Performance Analysis of IPv6 vs IPv4 Using Dynamic routing OSPF

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

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APPROVAL

This Project titled "Performance Analysis of IPv6 vs IPv4 Using Dynamic Routing OSPF", submitted by Abu Nowshad Rasel ID: 161-15-6861 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 B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on July 09, 2020

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DECLARATION

I hereby declare that, this project has been done by me under the supervisor of **Mr. Narayan Ranjan Chakraborty, Assistant Professor and Department of CSE** daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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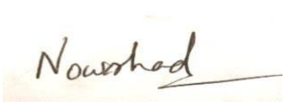

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ABSTRACT

Most specifically, digital networks are gradually being introduced, with many industries now depending on the Internet Protocol to offer direct connectivity to customers whenever and wherever they might be. IP is currently used in vital areas such as telemedicine, video control, telepresence, electronic payment and so on. IP resides in version 4 (IPv4) and version 6 (IPv6), which defines the distinction between those two protocols in terms of features, service and performance. IPv4 is almost running out of companies and they are finally switching to IPv6. IPv6 has more Ip addresses than IPv4. IPv4 is 32-bit and IPv6 is 128-bit. IPv6 is more secure than IPv4. In this paper, I will assess and examine the efficacy of the two IPv4 and IPv6 protocols in collaborative business networks. The research will be performed utilizing the OSPF vector routing protocol.

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CHAPTER 1

Indication

1.1Indication

The internet networks have been introduced more and more lately and both industries now depend on the Internet Protocol interface to offer direct connectivity to customers, wherever at every time. In critical fields such as telemedicine, remote sensing, telepresence, online payments, etc., IP is currently active. IP is usable in two variants 4 (IPv4) and 6 (IPv6), the distinction in functionality, application and efficiency of these two protocols is distinctive. The performance of the IPv4 and IPv6 protocols on communications networks will be calculated and analyzed in this paper.

Dynamic routing is a networking technique that offers optimized routing of the files. Dynamic routing, unlike static routing, enables routers to choose paths due to modifications to the logical network structure in real time. Dynamic routing takes advantage of many algorithms and protocols. The most popular are OSPF (Open Shortest Path First) routing. Dynamic routing protocols enable routers to exchange network details with other routers so they can choose the right route to reach a destination.

1.2 Inspiration

Also known as adaptive routing is dynamic routing which changes the routing table according to topology shift. Dynamic routing requires routing details to be shared if the network undergoes a topology transition. It is less susceptible to errors than static routing. Requires scalability, as operating overheads are less involved. As the network change(topology) happens, the notification is transmitted to the router to ensure the modifications are recalculated for modified routing details to be submitted.

IP exists in version 4 and version 6. Those are known as IPv4 and IPv6. Distinguishing the difference between these two protocols in terms of features, operation, and performance. Within this report we should assess and analyze the efficiency of the two protocols IPv4 and IPv6 in the interacting business networks. The analysis is carried out by changing the OSPFv3 routing protocols.

1.3 Objectives

• The key purpose of this project is to build an OSPFv3 campus network
• To compare between IPv4 and IPv6 versions

1.4 Expected Outcome

As the Internet gradually switches to IPv6, the routing protocols used to forward traffic around this global network need to change to accommodate this incremental move. In this project the usage of ipv6 would be seen to be more successful than ipv4. While ipv4 today uses allover, ipv6 is the future, since it has more IP address than ipv4. I will be showing in this project how ipv6 is better than IPv4.

1.5 Report Layout

Chapter 1: Introduction- The description, inspiration, expectations and planned result of the project work that we had written here and the style of the paper.
Chapter 2: History- The following part deals with the history condition of our job we did. I also received project literature analysis, Quantitative tests, and device checking.
Chapter 3: Design specification- All design specification is covered in this chapter. Beside that I introduced in this chapter the machine architecture.

Chapter 4: Implementation and Testing - All the experimental outcomes obtained by the suggested programs are addressed in this chapter along with the introduction review, and a description of the outcome is provided.

Chapter 5: Impact on Society, Environment and Sustainability - The following chapter is all the effects of our research that I have performed on community and the environmental condition.

Chapter 6: Conclusion and Future Scope - The End of the Topic and End Section and the Inference Suggestions of Further Research on this subject in this portion.

Chapter 2

Background

2.1 Insertion

The OSPF (Open Shortest Route First) protocol is one of a family of IP Routing protocols and is an Internet Interior Gateway Protocol (IGP), used to spread IP routing details through an IP network via a single Autonomous Device (AS).

The OSPF protocol is regarded as the link-state routing protocol, meaning that routers exchange topology information with their closest neighbors. Throughout the AS topology knowledge is filled, so that any router inside the AS has a full AS topology image. This picture is then used to calculate end-to - end paths across the AS, usually utilizing the Dijkstra variant of the algorithm. The next hop address to which data is forwarded in a link-state routing protocol is then determined by choosing the fastest end-to - end path to the final destination.

2.2 Related Works

Open Shortest Path First, is a link-state protocol based on three tables in order to achieve the convergence state: the neighboring table, the topology table, and the routing table. The adjacent table includes routers and their functions explicitly linked by the identifier. The topology table includes the complete layout of the network including all possible ways to access all destinations. The routing chart, which includes only the safest way to reach a given destination, based on the cost metric.

OSPF for (OSPFv2) IPv4 or (OSPFv3) IPv6have the same operating principle, the network is structured as multiple areas, the backbone area (Area 0) and the standard area (Area> 0) Two typical locations can only connect via a backbone region, or through virtual ties. The option of a specified router and Backup is performed by region in a broadcast or multi-access network, and the option is rendered according to the highest priority or router Id.

