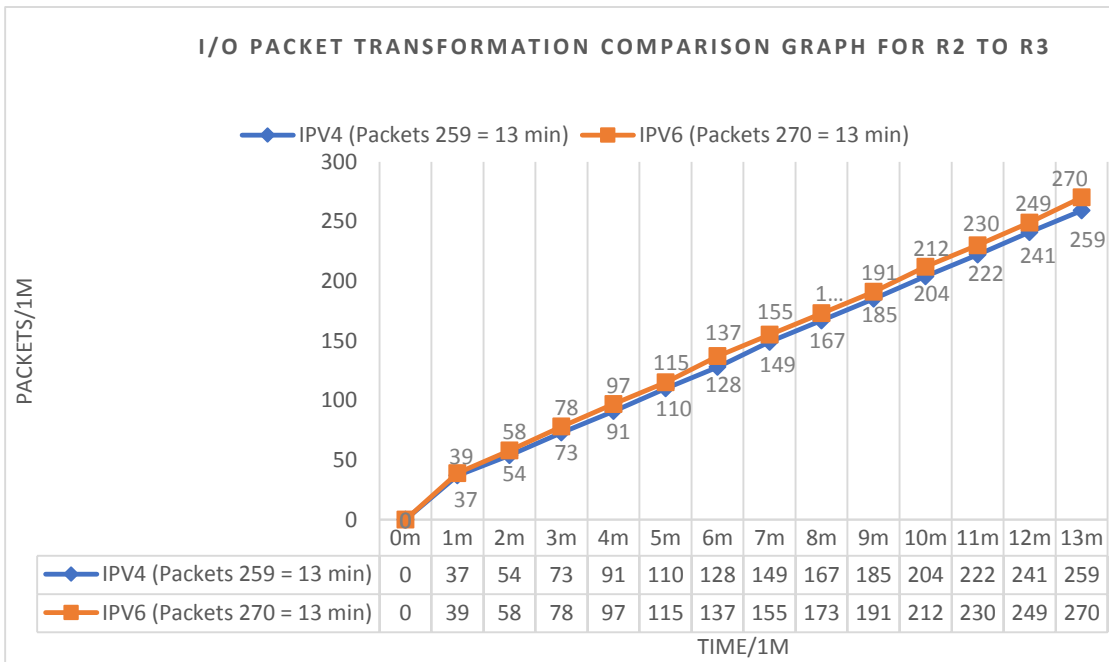|	0 m	1m	2m	3m	4m
IPV4 (Packets 93 = 4 min)	0	37	57	75	93
IPV6 (Packets 102 = 4 min)	0	37	65	84	102

Fig 5.1.5: I/O packet transformation comparison graph for R4 to R6

As view in figure 5.1.5 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 4th minute then we can see that in this time there are 93 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 102. As said that in this network IPV6 performs better than IPV4

I/O GRAPH PACKET TRANSFORMATION COMPARISON FOR R4 TO R6

	0 m	1m	2m
IPV4 (Packets 55 = 2 min)	0	37	55
IPV6 (Packets 66 = 2 min)	0	48	66

Fig 5.1.6: I/O graph packet transformation comparison for R4 to R6

As view in figure 5.1.6 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 2th minute then we can see that in this time there are 55 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 66. As said that in this network IPV6 performs better than IPV4

I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R6 TO R5

|	0 m	1m	2m
IPV4 (Packets 56 = 2 min)	0	39	56
IPV6 (Packets 75 = 2 min)	0	47	75

TIME/1M

Fig 5.1.7:   I/O packet transformation comparison graph for R6 to R5

As view in figure 5.1.7 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 2th minute then we can see that in this time there are 56 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 75. As said that in this network IPV6 performs better than IPV4
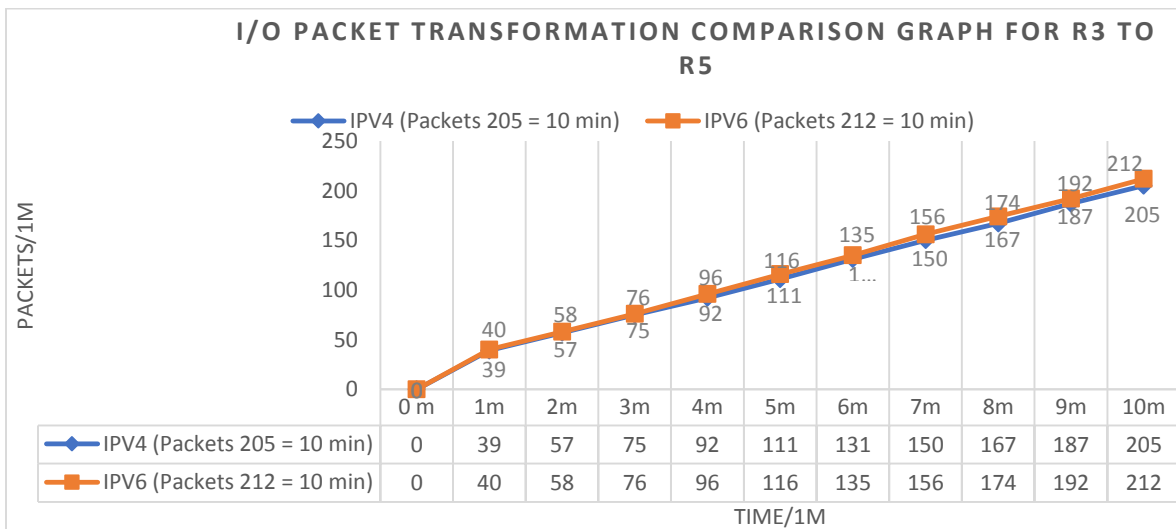
I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R6 TO R7

	0 m	1m	2m
IPV4 (Packets 120 = 2 min)	0	80	120
IPV6 (Packets 131 = 2 min)	0	81	131

PACKETS/1M — TIME/1M

Fig 5.1.8: I/O packet transformation comparison graph for R6 to R7

As view in figure 5.1.8 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 2th minute then we can see that in this time there are 120 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 131. As said that in this network IPV6 performs better than IPV4
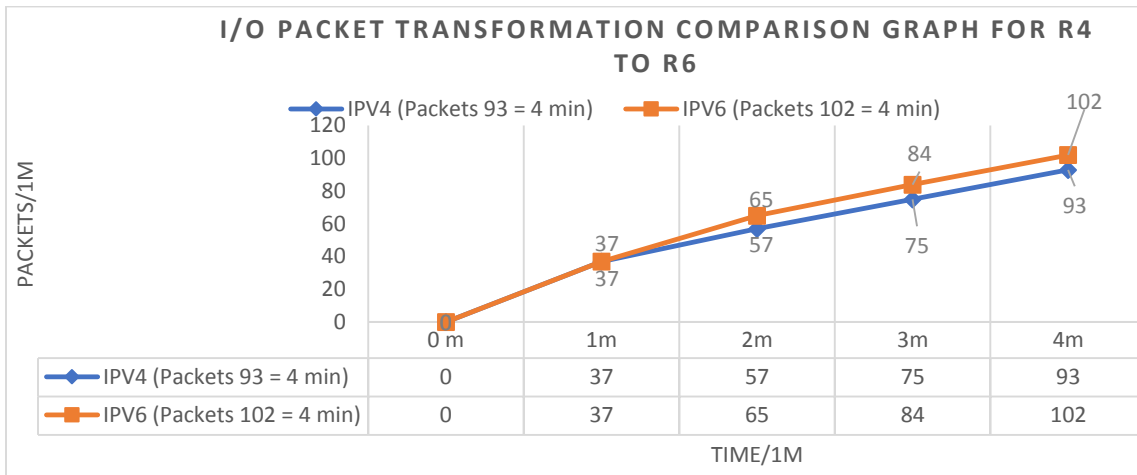
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I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R6 TO R8

	0 m	1m	2m
IPV4 (Packets 120 = 2 min)	0	80	120
IPV6 (Packets 131 = 2 min)	0	80	131

PACKETS/1M — TIME/1M

Fig 5.1.9: I/O packet transformation comparison graph for R6 to R8

As view in figure 5.1.9 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 2th minute then we can see that in this time there are 120 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 131. As said that in this network IPV6 performs better than IPV4
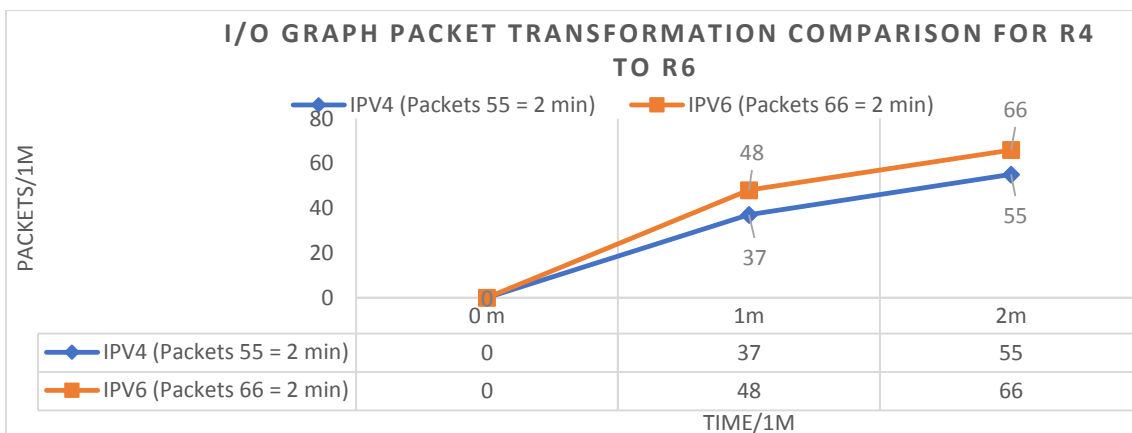

I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R6 TO R10

	0 m	1m	2m
IPV4 (Packets 120 = 2 min)	0	80	120
IPV6 (Packets 129 = 2 min)	0	80	129