Narula, R & Pallavi. [1] Routing relates to the most powerful form of transfer of information packets from source to destination and is often based on routing protocols. The routing protocols field unites the set of rules through which the networking network applies as computers attempt to connect with each other through networks and the connection between 2 routing protocols focuses on the routing law that is solely based on the metrics to look for the data transmission route of both networks. The routing protocols use the sequence number to store the results of these criteria. And we get two types of routing protocols, (1) Interior Gateway Protocol (IGP) and the (2) Exterior Gateway Protocol. RIP, OSPF, EIGRP field unit most widely used IGPs and the standard EGP is the BGP (Border Gateway Protocol)

Ahmed M, Litchfield T, Alan, Ahmed, S,[2]. The need to implement IPv6 has prompted the programming community to look at the latest IP update. Extensive work relevant to the IPv4-IPv6 switch has investigated the actions of users utilizing IPv6. While the change from IPv4 to IPv6 is unavoidable, the evolution of the current 'Net' definition and its related implementations will function in the modern environment. Replacing IPv4 with IPv6 is unavoidable and thus that is the suitability of IPv6 applications. It points out the need to research the output of IPv6 applications actually operating on IPv4. The study 's importance is twofold: it can help assess the suitability of a current program to be introduced under IPv6, and the degree of modifications required to render a program compliant with communication networks dependent on IPv6. Considering the importance of Voice over Internet Protocol (VoIP), attention should be given to the appropriateness of VoIP implementation in IPv6-based networks.

Al-Ani, D. R., & Al-Ani, A. R. (2018) [3]. IP (Internet Protocol) has been manipulated with the Internet's popularity in a number of sciences and disciplines that are limited by stability, availability, and real-time processing. Through linking all kinds of artifacts, the IP protocol has provided unprecedented versatility, thus the modern Internet of Things (IoT) network, this system utilizes sensors to track a vast volume of data to controllers. IP operates in two variants, version 4 (IPv4) and version 6 (IPv6), the latter is the most powerful in the telecommunications industry given its many vulnerabilities. Such vulnerabilities may be listed on many levels, we primarily quote protection order, i.e. IPv4 does not have confidentiality, privacy and authentication protocols by default, the usage of IPsec protocol is optional. IPv4 suffers mostly from the depletion of the address set, with the IoT infrastructures, the addresses are no longer adequate, but with the NAT mechanisms we can answer this question more or less, but in short. IPv6 provides a significantly wider address space than IPv4 for 128-bit instead of 32-bit addresses (nearly 100 trillion times more), and this vast number of addresses allows for more consistency when assigning addresses. IPv6's advantages are numerous but with a fairly complex addressing scheme compared to IPv4, the IPv6 address management stateless self-configuration system is a significant simplification compared to IPv4.

Whitefield, R.J & Zhu, S.Y(2015) [4] As the net slowly transitions towards IPv6, the routing protocols that area unit won't to forward traffic across this international network should adapt to support this gradual transition. 2 of the foremost often mentioned interior dynamic routing protocols nowadays area unit the IETF’s OSPF and Cisco’s EIGRP routing protocol. A wealth of papers had compared OSPF and EIGRP in terms of converge times and resource usage, but few papers have assessed the performance of every once implementing their various security mechanisms. So, a comparison of OSPFv3 and EIGRPv6 are going to be conducted victimization dedicated Cisco hardware. This paper can first introduce every protocol and its security mechanisms, before conducting a comparison of OSPFv3 and EIGRPv6 victimization Cisco instrumentation. once discussing the simulation results, a conclusion is going to be drawn to reveal the findings of this paper and that protocol performs the simplest upon implementing their various security mechanisms at intervals a little IPv6 enterprise network.

Mohamed, H. H. A. (2018).[5] Real time applications over science network became wide utilized in totally different fields; video conference, on-line academic lectures, on-line decision, on-line games and IP-TV. the aim of this study is to look at and analyze the impact of science networks parameters;

delay, jitter, and packet loss on the performance of period of time traffic “VOIP” sent across totally different science networks; IPv6, sciencev4 and compare the behavior of period of time traffic packets over IP networks. Experiments has been meted out in real in operation networks environment: epitome take a look at network, Ideal in operation network setting

“controlled”, real in operation network setting (University of Sudan- Dual-Stack) and real in operation network setting (Khartoum University- Dual-Stack). Victimization Phone lite application to get real time traffic information between client’s hosts over science (IPv4/IPv6) network. Examining delay, jitter, and packet loss for various packet sizes by victimization wire shark application and the way these parameters will have an effect on quality of real time traffic. contrary expectations; results showed that the IPv4 network had a lower Delay and lower noise than IPv6 network. that's in all probability as a result of IPv4 includes a lower overhead than IPv6 thus take less information measure to send the payload. IPv4 network had higher packet loss than IPv6 network. Results obtained from this analysis could encourage researchers within the field to seek out solutions to issues of period of time traffic problems associated with migration to IPv6.

2.3 Comparison Studies

The launch of IPv6 internet VoIP technologies is intended to run on IPv6 networks. However, the IPv4 to IPv6 transition is likely to proceed for several years owing to the wide base of IPv4 networks installed and the high costs involved in the move. Connecting to a variety of IPv6 networks will only be feasible during this period having sufficient IPv4 connections. The suggested intermediate solution to resolve this problem is 6 to 4 encoding, which integrates IPv4 encryption. The IPsec will be stored in it. IPv6 makes it easier to route worldwide than IPv4.Resource and recollection effects fewer, that will help boost efficiency and make it more effective. End-to-end authentication is provided by encryption implemented into IPv6. The addition of the traffic form flag set in IPv6 helps to offer priority to traffic with QOS from 0-7. This would ease pollution back. The flow mark of 20 bits is the norm of service. The 16-bit payload length is used to measure the data duration and is capable of transmitting up to 64 KB.

Table 1. IPv4 versus IPv6

Criteria	IPv4	IPv6
Standard	IETF1974	IETF1998
Addressing	32bit	128bit
IPsec	Optional	Mandatory
Flow	No	Packet Flow Label
Options	Yes	No

2.4 Challenges

We faced some problem when I was implementing my project

- GNS3 is required for the virtual network implementation which is hard to get some times
- Virtual machine was needed (normal computers memory and CPU can't take the load)
- VM was not working with upper or lower version of GNS3
- If I switched to the newer version of GNS3, the project couldn't able to run

Chapter 3

Specification of Design

3.1 Design of Front-end

In order to implement this project, we need the Router IOS file and we use the Router IOS 3725 for ipv4 and 7200 for ipv6. We do need VPC and switches.

The R1, R2, R3, R4, R5 routers are interconnected in sequence. They are classified as main routers for connecting via their protocol address with other routers. They are connected to fast-ethernet (f/0, f/1, f/2) with switches and there are ethernet networks between the pc and switches.

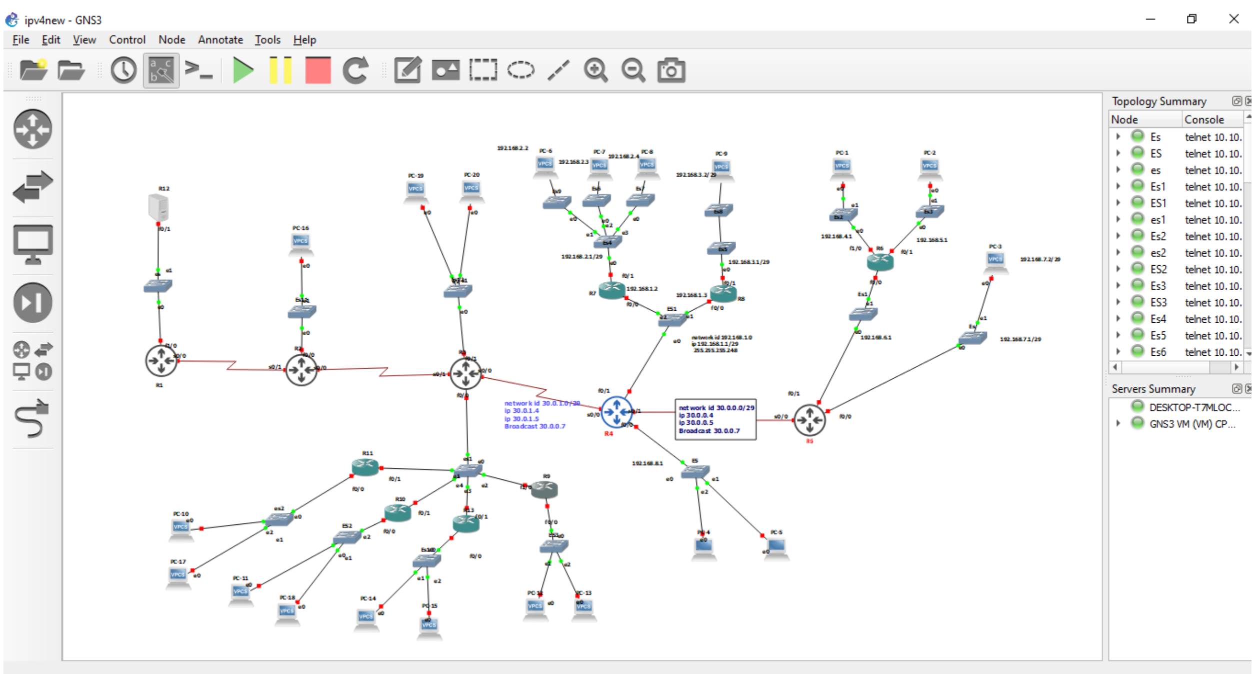

Fig 3.1 Implementation of ipv4 with OSPF

3.2 Design of Back-end

We need to have IP address and protocols to allow connections between routers. So, now we need to go to the router console to assign the commands to IP and protocols. Before that, I need to start the routers, and then we need to activate them in the console.

We need to customize the IP address and other device parameters before we can properly use them for routing. API mode is used for assigning an IP address and other parameters. We may reach the GUI feature from the global setup screen. For entering the global configuration to enable the function the following commands are used.