TIME/1M

Fig 5.1.10: I/O packet transformation comparison graph for R6 to R10

As view in figure 5.1.10 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 2th minute then we can see that in this time there are 120 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 129. As said that in this network IPV6 performs better than IPV4
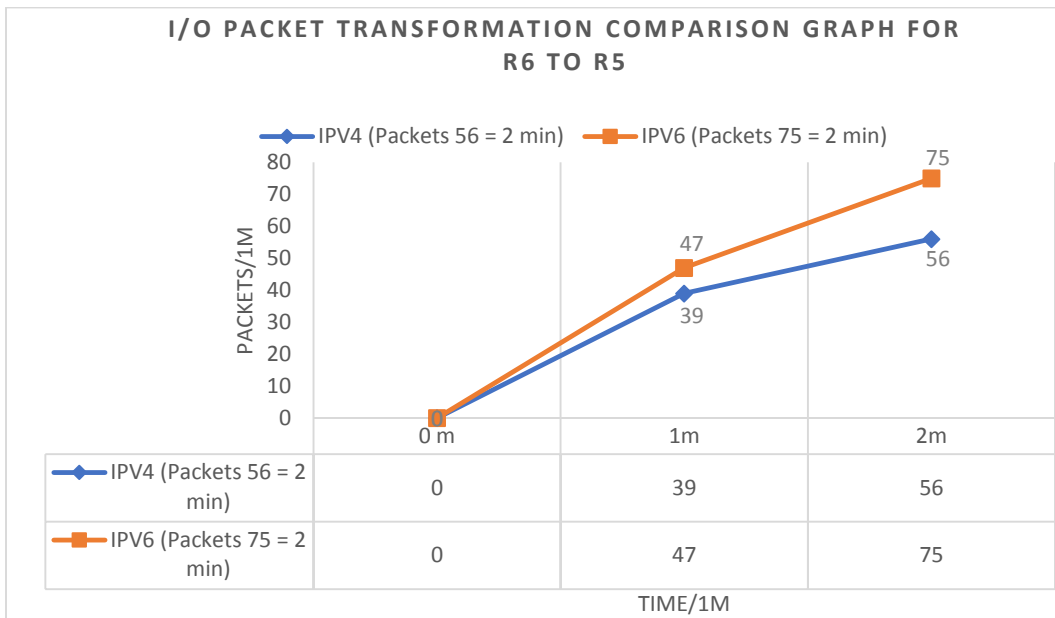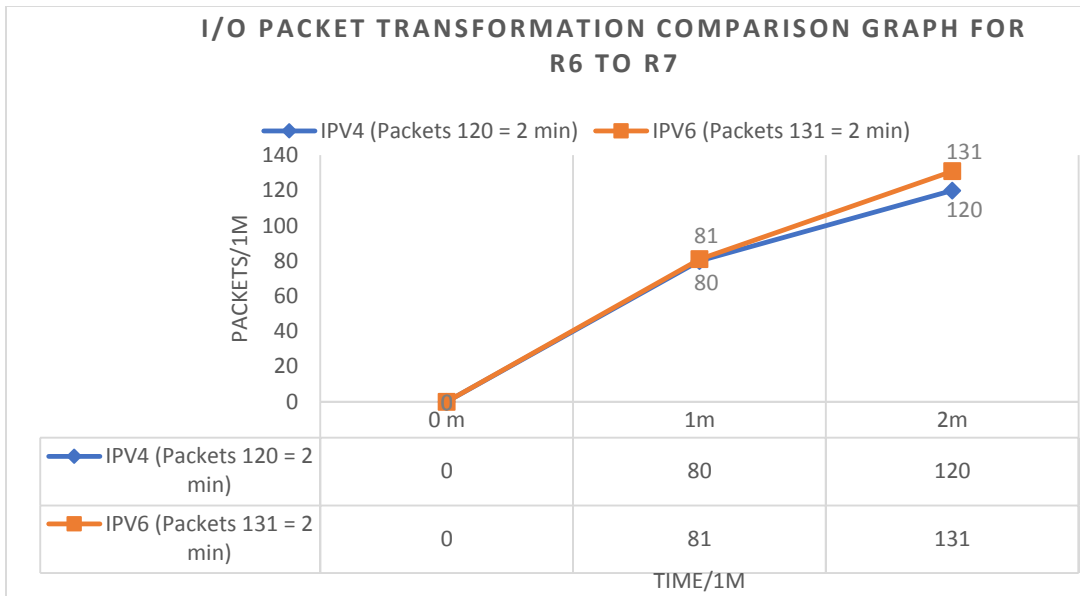

I/O GRAPH PACKET TRANSFORMATION COMPARISON GRAPH FOR R7 TO R9

	0 m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
IPV4 (Packets 561 = 13 min)	0	80	120	160	200	240	280	319	360	401	441	481	521	561
IPV6 (Packets 568 = 13 min)	0	81	122	161	202	243	285	325	366	408	448	487	529	568

TIME/1M

Fig 5.1.11: I/O graph packet transformation comparison graph for R7 to R9

As view in figure 5.1.11 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 13th minute then we can see that in this time there are 561 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 568. As said that in this network IPV6 performs better than IPV4
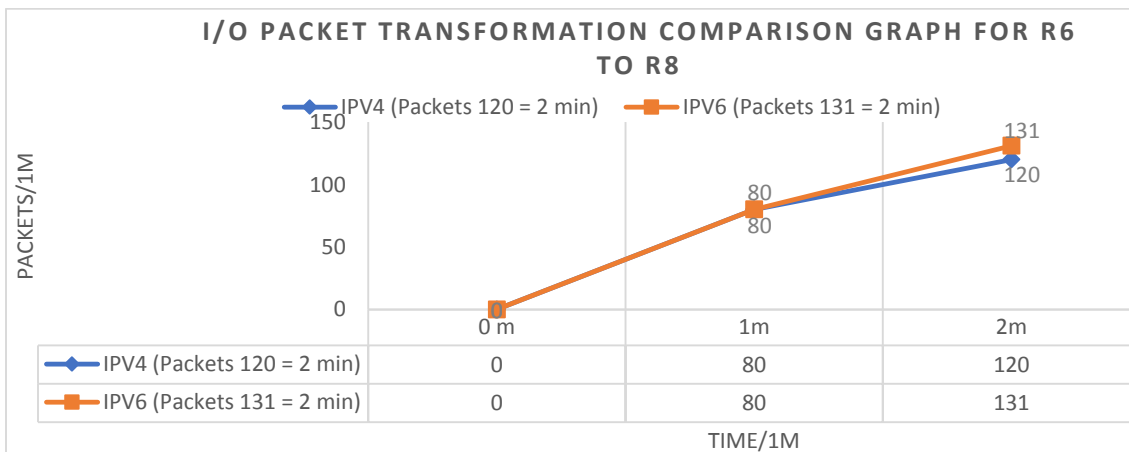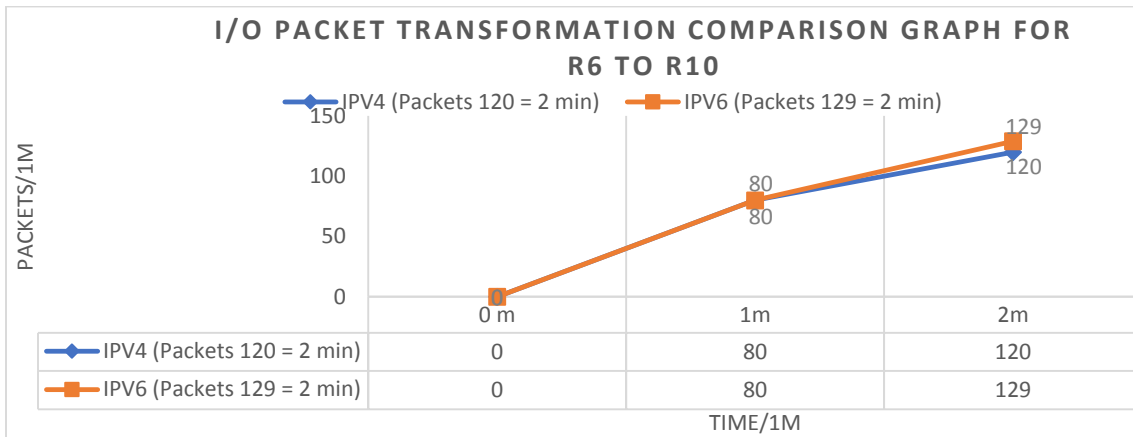
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Fig 5.1.12: I/O packet transformation comparison graph for R9 to R10

As view in figure 5.1.12X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 13th minute then we can see that in this time there are 563 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 571. As said that in this network IPV6 performs better than IPV4

I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R10 TO R11

	0 m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m
IPV4 (Packets 559 = 13 min)	0	80	119	159	199	239	280	321	361	401	441	480	519	559
IPV6 (Packets 571 = 13 min)	0	81	123	163	204	246	288	327	368	409	448	488	531	571

Fig 5.1.13: I/O packet transformation comparison graph for R10 to R11

As view in figure 5.1.13 X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 13th minute then we can see that in this time there are 559 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 571. As said that in this network IPV6 performs better than IPV4
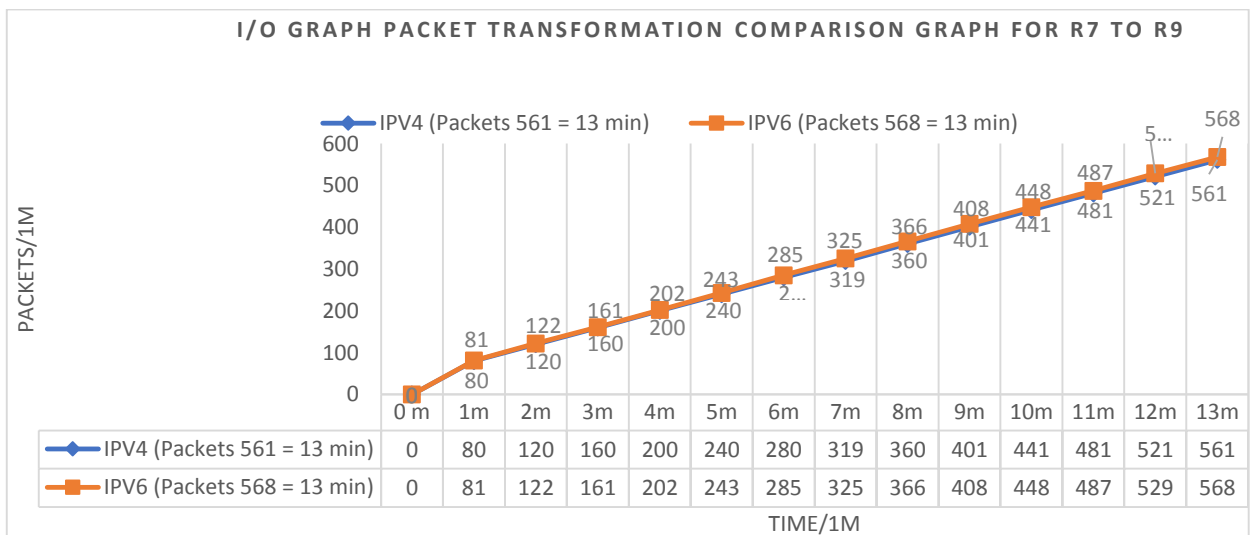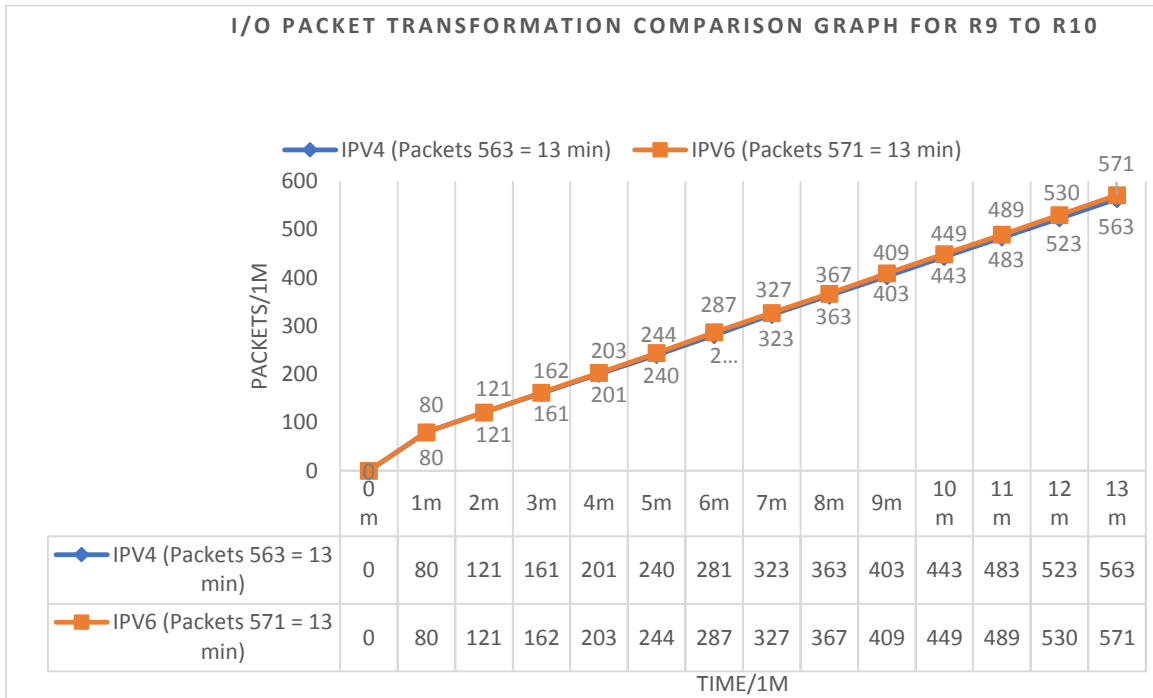

I/O PACKET TRANSFORMATION COMPARISON GRAPH FOR R11 TO R8

	0 m	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m
IPV4 (Packets 522 = 12 min)	0	80	120	160	200	240	280	321	362	402	442	482	522
IPV6 (Packets 529 = 12 min)	0	79	121	162	203	244	286	325	366	407	447	487	529

Fig 5.1.14: I/O packet transformation comparison graph for R11 to R8

As view in figure 5.1.14X-axis denotes times and Y-axis denotes packets per minutes. As is observed if we take a specific time like 12th minute then we can see that in this time there are 522 packets has been transferred in IPV4 where In IPV6 the no. of packets transfer is 529. As said that in this network IPV6 performs better than IPV4
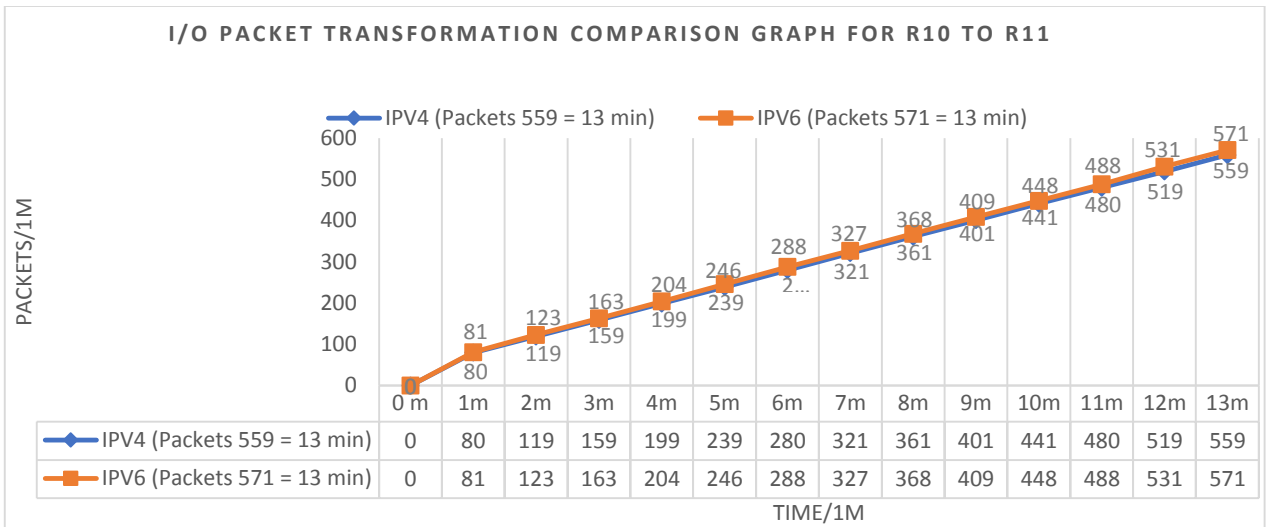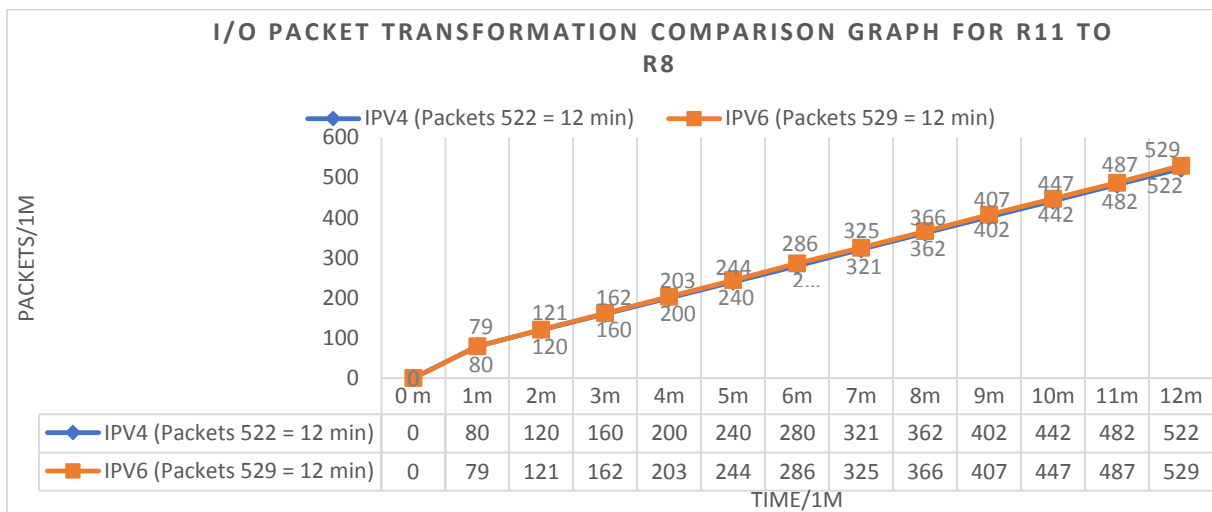
5.2 Network to Network Time **Distinguish** Graph between IP V4 & IP V6

Like as previous chapter we have discussed about network to network time comparison, in which IP version has performed better than other one through the network to network time comparison to transfer the packets.

Fig 5.2.1: Network to network time comparison graph for network N1 to all networks.

As view in figure 5.2.1 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N1 to N9 then we can view that in this network 1382.4 MS need to transfer packets from networks N1 to N9 in IPV4 where In IPV6 need only 1206.6 MS to transfer packets from networks N1 to N9. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets

Fig 5.2.2: Network to network time comparison graph for network N2 to all networks.

As view in figure 5.2.2 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N2 to N1 then we can view that in this network 1113.8 MS need to transfer packets from networks N2 to N1 in IPV4 where In IPV6 need only 1032.8 MS to transfer packets from networks N2 to N1. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets
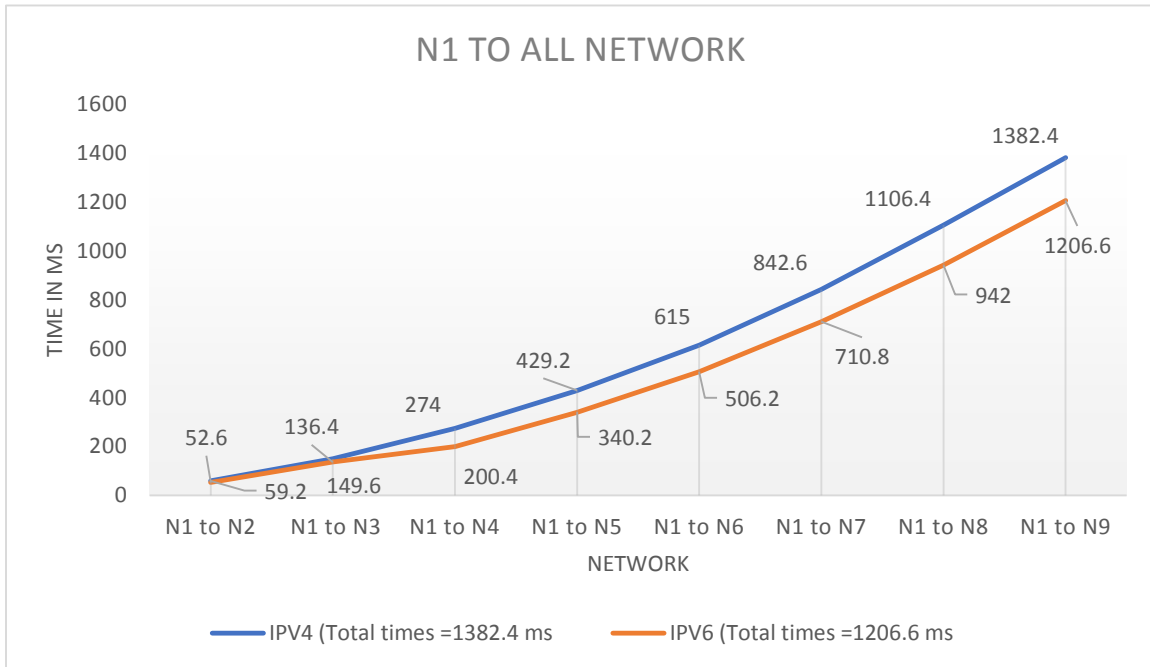

Fig 5.2.3: Network to network time comparison graph for network N3 to all networks.

As view in figure 5.2.3 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N3 to N1 then we can view that in this network 981.8 MS need to transfer packets from networks N3 to N1 in IPV4 where In IPV6 need only 901.6 MS to transfer packets from networks N3 to N1. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets
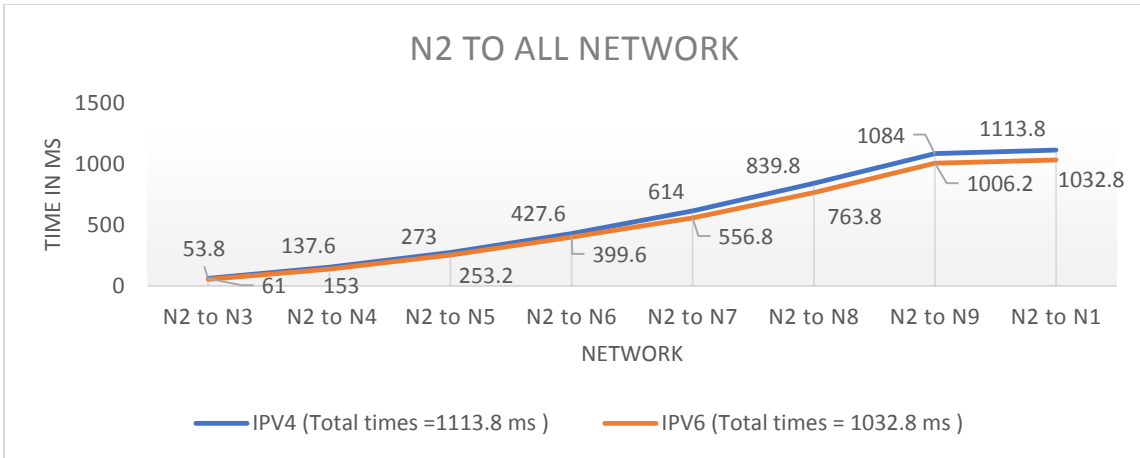
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Fig 5.2.4: Network to network time comparison graph for network N4 to all networks.