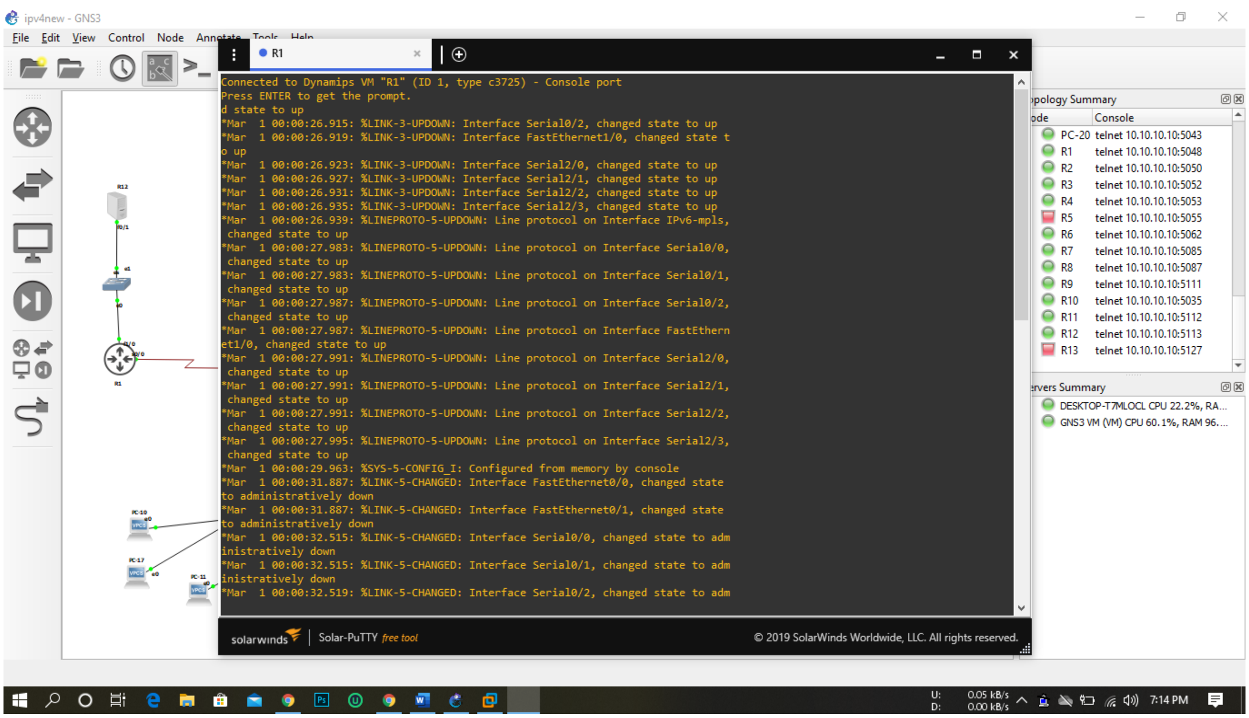

Fig 3.2 Backend design of IPV4 with OSPF

#Router>> enable.

#Router>> config terminal.

Enter configuration commands, or end with CNTL/Z

#Router>>(config)#

We will reach the GUI mode from the global configuration screen. We will customize the GUI from there. The following commands should grant an IP address to FastEthernet1/0 and FastEthernet1/1**.**

#Router(config)>> int f1/0

#Router(config-if)>> IP address 192.168.1.1 255.255.255.252

#Router(config-if)>> no shut

#Router(config-if)>> exit

#Router(config)>>

#Router(config)>> int f1/1

#Router(config-if)>> IP address 192.168.1.2 255.255.255.252

#Router(config-if)>> no shut

#Router(config-if)>> exit

#Router(config)>>

Here, **Interface Fast-ethernet 0/1** is used to enter the interface mode of the router.

Next, I need to set the IP address of the interface, **IP address** 192.168.1.1 255.255.255.252.

Then need to put command **no shutdown** for keep the interface up.

exit is for returning in global configuration mode.

#Router(config)>> int f0/0

#Router(config-if)>> IP address 192.168.2.1 255.255.255.252

#Router(config-if)>> no shut

#Router(config-if)>> exit

#Router(config)>>

#Router(config)>> int f0/1

#Router(config-if)>> IP address 192.168.1.2 255.255.255.252

#Router(config-if)>> no shut

#Router(config-if)>> exit

Router#(configure) Command is used to enter in global configuration mode.

Router#(config) **#**interface serial 0/1 is used to enter in interface mode.

Router# (config-if) **#**ip address 192.168.1.2 255.255.255.252 is IP address to interface and for serial link I used IP address for /29 subnet.

Configuring the OSPF routing protocol process

After assigning the IP address I need to configure the routing protocol OSPF

#Router(config)>> router OSPF 10

#Router(config)>> network address

#Router(config)>>

#Router(config) >> Router OSPF >This instruction triggers the OSPF routing protocol on the router. The identifying method is a positive integer. That could be used any number from 1 to 100. Method is locally important. There are many OSPF processes that can be run on the same router. Method ID is used to differentiate amongst themselves. And not all routers need to match Server IDs.

#router(config-router)>> IP and mask the Network command lets us identify the interfaces the we would like to use in OSPF.

3.3 Interface Design and Experience of user

I need to update GNS3 first. I'm going to operate my project within the GNS3. But the project is big for normal CPU and memory, so I need to use VM (virtual machine). VM is going to support her fly with her cup and brain.

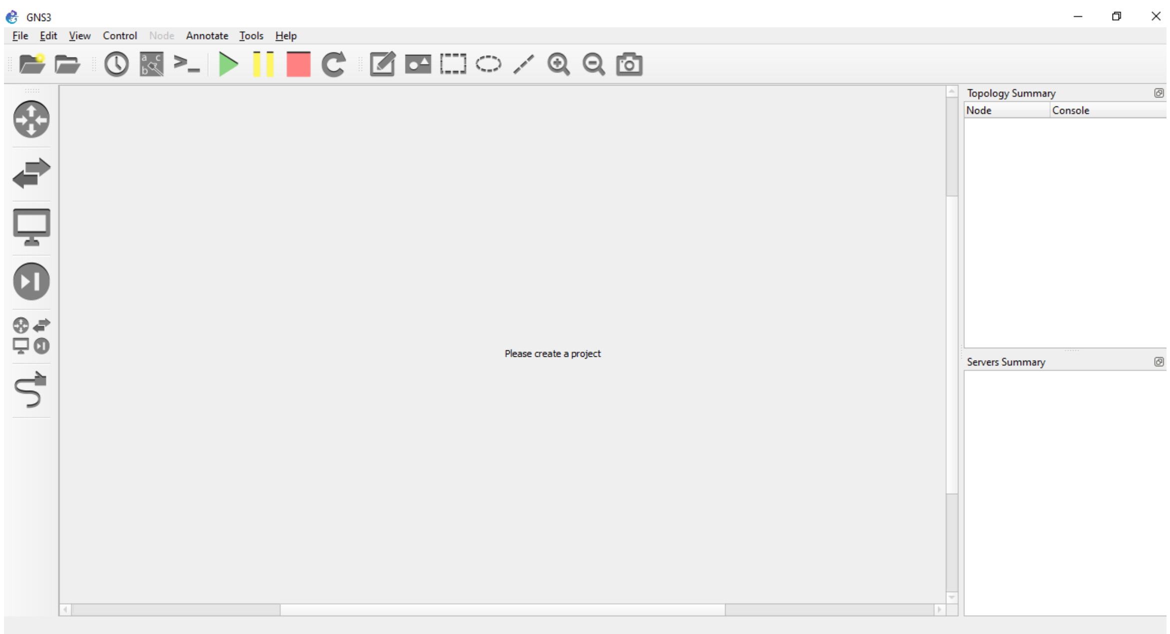

Fig 3.3.1 GNS3 first run GUI

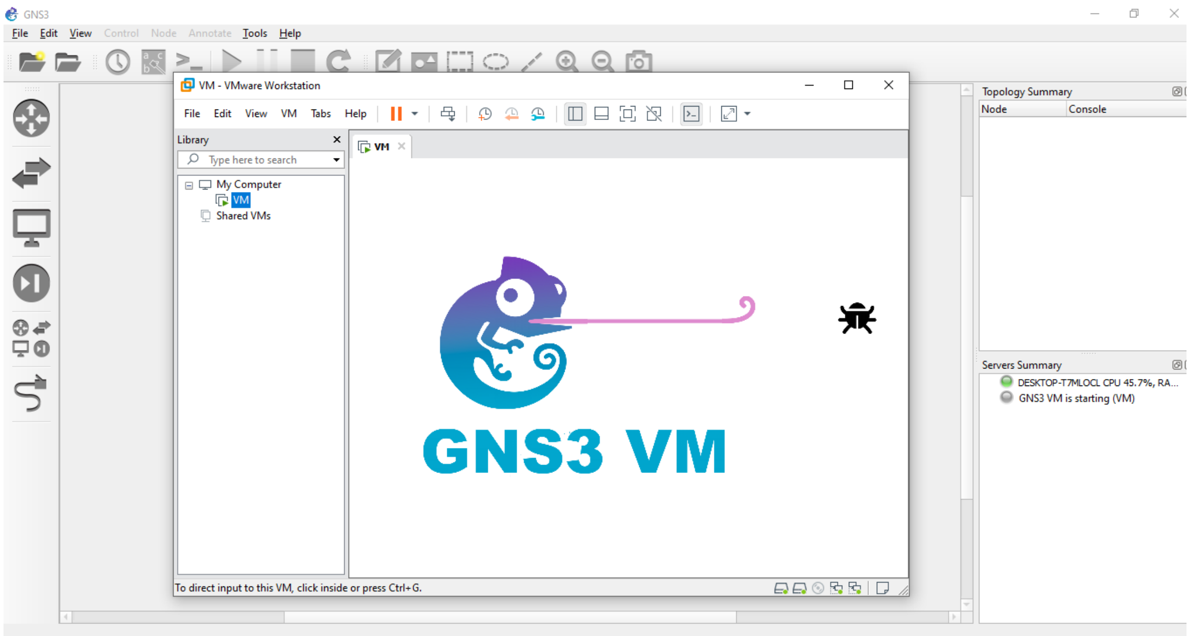

Fig 3.3.2 GNS3 VM first run GUI

3.4 Requirements for Implementation

Once we decided to do this networking, it was a really different job for us. It was tough to face up to these obstacles. We need technical resources to operate this program.

a) GNS3

b) VMWARE

c) WORKSTATION PRO 15

CHAPTER 4

Implementation and Testing

4.1 Implementation of Front-end Design

In order to complete the project, we must first design the Virtual Network. We need to use routers and switches to execute the front-end architecture. Switch is a physical networking system that links several hosts to a local region like a server. Router connects to computers by switching using IP and protocols.