As view in figure 5.2.4 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N4 to N3 then we can view that in this network 890.4 MS need to transfer packets from networks N4 to N3 in IPV4 where In IPV6 need only 836.2 MS to transfer packets from networks N4 to N3. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets.
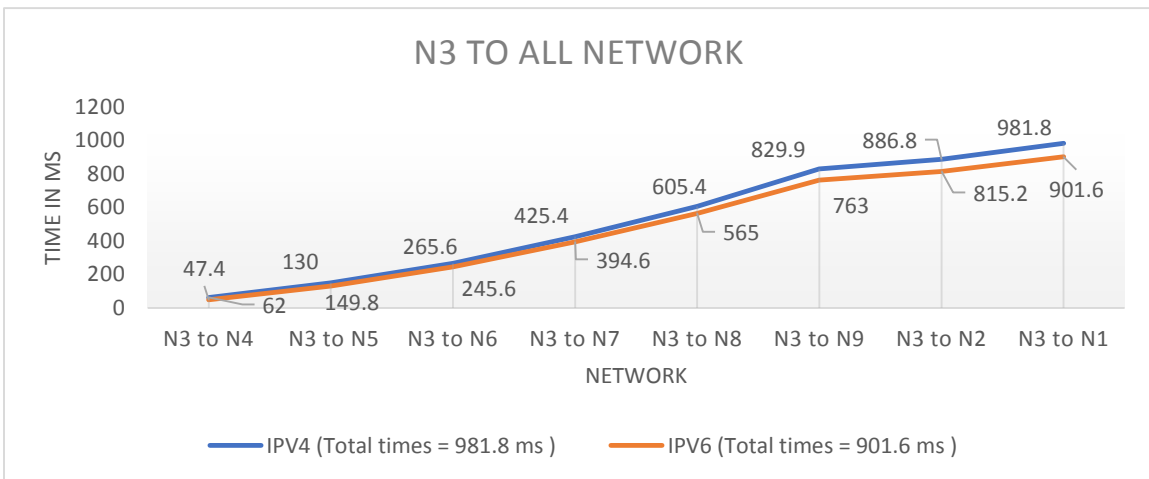
Fig 5.2.5: Network to network time comparison graph for network N5 to all networks.

As view in figure 5.2.5 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N5 to N4 then we can view that in this network 848.8 MS need to transfer packets from networks N5 to N4 in IPV4 where In IPV6 need only 790.2 MS to transfer packets from networks N5 to N4. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets
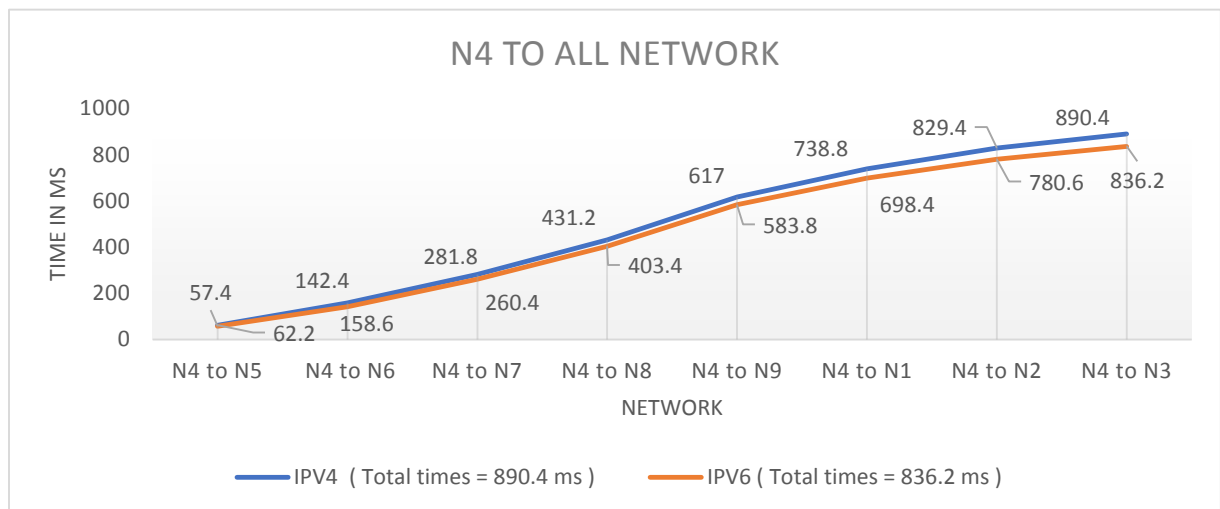

Fig 5.2.6: Network to network time comparison graph for network N6 to all networks.

As view in figure 5.2.6 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N6 to N4 then we can view that in this network 828.8 MS need to transfer packets from networks N6 to N4 in IPV4 where In IPV6 need only 654.8 MS to transfer packets from networks N6 to N4. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets.
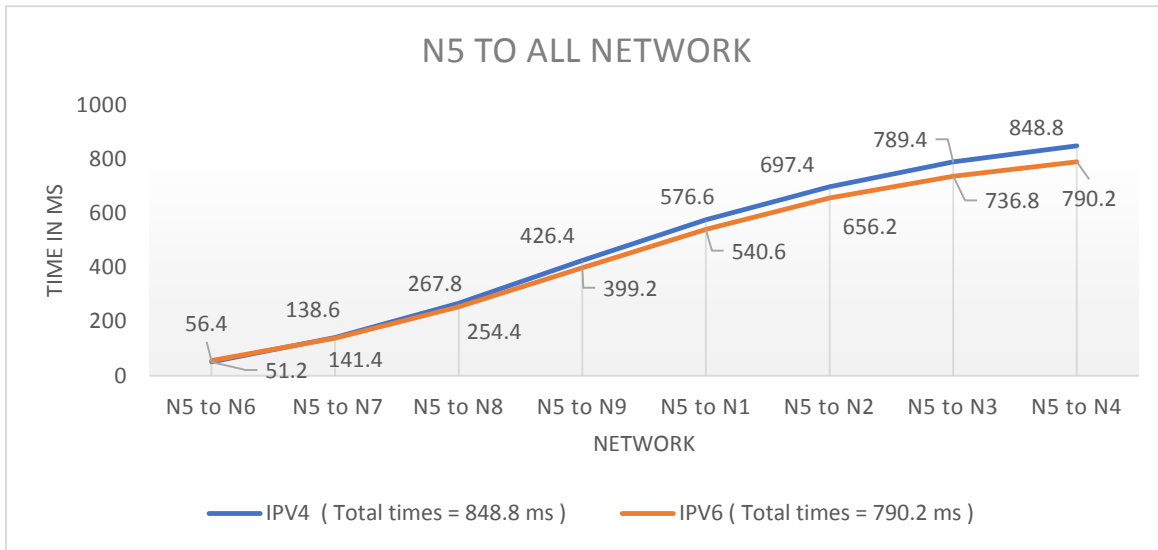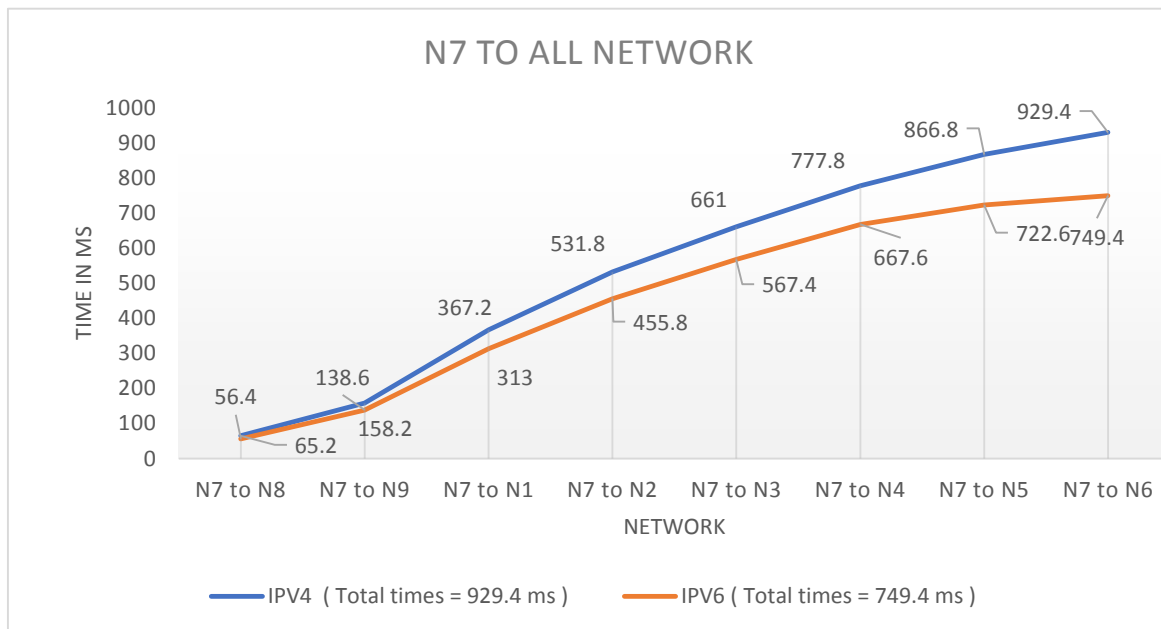

Fig 5.2.7: Network to network time comparison graph for network N7 to all networks.

As view in figure 5.2.7 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N7 to N6 then we can view that in this network 929.4 MS need to transfer packets from networks N7 to N6 in IPV4 where In IPV6 need only 749.4 MS to transfer packets from networks N7 to N6. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets
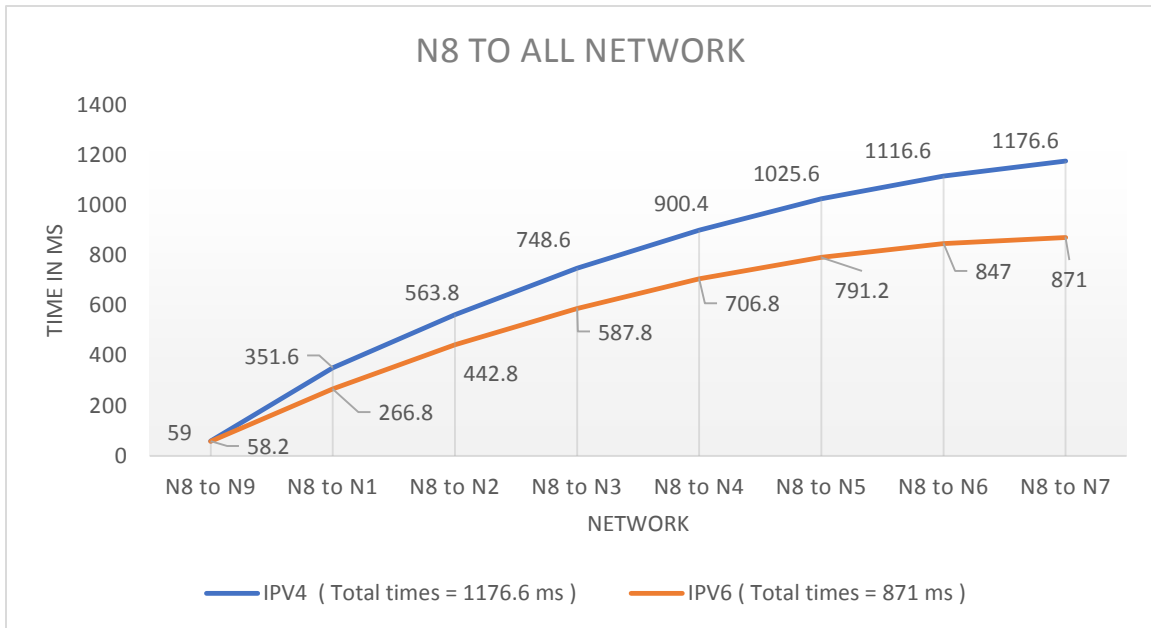
Fig 5.2.8: Network to network time comparison graph for network N8 to all networks.

As view in figure 5.2.8 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N8 to N7 then we can view that in this network 1176.6 MS need to transfer packets from networks N8 to N7 in IPV4 where In IPV6 need only 871 MS to transfer packets from networks N8 to N7. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets
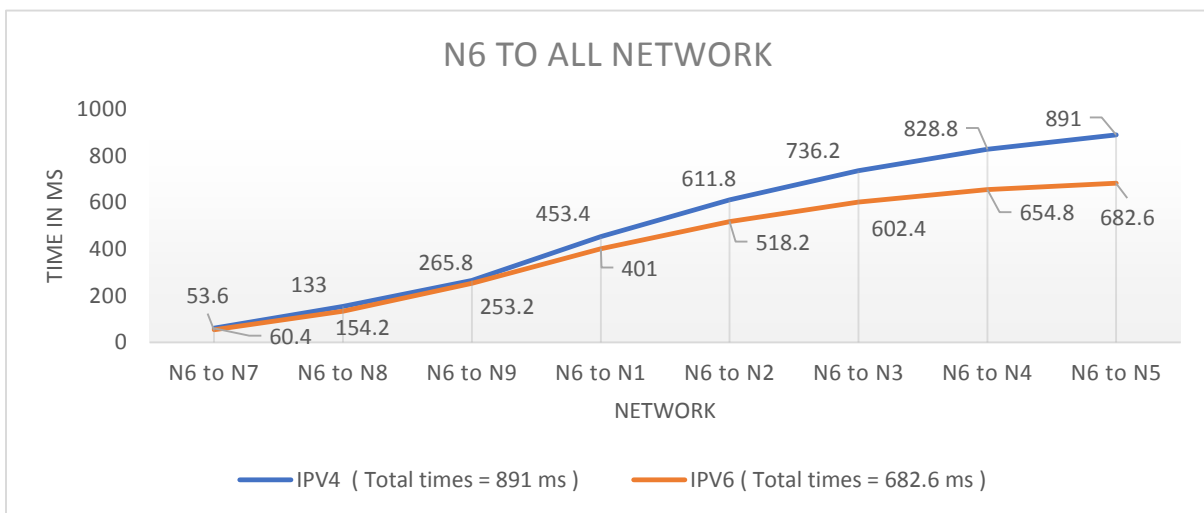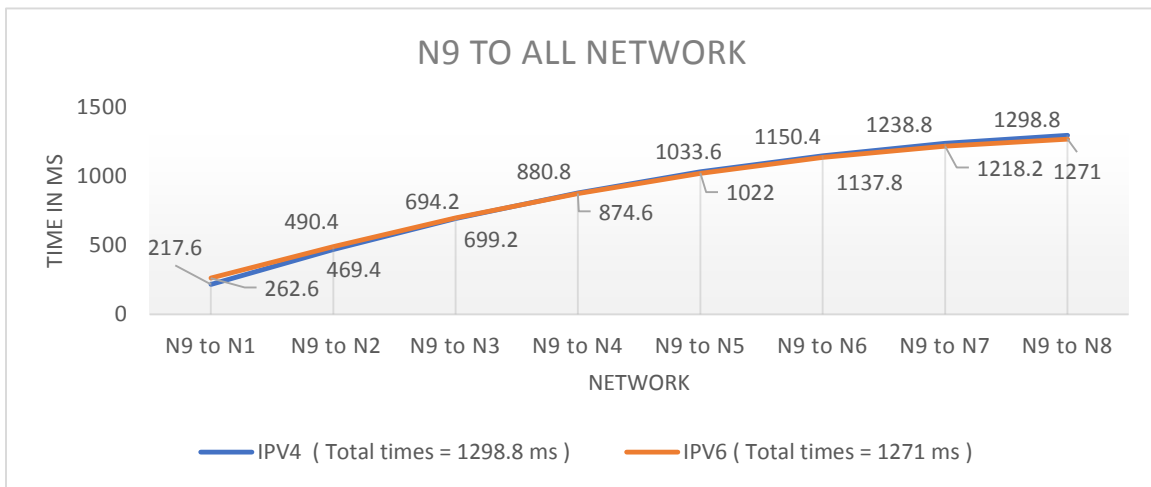

Fig 5.2.9: Network to network time comparison graph for network N9 to all networks.

As view in figure 5.2.9 X- axis explain no. of networks & Y axis denotes times in milliseconds. As is observed if we take a specific network like N9 to N8 then we can view that in this network 1298.8 MS need to transfer packets from networks N9 to N8 in IPV4 where In IPV6 need only 1271 MS to transfer packets from networks N9 to N8. So, we said that in this network IPV6 better than IPV4 according to network to network time comparison to transfer packets

5.3 Protocol to Protocol Distinguish Graph between IP V4 & IP V6

Like as previous chapter we have discussed about protocol comparison, in which IP version has performed better & which protocol performed better than other one through the protocol comparison based on the transfer the packets transformation according to the time in minutes.

Fig 5.3.1: EIGRP protocol distinguish between IP v4 & IP v6.

As view in figure 5.3.1 X axis explain time in minutes and Y axis explain no. of packets per minutes. As is observed if we take a specific time like 16 minutes then we can view that in this time 639 packets transfer in IPV4 where In IPV6 651 packets transfer for EIGRP protocol. So, said that in this time IPV6 better than IPV4 & EIGRP protocol better in IPV6 than IPV4.

Fig 5.3.2:   OSPF protocol distinguish between Ip v4 & Ip v6.

As view in figure 5.3.2 X axis explain time in minutes and Y axis explain no. of packets per minutes. As is observed if we take a specific time like 16 minutes then we can view that in this time 419 packets transfer in IPV4 where In IPV6 465 packets transfer for EIGRP protocol. So, said that in this time IPV6 better than IPV4 & EIGRP protocol better in IPV6 than IPV4.
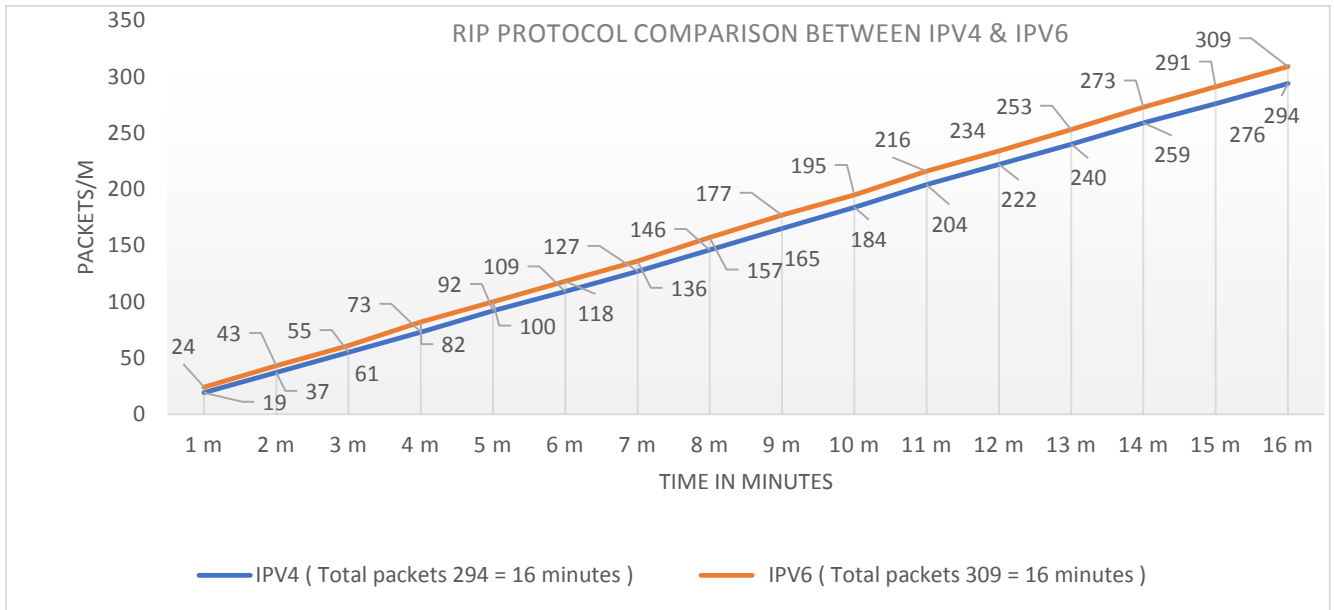
Fig 5.3.3: RIP protocol distinguishes between IP v4 & IP v6.

As view in figure 5.3.3 X axis explain time in minutes and Y axis explain no. of packets per minutes. As is observed if we take a specific time like 16 minutes then we can view that in this time 294 packets transfer in IPV4 where In IPV6 309 packets transfer for EIGRP protocol. So, said that in this time IPV6 better than IPV4 & EIGRP protocol better in IPV6 than IPV4.
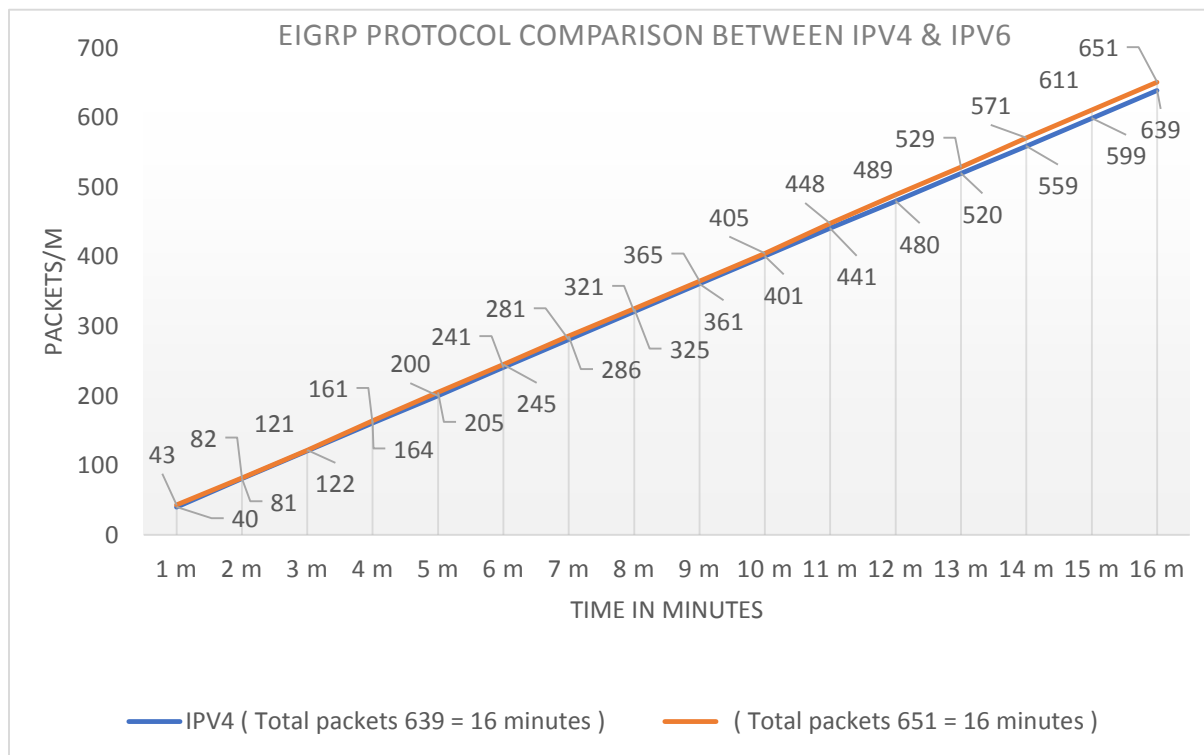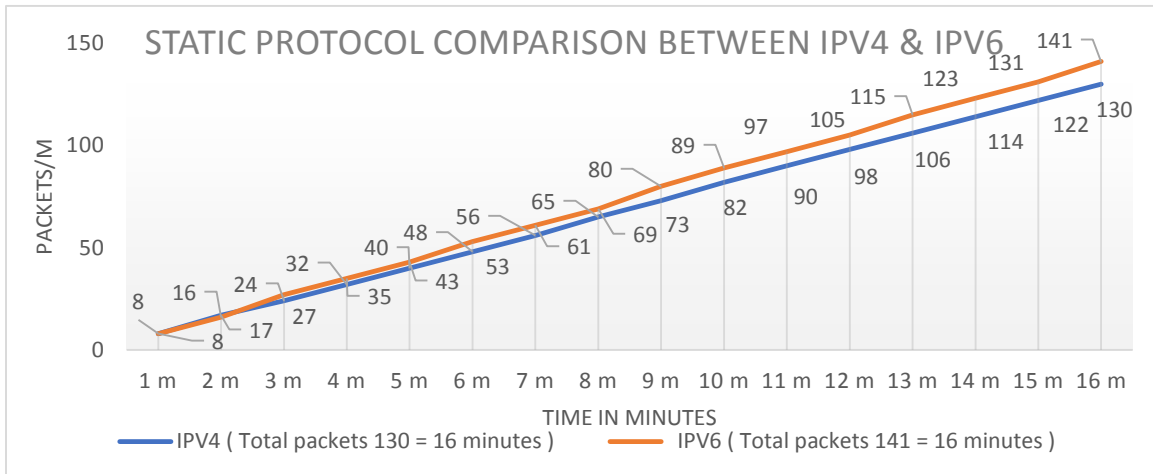
Fig 5.3.4: STATIC protocol distinguishes between IP v4 & IP v6.