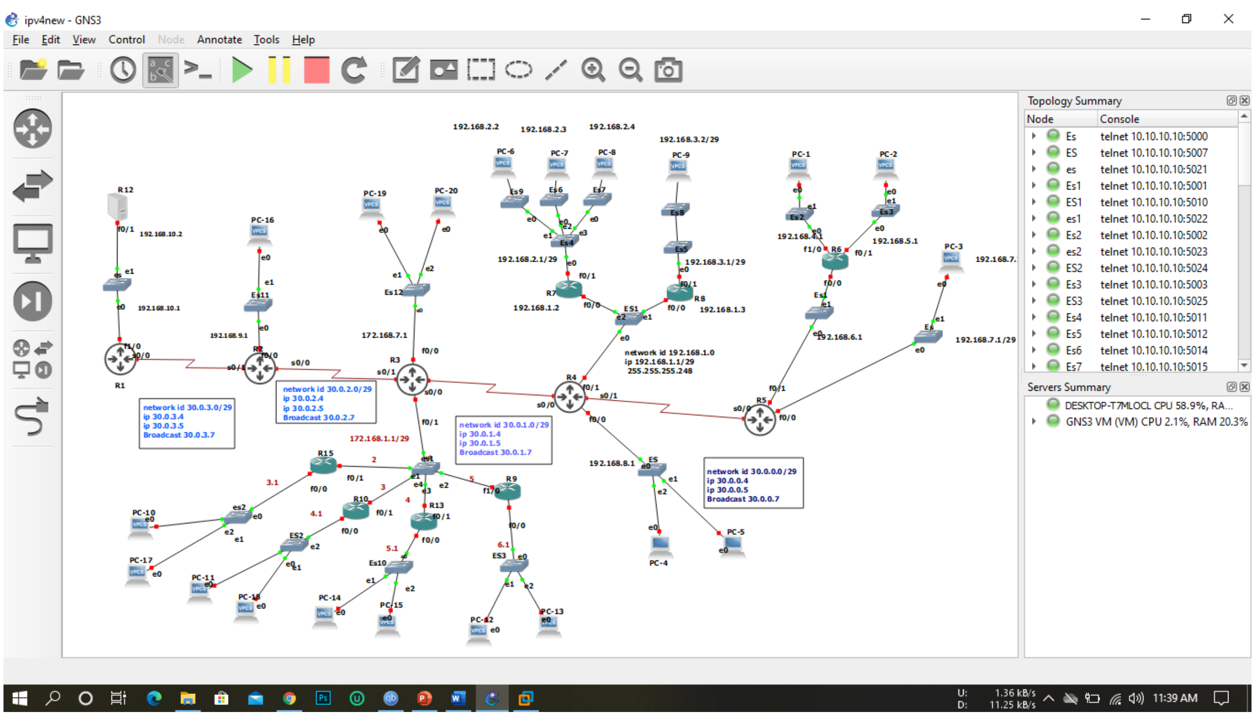

Fig 4.1 Network design of IPV4

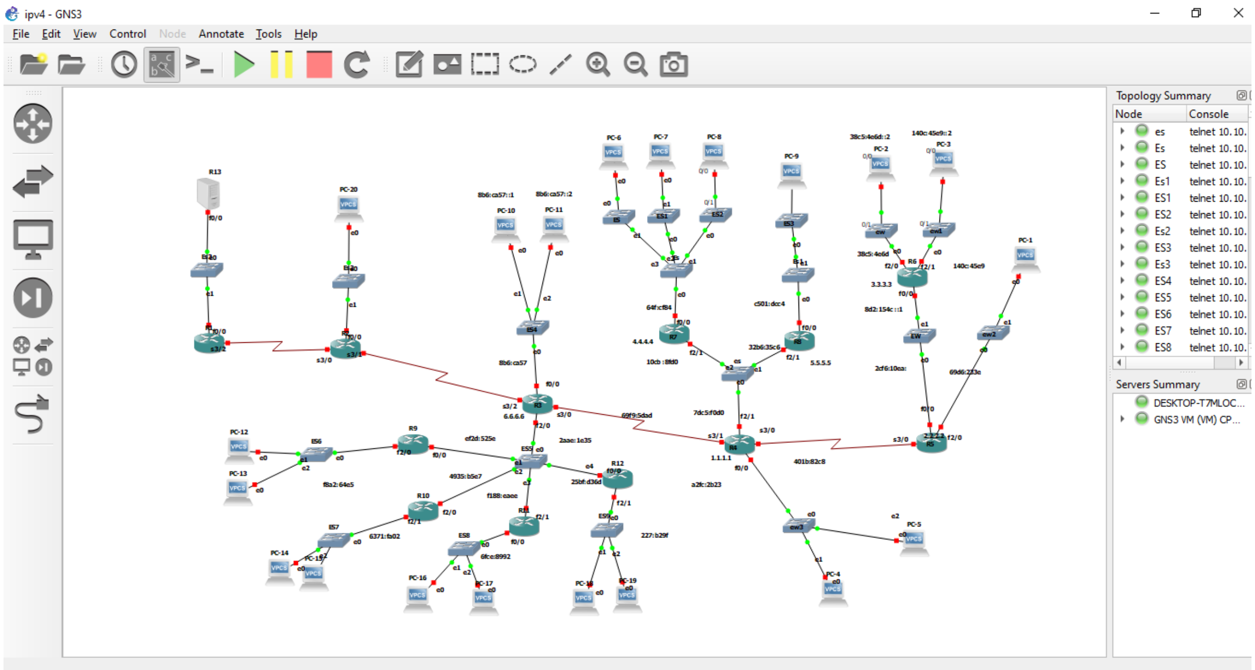

Fig 4.1.2 Network design of IPV6

4.2 Implementation of Interaction

Although IPv6 has used for the last few years, due to lack of IPv4 space exhaustion. Using phones, an experimental experiment is carried out to analyze anomalies in order to investigate the behavior of both the network and the device. After the study of various of things such as IP data, signaling, site loading time and power, it is concluded that IPv6 generates less signaling and less energy. There is not much difference in battery life between IPv4 and IPv6.

The OSPF for IPv4 (OSPFv2) or IPv6 (OSPFv3) has the same operational theory, the network is organized as different regions, the backbone region (region 0) and the regular area (area > 0). Two normal locations can connect either via a spine field, or via virtual connections. Within a broadcast or multi-access network, the choosing of assigned router and backup is carried out by field and the decision is rendered according to the highest priority or router Id.

OSPF(v2) refers for Open Shortest Path First version 2 and OSPF(v3) refers for Open Shortest Path First version 3. OSPF(v2) is the OSPF version of IPv4, while OSPF(v3) is the OSPF version of IPv6. In OSPF(v2), OSPF instances per interface are not provided, while many Routing protocols instances per interface are provided in OSPF(v3).

4.3 Testing result and report

Since the latest pattern is migration to the modern IPv6 interface, this article analyzed the efficiency of IPv4 and IPv6-based networks. The research addressed many specific aspects; testing the scalability of the two protocols, analyzing the OSPF routing protocols of both models, and assessing the effect of these elements on the efficiency of the transported applications. Simulations have been conducted in GNS3. The findings obtained demonstrated the usefulness of the IPv6 protocol relative to IPv6 in nearly all of the data obtained.