As view in figure 5.3.4 X axis explain time in minutes and Y axis explain no. of packets per minutes. As is observed if we take a specific time like 16 minutes then we can view that in this time 130 packets transfer in IPV4 where In IPV6 141 packets transfer for EIGRP protocol. So, said that in this time IPV6 better than IPV4 & EIGRP protocol better in IPV6 than IPV4.
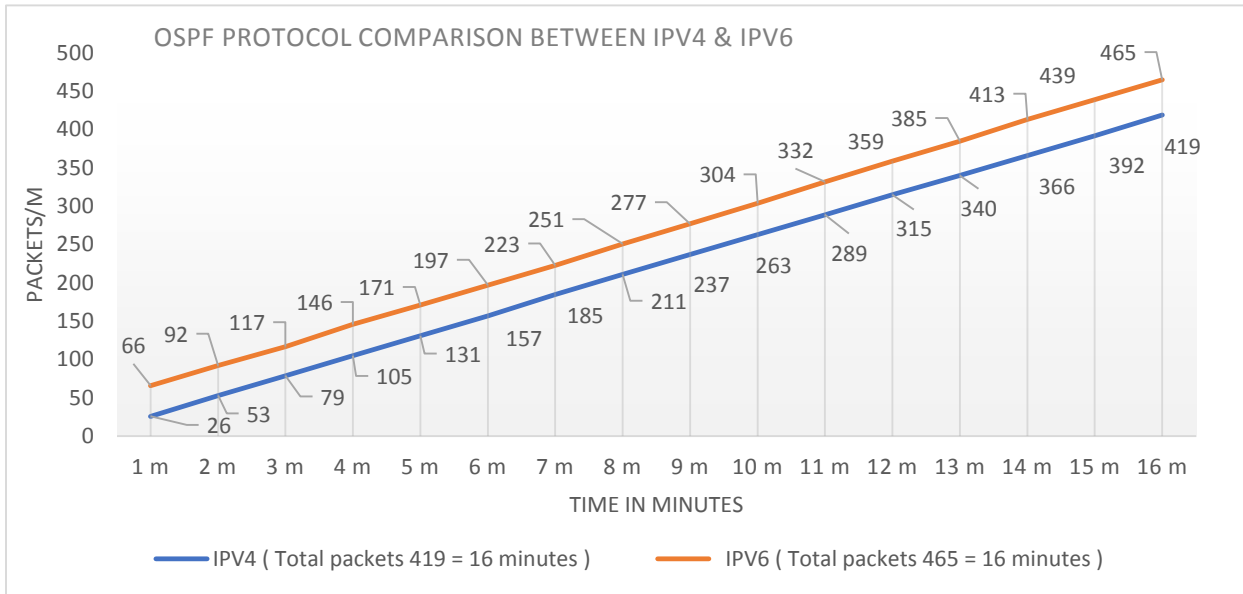
5.4 Protocol hierarchy Distinguish between IP V4 & IP V6.

Like as previous in this part we analyzing EIGRP, OSPF, RIP, STATIC protocol for IPV4 using Wireshark to analysis which protocol transfer more packets & based on the packets transformation make a hierarchy where hierarchy represent the protocol position top to down.
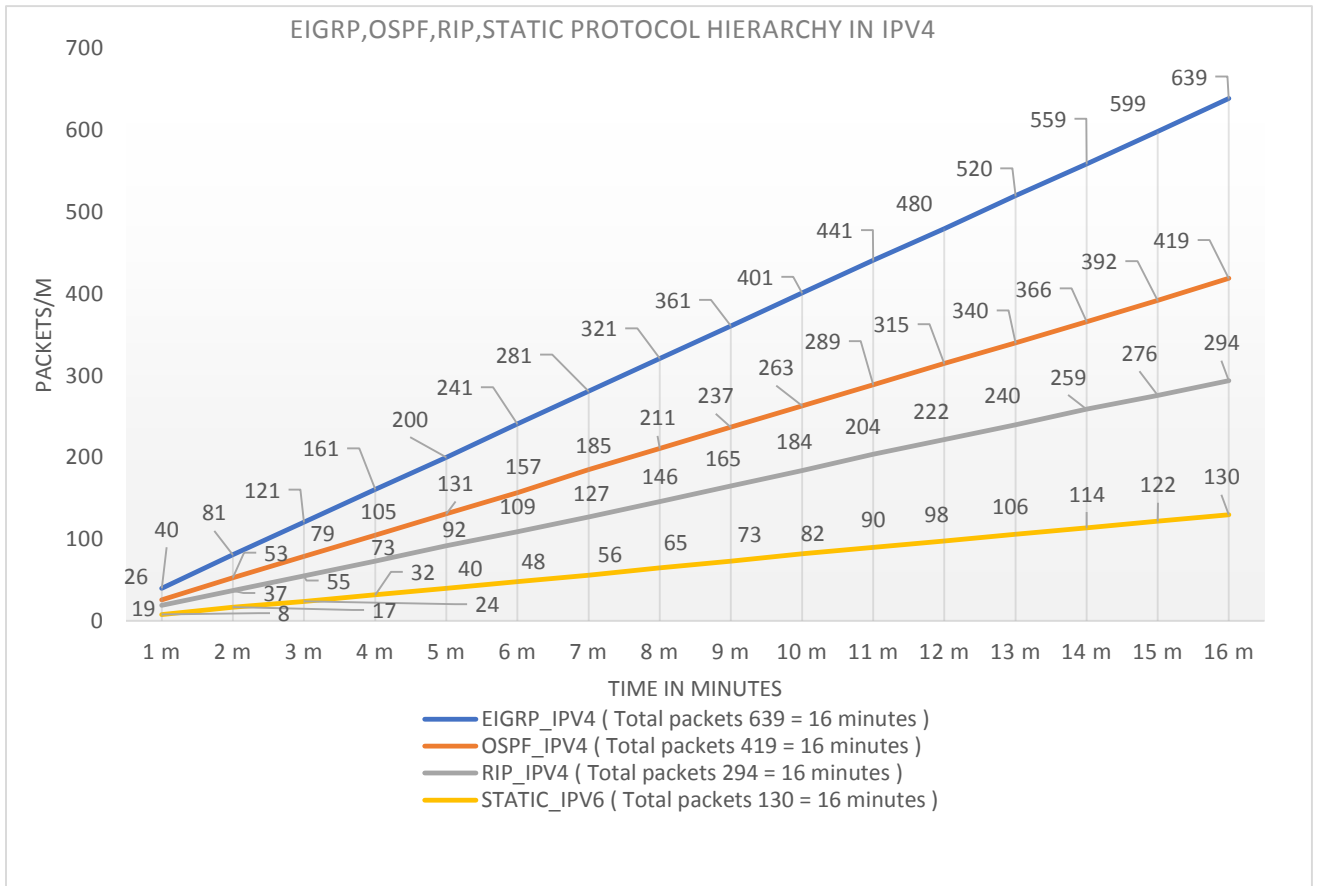
Fig 5.4.1: EIGRP, OSPF, RIP, STATIC protocol hierarchy in IPV4

As view in figure 5.4.1 X-axis explain time in minutes and Y-axis explain no. of packets per minutes. As is observed if we take a specific time like 16 minutes then we can view that in this time 639 packets transfer for EIGRP, 419 packets transfer for OSPF, 294 packets transfer for RIP, 130 packets transfer for STATIC protocols in IPV4. So, said that in this time which view in fig 5.4.1 hierarchy EIGRP is the 1st level protocol, OSPF is the 2nd level protocol, RIP is the 3rd level protocol & STATIC is the 4th level protocol in IPV4.
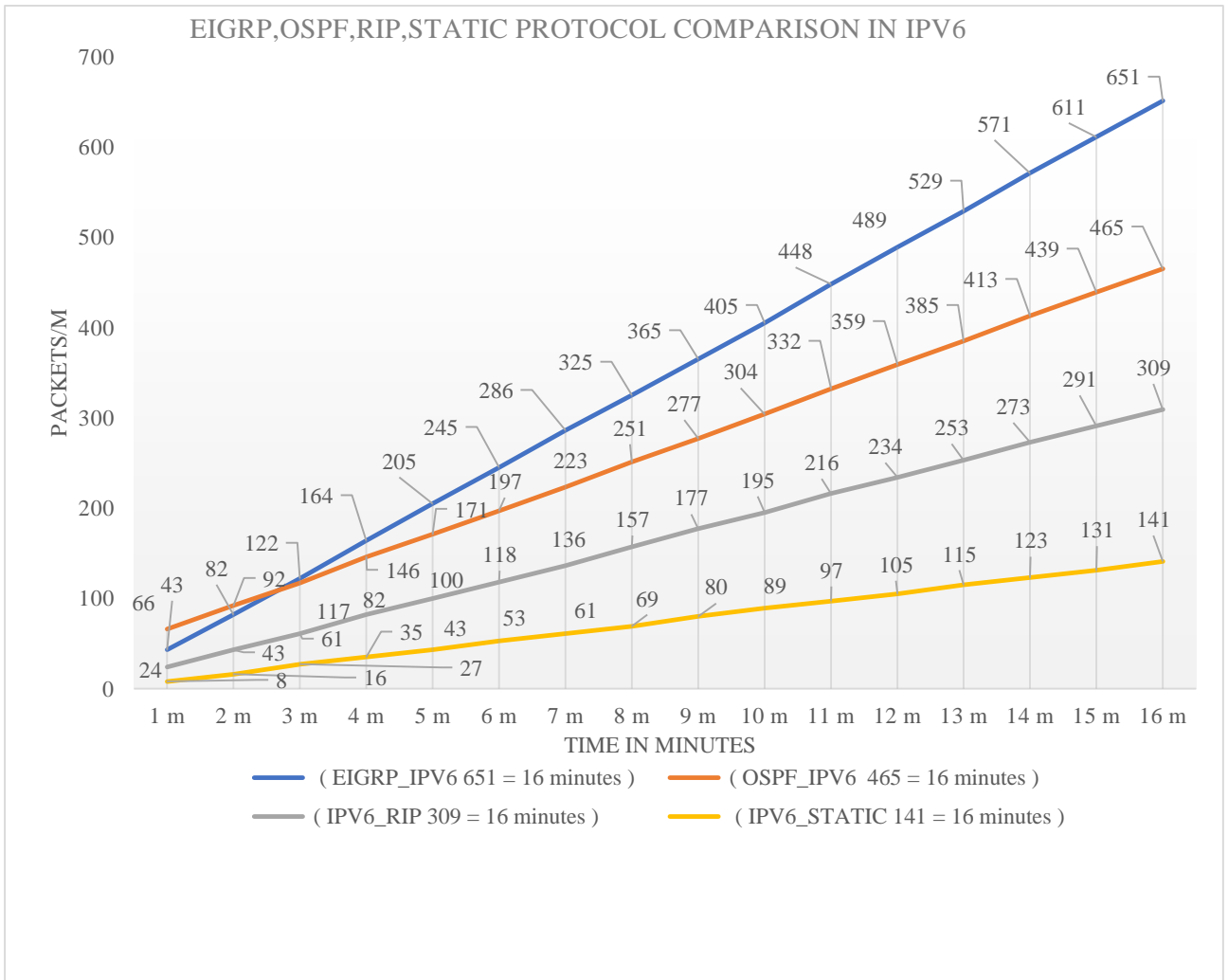
5.4.2 EIGRP, OSPF, RIP, STATIC protocol hierarchy in IPV6

As view in figure 5.4.2 X-axis explain time in minutes and Y-axis explain no. of packets per minutes. As is observed if we take a specific time like 16 minutes then we can view that in this time 651 packets transfer for EIGRP, 465 packets transfer for OSPF, 309 packets transfer for RIP, 141 packets transfer for STATIC protocols in IPV4. So said that in this time which view in fig 5.4.2 hierarchy EIGRP is the 1st level protocol, OSPF is the 2nd level protocol, RIP is the 3rd level protocol & STATIC is the 4th level protocol in IPV6.

CHAPTER 6
CONCLUSION

Now after our research and analysis on our project we have arrived in such a condition which shows us a way to conclude with some answers. First of all, we have done a project where we give some practical reasons why should we move on to IP V6 from IP V4. In 3 different categories we have proved the better performance of IP V6 than IP V4 practically. Also, our effort was to bring a new and more practical path to show the world what facilities we can get and how it should be good as we will be moving on to IP V6 after few years later from now. May be everyone has little bit knowledge and concept about it but in most of the cases that was just theoretically. But we have come forward to an idea to make it more practical to everyone to understand their concept or have practical knowledge about in which aspect or basis IP V6 is better than IP V4. Also in future through our research and analysis we can say an infinite possibilities will be remaining for us to research and analysis on security aspect and as we have researched and analyzed our project with limited resource, but in future there will be a possible way to test it in more larger area like from one continental to another across the world. That's way our project is unique and has possible spaces left for others to research more and try to find some good ways which may help the next generation technology to facilitate our way of communication.

APPENDIX
ROUTER TO ROUTER PACKET TRASFORMATION THROUGH REDISTRIBUTION (IPV4)

R1#en

R1#conf t

R1(config)#interface fastEthernet 0/1

R1(config-if)#ip address 10.1.1.1 255.0.0.0

R1(config-if)#no shut

R1(config-if)#

R1(config-if)#exit

R1(config)#interface fastEthernet 0/0

R1(config-if)#ip address 15.1.1.1 255.0.0.0

R1(config-if)#no shut

R1(config-if)#

R1(config-if)#exit

R1(config)#router rip

R1(config-router)#network 10.1.1.0

R1(config-router)#network 15.1.1.0

R1(config-router)#no auto-summary

R1(config-router)#exit

R1(config)#do wr

R2#en

R2#conf t

R2(config)#interface fastEthernet 0/1

R2(config-if)#ip address 10.1.1.2 255.0.0.0

R2(config-if)#no shut

R2(config-if)#

R2(config-if)#exit

R2(config)#interface serial 0/1

R2(config-if)#ip address 20.1.1.1 255.0.0.0

R2(config-if)#clock rate 64000

R2(config-if)#no shut

R2(config-if)#

R2(config-if)#exit

R2(config)#interface fastEthernet 0/0

R2(config-if)#ip address 25.1.1.1 255.0.0.0

R2(config-if)#no shut

R2(config-if)#

R2(config-if)#exit

R2(config)#router rip

R2(config-router)#network 10.1.1.0

R2(config-router)#network 20.1.1.0

R2(config-router)#network 25.1.1.0

R2(config-router)#no auto-summary

R2(config-router)#exit

R2(config)#do wr

R3#en

R3#conf t

Enter configuration commands, one per line. End with CNTL/Z.

R3(config)#interface fastEthernet 0/0

R3(config-if)#ip address 25.1.1.2 255.0.0.0

R3(config-if)#no shut

R3(config-if)#

R3(config-if)#exit

R3(config)#interface fastEthernet 0/1

R3(config-if)#ip address 30.1.1.1 255.0.0.0

R3(config-if)#no shut

R3(config-if)#

R3(config-if)#exit

R3(config)#router rip

R3(config-router)#network 25.1.1.0

R3(config-router)#network 30.1.1.0

R3(config-router)#no auto-summary

R3(config-router)#exit

R3(config)#do wr

R4#en

R4#conf t

R4(config)#interface fastEthernet 0/0

R4(config-if)#ip address 15.1.1.2 255.0.0.0

R4(config-if)#no shut

R4(config-if)#

R4(config-if)#exit

R4(config)#interface serial 0/0

R4(config-if)#ip address 35.1.1.1 255.0.0.0

R4(config-if)#clock rate 64000

R4(config-if)#no shut

R4(config-if)#

R4(config-if)#exit

R4(config)#router rip

R4(config-router)#network 15.1.1.0

R4(config-router)#network 35.1.1.0

R4(config-router)#no auto-summary

R4(config-router)#exit

R4(config)#do wr

R5#en

R5#conf t

R5(config)#interface fastEthernet 0/1

R5(config-if)#ip address 30.1.1.2 255.0.0.0

R5(config-if)#no shut

R5(config-if)#

R5(config-if)#exit

R5(config)#interface serial 2/0

R5(config-if)#ip address 40.1.1.1 255.0.0.0

R5(config-if)#clock rate 64000

R5(config-if)#no shut

R5(config-if)#

R5(config-if)#exit

R5(config)#router rip

R5(config-router)#network 30.1.1.0

R5(config-router)#network 40.1.1.0

R5(config-router)#no auto-summary

R5(config-router)#exit

R5(config)#do wr

R6#en

R6#conf t

R6(config)#interface serial 0/0

R6(config-if)#ip address 35.1.1.2 255.0.0.0

R6(config-if)#clock rate 64000

R6(config-if)#no shut

R6(config-if)#

R6(config-if)#exit

R6(config)#interface serial 0/1

R6(config-if)#ip address 20.1.1.2 255.0.0.0

R6(config-if)#clock rate 64000

R6(config-if)#no shut

R6(config-if)#

R6(config-if)#exit

R6(config)#interface serial 2/0

R6(config-if)#ip address 40.1.1.2 255.0.0.0

R6(config-if)#clock rate 64000

R6(config-if)#no shut

R6(config-if)#

R6(config-if)#exit

R6(config)#interface serial 2/1

R6(config-if)#ip address 45.1.1.1 255.0.0.0

R6(config-if)#clock rate 64000

R6(config-if)#no shut

R6(config-if)#

R6(config-if)#exit

R6(config)#interface serial 2/2

R6(config-if)#ip address 50.1.1.1 255.0.0.0

R6(config-if)#clock rate 64000

R6(config-if)#no shut

R6(config-if)#

R6(config-if)#exit

R6(config)#interface serial 2/3

R6(config-if)#ip address 55.1.1.1 255.0.0.0

R6(config-if)#clock rate 64000

R6(config-if)#no shut

R6(config-if)#

R6(config-if)#exit

R6(config)#router rip

R6(config-router)#network 35.1.1.0

R6(config-router)#network 20.1.1.0

R6(config-router)#network 40.1.1.0

R6(config)#router eigrp 100

R6(config-router)#network 45.1.1.0 0.255.255.255

R6(config-router)#network 50.1.1.0 0.255.255.255

R6(config-router)#network 55.1.1.0 0.255.255.255

R6(config-router)#no auto-summary

R6(config)#router eigrp 100

R6(config-router)#redistribute rip metric 1 1 1 1 1

R6(config-router)#exit

R6(config)#router rip

R6(config-router)#redistribute eigrp 100 metric 5

R6(config-router)#exit

R6(config)#do wr

R7#en

R7#conf t

R7(config)#int

R7(config)#interface se

R7(config)#interface serial 2/1

R7(config-if)#ip address 45.1.1.2 255.0.0.0

R7(config-if)#clock rate 64000

R7(config-if)#no shut

R7(config-if)#exit

R7(config)#interface fastEthernet 0/0

R7(config-if)#ip address 60.1.1.1 255.0.0.0

R7(config-if)#no shut

R7(config-if)#exit

R7(config)#router eigrp 100

R7(config-router)#network 45.1.1.0 0.255.255.255

R7(config-router)#network 60.1.1.0 0.255.255.255

R7(config-router)#no auto-summary

R7(config-router)#exit

R8#en

R8#conf t

R8(config)#interface serial 2/3

R8(config-if)#ip address 55.1.1.2 255.0.0.0

R8(config-if)#clock rate 64000

R8(config-if)#no shut

R8(config-if)#exit

R8(config)#interface fastEthernet 0/1

R8(config-if)#ip address 65.1.1.1 255.0.0.0

R8(config-if)#no shut

R8(config-if)#exit

R8(config)#router eigrp 100

R8(config-router)#network 55.1.1.0 0.255.255.255

R8(config-router)#network 65.1.1.0 0.255.255.255

R8(config-router)#no auto-summary

R8(config-router)#exit

R9#en

R9#conf t

R9(config)#interface fastEthernet 0/0

R9(config-if)#ip address 60.1.1.2 255.0.0.0

R9(config-if)#no shut

R9(config-if)#exit

R9(config)#interface fastEthernet 0/1

R9(config-if)#ip address 70.1.1.1 255.0.0.0

R9(config-if)#no shut

R9(config-if)#exit

R9(config)#router eigrp 100

R9(config-router)#network 60.1.1.0 0.255.255.255

R9(config-router)#network 70.1.1.0 0.255.255.255

R9(config-router)#no auto-summary

R9(config-router)#exit

R10#en

R10#conf t

R10(config)#interface fastEthernet 0/1

R10(config-if)#ip address 70.1.1.2 255.0.0.0

R10(config-if)#no shut

R10(config-if)#exit

R10(config)#interface serial 2/2

R10(config-if)#ip address 50.1.1.2 255.0.0.0

R10(config-if)#clock rate 64000

R10(config-if)#no shut

R10(config-if)#exit

R10(config)#interface fastEthernet 0/0

R10(config-if)#ip address 75.1.1.1 255.0.0.0

R10(config-if)#no shut

R10(config-if)#exit

R10(config)#router eigrp 100

R10(config-router)#network 50.1.1.0 0.255.255.255

R10(config-router)#network 70.1.1.0 0.255.255.255

R10(config-router)#network 75.1.1.0 0.255.255.255

R10(config-router)#no auto-summary

R10(config-router)#exit

R11#en

R11#conf t.