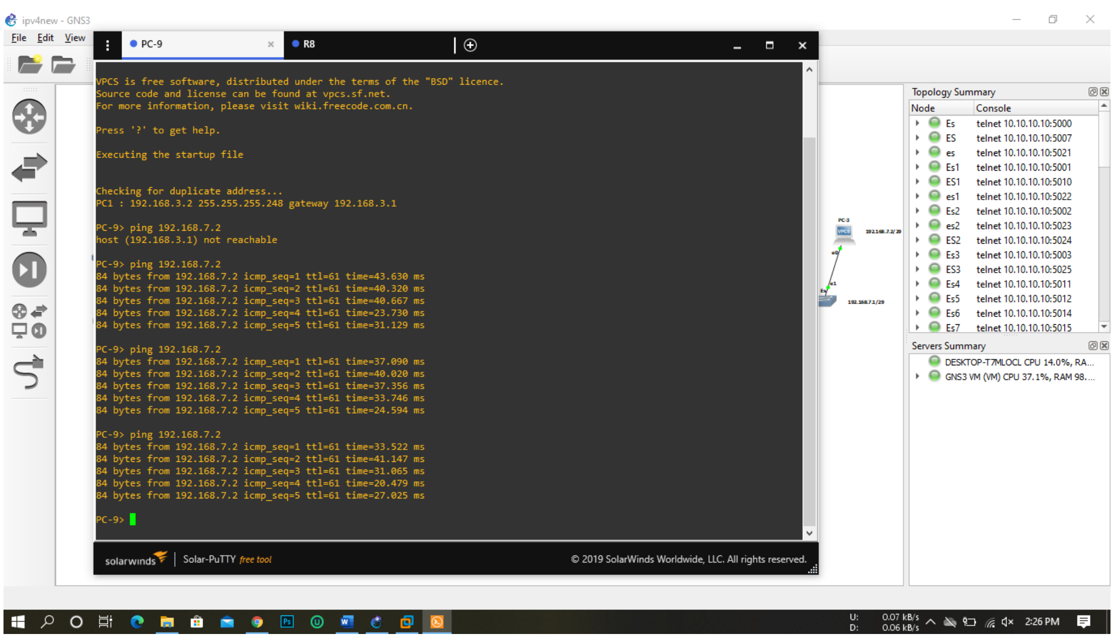

Fig 4.3.1 packet transfer time using IPv4

We need to check the results after finishing the implementation. So, first of all, we need to transfer a packet from one PC to another. Then we will see the length in the screen, which indicates how long time it takes for you to transfer the data through two machines. Here I am making a link between ipv4 and ipv6 using the OSPF protocol (Open the shortest route first)