R11(config)#interface fastEthernet 0/0

R11(config-if)#ip address 75.1.1.2 255.0.0.0

R11(config-if)#no shut

R11(config-if)#exit

R11(config)#interface fastEthernet 0/1

R11(config-if)#ip address 65.1.1.2 255.0.0.0

R11(config-if)#no shut

R11(config-if)#exit

R11(config)#router eigrp 100

R11(config-router)#network 75.1.1.0 0.255.255.255

R11(config-router)#network 65.1.1.0 0.255.255.255

R11(config-router) #no auto-summary

R11(config-router)#exit

APPENDIX

ROUTER TO ROUTER PACKET TRANSFORMATION
THROUGH REDISTRIBUTION (IPV6)

R1#en

R1#conf t

R1(config)#ipv6 unicast-routing

R1 (config)#interface fastEthernet 0/1

R1 (config-if)#ipv6 address 2001::1/64

R1 (config-if)#no shut

R1 (config-if)#exit

R1 (config)#interface fastEthernet 0/0

R1 (config-if)#ipv6 address 2002::1/64

R1 (config-if)#no shut

R1 (config-if)#exit

R1 (config-if)#exit

R1 (config)#ipv6 router rip NTIC

R1 (config-rtr)#exit

R1 (config)#interface fastEthernet 0/1

R1 (config-if)#ipv6 rip NTIC enable

R1 (config-if)#exit

R1 (config)#interface fastEthernet 0/0

R1 (config-if)#ipv6 rip NTIC enable

R1 (config-if)#exit

R2 #en

R2 #conf t

R2 (config)#ipv6 unicast-routing

R2 (config)#interface fastEthernet 0/1

R2 (config-if)#ipv6 address 2001::2/64

R2 (config-if)#no shut

R2 (config-if)#exit

R2 (config)#interface serial 0/1

R2 (config-if)#ipv6 address 2003::1/64

R2 (config-if)#clock rate 64000

R2 (config-if)#no shut

R2 (config-if)#exit

R2 (config)#interface fastEthernet 0/0

R2 (config-if)#ipv6 address 2004::1/64

R2 (config-if)#no shut

R2 (config-if)#exit

R2 (config-if)#exit

R2 (config)#ipv6 router rip NTIC

R2 (config-rtr)#exit

R2 (config)#interface fastEthernet 0/1

R2 (config-if)#ipv6 rip NTIC enable

R2 (config-if)#exit

R2 (config)#interface serial 0/1

R2 (config-if)#ipv6 rip NTIC enable

R2 (config-if)#exit

R2 (config)#interface fastEthernet 0/0

R2 (config-if)#ipv6 rip NTIC enable

R2 (config-if)#exit

R3#en

R3#conf t

R3 (config)#ipv6 unicast-routing

R3 (config)#interface fastEthernet 0/0

R3 (config-if)#ipv6 address 2004::2/64

R3 (config-if)#no shut

R3 (config-if)#exit

R3 (config)#interface fastEthernet 0/1

R3 (config-if)#ipv6 address 2005::1/64

R3 (config-if)#no shut

R3 (config-if)#exit

R3 (config)#ipv6 router rip NTIC

R3 (config-rtr)#exit

R3 (config)#interface fastEthernet 0/0

R3 (config-if)#ipv6 rip NTIC enable

R3 (config-if)#exit

R3 (config)#interface fastEthernet 0/1

R3 (config-if)#ipv6 rip NTIC enable

R3 (config-if)#exit

R4 #en

R4 #conf t

R4 (config)#ipv6 unicast-routing

R4 (config)#interface fastEthernet 0/0

R4 (config-if)#ipv6 address 2002::2/64

R4 (config-if)#no shut

R4 (config-if)#exit

R4 (config)#interface serial 0/0

R4 (config-if)#ipv6 address 2006::1/64

R4 (config-if)#clock rate 64000

R4 (config-if)#no shut

R4 (config-if)#exit

R4 (config)#ipv6 router rip NTIC

R4 (config-rtr)#exit

R4 (config)#interface fastEthernet 0/0

R4 (config-if)#ipv6 rip NTIC enable

R4 (config-if)#exit

R4 (config)#interface serial 0/0

R4 (config-if)#ipv6 rip NTIC enable

R4 (config-if)#exit

R5 #en

R5 #conf t

R5 (config)#ipv6 unicast-routing

R5 (config)#interface fastEthernet 0/1

R5 (config-if)#ipv6 address 2005::2/64

R5 (config-if)#no shut

R5 (config-if)#exit

R5 (config)#interface serial 2/0

R5 (config-if)#ipv6 address 2007::1/64

R5 (config-if)#clock rate 64000

R5 (config-if)#no shut

R5 (config-if)#exit

R5 (config)#ipv6 router rip NTIC

R5 (config-rtr)#exit

R5 (config)#interface fastEthernet 0/1

R5 (config-if)#ipv6 rip NTIC enable

R5 (config-if)#exit

R5 (config)#interface serial 2/0

R5 (config-if)#ipv6 rip NTIC enable

R5 (config-if)#exit

R6 #en

R6 #conf t

R6 (config)#interface serial 0/0

R6 (config-if)#ipv6 address 2006::2/64

R6 (config-if)#clock rate 64000

R6 (config-if)#no shut

R6 (config-if)#exit

R6 (config)#interface serial 0/1

R6 (config-if)#ipv6 address 2003::2/64

R6 (config-if)#clock rate 64000

R6 (config-if)#no shut

R6 (config-if)#exit

R6 (config)#interface serial 2/0

R6 (config-if)#ipv6 address 2007::2/64

R6 (config-if)#clock rate 64000

R6 (config-if)#no shut

R6 (config-if)#exit

R6 (config)#interface serial 2/1

R6 (config-if)#ipv6 address 2008::1/64

R6 (config-if)#clock rate 64000

R6 (config-if)#no shut

R6 (config-if)#exit

R6 (config)#interface serial 2/2

R6 (config-if)#ipv6 address 2009::1/64

R6 (config-if)#clock rate 64000

R6 (config-if)#no shut

R6 (config-if)#exit

R6 (config)#interface serial 2/3

R6 (config-if)#ipv6 address 2010::1/64

R6 (config-if)#clock rate 64000

R6 (config-if)#no shut

R6 (config)#ipv6 router rip NTIC

R6 (config-rtr)#exit

R6 (config)#interface serial 0/0

R6 (config-if)#ipv6 rip NTIC enable

R6 (config-if)#exit

R6 (config)#interface serial 0/1

R6 (config-if)#ipv6 rip NTIC enable

R6 (config-if)#exit

R6 (config)#interface serial 2/0

R6 (config-if)#ipv6 rip NTIC enable

R6 (config-if)#exit

R6(config)#ipv6 router eigrp 100

R6(config-rtr)#router-id 1.1.1.1

R6(config-rtr)#no shut

R6(config)#interface serial 2/1

R6(config-if)#ipv6 eigrp 100

R6(config-if)#int serial 2/2

R6(config-if)#ipv6 eigrp 100

R6(config-if)#int serial 2/3

R6(config-if)#ipv6 eigrp 100

R6(config)#ipv6 router rip NTIC

R6(config-if)#redistribute eigrp 100 include-connected metric 8

R6(config-if)#redistribute connected metric 8

R6(config-if)#exit

R6(config)#ipv6 router eigrp 100

R6(config-if)#redistribute rip NTIC include-connected metric 1000 0 255 1 1500

R6(config-if)#redistribute connected metric 1000 0 255 1 1500

R7#en

R7#conf t

R7 (config)#ipv6 unicast-routing

R7 (config)#interface serial 2/1

R7 (config-if)#ipv6 address 2008::2/64

R7 (config-if)#no shut

R7 (config-if)#exit

R7 (config)#

R7 (config)#interface fastEthernet 0/0

R7 (config-if)#ipv6 address 2011::1/64

R7 (config-if)#no shut

R7 (config-if)#exit

R7 (config)#ipv6 router eigrp 100

R7 (config-rtr)#router-id 2.2.2.2

R7 (config-rtr)#no shut

R7 (config)#interface serial 2/1

R7 (config-if)#ipv6 eigrp 100

R7 (config-if)#int f0/0

R7 (config-if)#ipv6 eigrp 100

R8#en

R8#conf t

R8 (config)#ipv6 unicast-routing

R8 (config)#interface serial 2/3

R8 (config-if)#ipv6 address 2010::2/64

R8 (config-if)#no shut

R8 (config-if)#exit

R8 (config)#interface fastEthernet 0/1

R8 (config-if)#ipv6 address 2012::1/64

R8 (config-if)#no shut

R8 (config-if)#exit

R8 (config)#ipv6 router eigrp 100

R8 (config-rtr)#router-id 3.3.3.3

R8 (config-rtr)#no shut

R8 (config)#interface serial 2/3

R8 (config-if)#ipv6 eigrp 100

R8 (config-if)#int f0/1

R8 (config-if)#ipv6 eigrp 100

R9#en

R9#conf t

R9 (config)#ipv6 unicast-routing

R9 (config)#interface fastEthernet 0/0

R9 (config-if)#ipv6 address 2011::2/64

R9 (config-if)#no shut

R9 (config-if)#exit

R9 (config)#interface fastEthernet 0/1

R9 (config-if)#ipv6 address 2013::1/64

R9 (config-if)#no shut

R9 (config-if)#

R9 (config-if)#exit

R9 (config)#ipv6 router eigrp 100

R9 (config-rtr)#router-id 4.4.4.4

R9 (config-rtr)#no shut

R9 (config-if)#int f0/0

R9 (config-if)#ipv6 eigrp 100

R9 (config-if)#int f0/1

R9 (config-if)#ipv6 eigrp 100

R10#en

R10#conf t

R10 (config)#ipv6 unicast-routing

R10 (config)#interface fastEthernet 0/1

R10 (config-if)#ipv6 address 2013::2/64

R10 (config-if)#no shut

R10 (config-if)#exit

R10 (config)#interface serial 2/2

R10 (config-if)#ipv6 address 2009::2/64

R10 (config-if)#no shut

R10 (config-if)#exit

R10 (config)#interface fastEthernet 0/0

R10 (config-if)#ipv6 address 2014::1/64

R10 (config-if)#no shut

R10 (config-if)#exit

R10 (config)#ipv6 router eigrp 100

R10 (config-rtr)#router-id 5.5.5.5

R10 (config-rtr)#no shut

R10 (config-if)#int f0/0

R10 (config-if)#ipv6 eigrp 100

R10 (config)#interface serial 2/2

R10 (config-if)#ipv6 eigrp 100

R10 (config-if)#int f0/1

R10 (config-if)#ipv6 eigrp 100

R11#en

R11#conf t.

R11 (config)#ipv6 unicast-routing

R11 (config)#interface fastEthernet 0/0

R11 (config-if)#ipv6 address 2014::2/64

R11 (config-if)#no shut

R11 (config-if)#exit

R11 (config)#interface fastEthernet 0/1

R11 (config-if)#ipv6 address 2012::2/64

R11 (config-if)#no shut

R11 (config-if)#exit

R11 (config)#ipv6 router eigrp 100

R11 (config-rtr)#router-id 6.6.6.6

R11 (config-rtr)#no shut

R11 (config-if)#int f0/0

R11 (config-if)#ipv6 eigrp 100

R11 (config-if)#int f0/1

R11 (config-if)#ipv6 eigrp 100

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