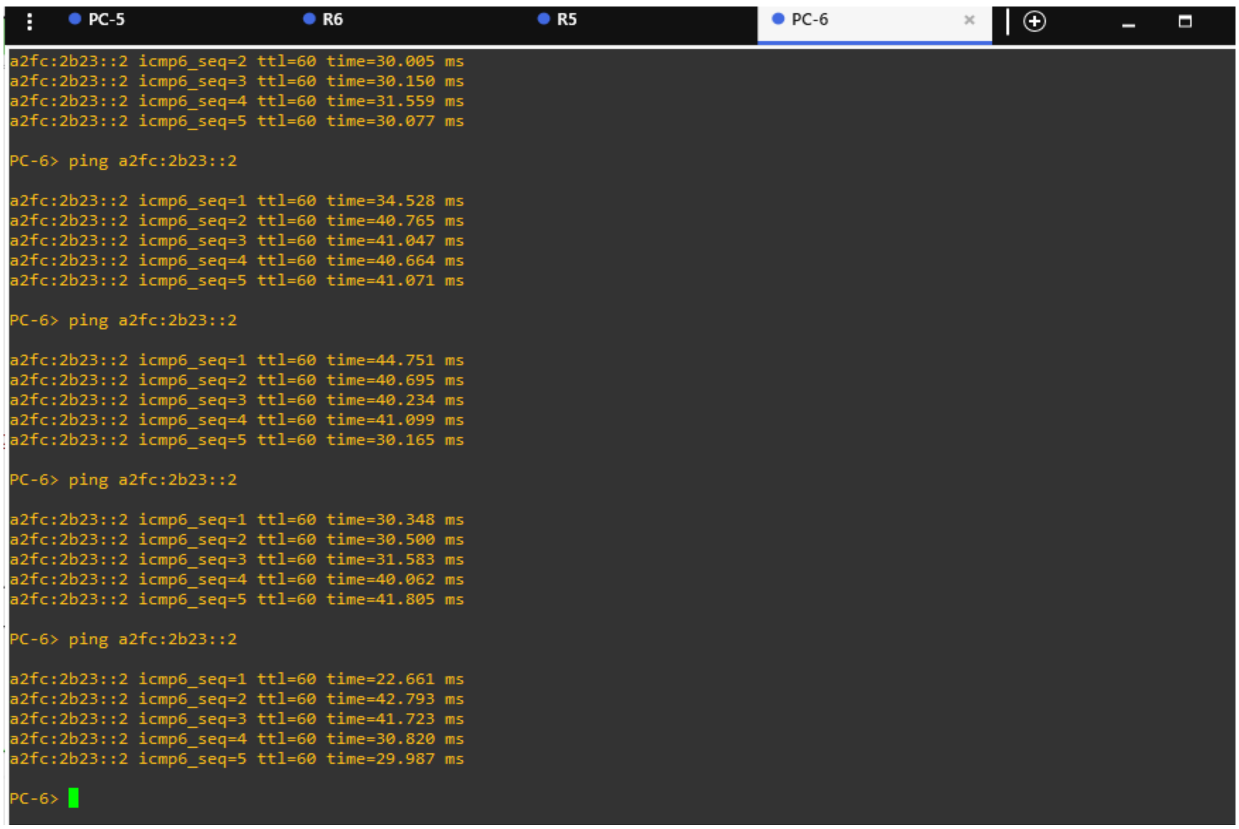

Fig 4.3.2 packet transfer time using IPv6

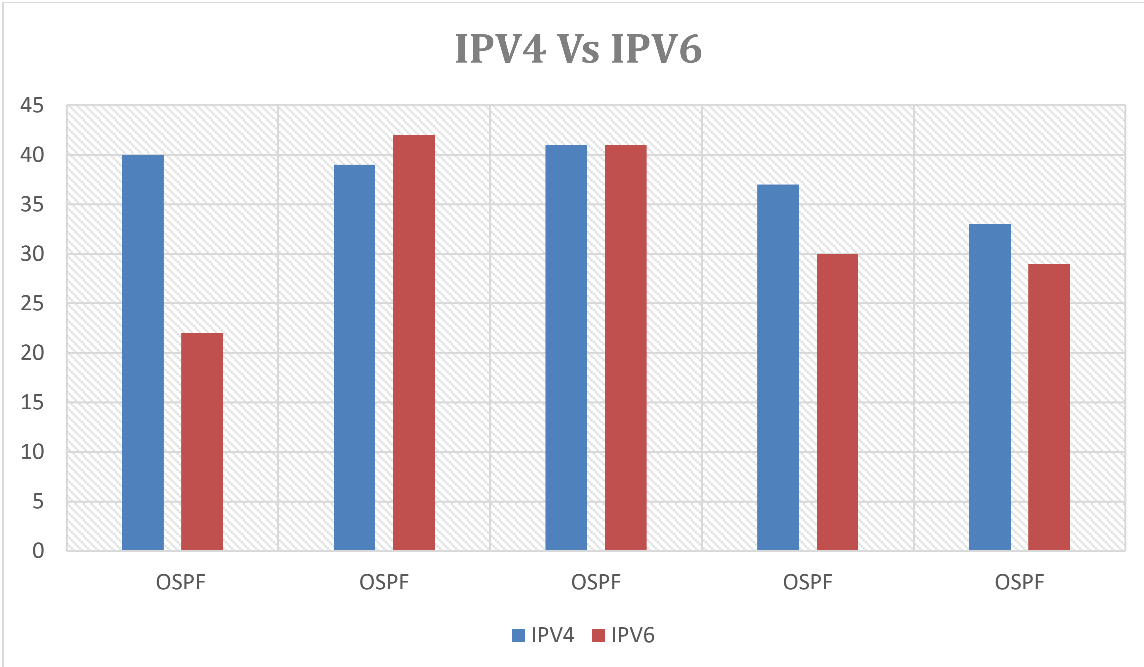

Fig 4.3.3 Time comparison between IPv4 and IPv6

CHAPTER 5

Impact on Society, Environment and Sustainability

5.1 Impact on society

The IPv4 address has approximately 4.3B(billion) addresses and is managed and allocated to the National Internet Registers by the Internet Assigned Numbers Authority in blocks of approximately 16.8 million addresses each. Depletion of the Internet Protocol Version 4 of ipv4 for fixed and unallocated addresses began in 2011.Though the IPv6 started in 2012.

Cloud infrastructure is now important for most enterprises, offering inexpensive, efficient services such as repositories, software, protection and network management that can't be delivered on an individual basis. IP address is important for cloud operations to be coordinated. Multiple IP addresses must be reserved or freed with blinding speed in order to commission or decommission virtual machines. The IPv4-based Internet, increasingly hamstrung by NATs, do not have such features, and the requisite number of addresses simply does not exist in IPv4.

5.2 Impact on Environment

Connectivity is also key to the survival of several businesses. Management must always be aware of issues that will have an impact on the delivery of services. IPv4 saturation is critical and would discourage businesses from increasing their networks substantially or taking advantage of innovative technology on a sustainable basis. Unfortunately, several layers of management have dismissed IPv6 as a technological improvement of little market significance. Avoiding IPv6 is low, even in the sense of global governmental acceptance, and not acting is a lack of corporate obligations. Adopting IPv6 is a cost-effective enterprise continuity method.

While IPv6 is still rare, it will be used by those who are seeking to avoid scrutiny. The most mysterious networks remain unknown except for devotees, except Pirate Bay, a well-known peer-to - peer file sharing network, visited IPv6 two years ago after courts started forcing European ISPs to block IPv4 addresses to Pirate Bay. Now ipv6 is being used for an open, fast internet connection. In

2012, huge numbers of scholars began using the IPv6Now tunnel software to bypass their slow ISP and using a free IPv6 framework tutorial. Since then, the app has been downloaded hundreds of thousands of times worldwide. While not extrajudicial, this sometimes simply falls under the calculating instrument of their network service provider.

5.4 Sustainability

IPv6 is evident in the assessment of low power grids. It absorbs fewer cell strength. Such systems are designed to operate over a long period of time on small cell battery charges. Often traditional IPv4 and IPv6 networking tools will not operate in such conditions. Fortunately, the development of Low Plan allowed the use of IPv6 in low-power environments. Translating IPv4 continues to be significantly more difficult because it does not allow for auto configuration and other essential functionality in low power environments.

Excluding home or enterprise with safe network connectivity, the usage of IPv6 in commercial and industrial devices is limited by the capability of cellular networks. Conversations with the car supplier and one of the navigation systems performed for this study revealed that the absence of mobile network coverage was the primary explanation why IPv6 was not in service. For contrast, it was stated that, with the diligent issuance of IPv4 addresses to their existing vehicles, the requirement for new IPv4 addresses can be significantly diminished as, with a million working machines, most automobiles do not travel most of the time.

It proves that the IPv4 address has been ongoing and that the challenge will be stepped up with millions of new vehicles coming online in upcoming years. Meetings of suppliers to the automotive sector, such as Bosch, show that IPv6 is definitely on the road map for the delivery of vehicles as it will be in the immediate future. The explanation mentioned as one of the main advantages of IPv6 is improved address space and auto-configuration, as well as enhanced usability support. Seeing that certain cars today have up to 70-75 electronic gadgets, sensors and cameras on board, it is obvious that IPv6 will be of great value to a car.

CHAPTER 6

Conclusion and Future Scope

6.1 Conclusion

The efficiency of both IPv6 and IPv4 was examined in order to test their attitude using specific criteria, routing protocols, packet size interval between routers, etc., and a simulated network communication environment. All of these parameters were put together to test the performance of IPv4 and IPv6 at the same time. Since all the data has been obtained, it is obvious that IPv6 with all these specifications is better than IPv4. That length of the packet will affect the time the packet requires to reach its destination. Whenever the packet size is small, the packet reaches slowly in IPv4 with the OSPF protocol. Whereas, in the case of any routing system, the limited size of the packet affects the duration of the packet itself.

6.2 Scope for Future Developments

These are some of the causes that may raise the cost for information processing addresses is the increasing use of Smart Home applications. In a really nice household, a lot of routers and a lot of computers are connected to the home network and to the internet through those networks. Several of these devices and resources need to be constantly associated with the web and AI services run through cloud services. samples of such devices are the “SmartThings” hub. These devices would be best with a transparent and uninterrupted affiliation to the Internet and motorcar configuration. Instead, the suppliers presently realize that every client has only 1 IPv4 address and wishes to use a NAT. The utilization of a NAT, however, will disrupt the right functioning of those devices. As a result, despite the actual fact that they might have the benefit of IPv6, normally used devices like the Nest thermostat and therefore the SmartThings hub don't support IPv6 these days.

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