

Performance Evaluation of IPv4 Vs Ipv6 and Tunnelling Techniques Using Optimized Network Engineering Tools (OPNET)

Abass Mohamed Ahmed Kapashi Ahmed¹, Dr. Amin Babiker A/Nabi Mustafa²
Dr: Gasm Elseed Ibrahim³

^{1,2}, Faculty Of Engineering, Neelain University ,Khartoum -Sudan

Abstract: Internet Protocol version 6 (IPv6) is the latest version of the Internet Protocol (IP). IPv6 is intended to replace IPv4, which is still widely used, in order to deal with the problem of IPv4 address exhaustion. In addition to evaluating the performance of IPv6, it is important to consider the interoperability between IPv4 and IPv6 networks, in addition to the migration process from IPv4 to IPv6. One way for IPv4 users to access IPv6 users/hosts is by encapsulating IPv6 packets within IPv4, in effect using IPv4 as a link layer for IPv6. This is known as tunnelling. The aim of this paper is to compare and evaluate the performance of IPv4, IPv6 and tunnelling (6to4) using OPNET 17.5. A computer simulation shows the theoretical comparison in terms of delay, throughput and packet loss.

Keywords: Automatic tunnelling, Delay, IPv4, IPv6, Manual tunnelling, OPNET, Packet loss, Throughput

I. Introduction

A. Background

Today hundreds of millions of users are interconnected by communication channels allowing them to communicate and to share information. These users and the devices that interconnect them are what constitute the Internet. The Internet is a network of networks with a myriad of computer devices, including smart phones, game consoles (handheld/stationary), IP televisions, tablet computers, laptop computers, desktop computers, palmtop Computers.

B. IPv4

The IP layer of abstraction is mainly charged with delivering Internet Protocol (IP) packets from source to destination. In order to perform this task, the source and destination IP addresses are identified by unique fixed length addresses. In IPv4, a 32 bit numeric identifier was deemed sufficient when the Internet was created. However, as the Internet growth has been exponential it is clear that there is a need for a revision of the IPv4 addressing scheme. We will not delve deeply into the techniques that have been employed to delay IPv4 address exhaustion; instead we show the progression of events in order to better understand the proposed solutions. introduces class full network addressing architecture, the first classification of IP addresses. This scheme supported few individual networks and clearly could not support the growing Internet.

C. IPv6

The described IP address space exhaustion mitigation techniques, each with their own draw backs. These techniques were only short-term solutions to delay exhaustion, while more tangible solutions were sought. In this section we look at a long-term solution, the next generation addressing scheme, IPv6. The steep growth of the Internet has determined the fate of the Internet Protocol. The Internet Protocol version 6 or IPv6 emerged amidst concerns about whether the Internet would adapt to increasing demands. IPv6 is now gaining momentum as the apocalyptic predictions concerning address exhaustion have been fulfilled. We start our study by identifying problematic areas in IPv4 and examining the solutions provided in IPv6.

D. Tunnelling Techniques

Tunnelling techniques can be used to deploy an IPv6 forwarding infrastructure while the overall IPv4 infrastructure is still the basis and either should not or cannot be modified or upgraded. Tunnelling is also called encapsulation. With encapsulation, one protocol (in our case, IPv6) is encapsulated in the header of another protocol (in our case, IPv4) and forwarded over the infrastructure of the second protocol (IPv4). Transition mechanisms that allow IPv6 hosts to communicate via intervening IPv4 networks are based on a technique known as tunnelling or software, which ensures there is no disruption to the end-to-end IP communications model. To accommodate different administrative needs, two types of tunnelling techniques are available: configured (static) and automatic (dynamic).

i. Configured tunnelling

Configured tunnelling is typically used when sites or hosts exchange traffic regularly. It is also used when only a few sites need to be connected, in which case manual configuration of the tunnel ends is not a significant administrative burden for network managers. Configured tunnelling also offers the advantage of enabling hosts in IPv6 sites to use native IPv6 addresses, rather than IPv4-IPv6 address constructs. In the latter case, the IPv4 address of the tunnel endpoint (TEP) is embedded inside the IPv6 TEP.

ii. Automatic tunnelling

Automatic tunnelling is a transition scheme that requires an IPv4 address for each host. This enables a node to establish a tunnel without configuration. Automatic tunnels are created when required and eliminated when no longer needed. The IETF has specified various automatic tunnelling solutions. These include IPv4-compatible IPv6 addresses, the "6to4" transition mechanism (6to4), and Intra-Site Automatic Tunnel Addressing Protocol (ISATAP).

II. Method

The network is implemented by using different network After the network implementation, start to configure the attributes for Ipv6, Ipv4, Tunnelling (6to4) used OPENT 17.5 simulate for analysis of the traffic between source and destination, three parameters (delay ,Packet loss, throughput) Has considered to evaluate the network performance for each transition method.

Network Components

The components used in the suggested network models running on OPNET 17.5 device used in the network are ten clients, two switches, and three routers. To represent an IP-based gateway running and supporting up to two Ethernet interfaces at a selectable data rate, the label switch (ethernet16_layer4) and label router (tr2_slip8_gtwy_adv_6upgarte) are used. The IP packets arriving on the input interface are routed to the appropriate output interface based on packet destination IP address. The setup uses the following models and configurations and for the purpose described below:

A. Ethernet16_switch node

This node is used to represent a switch supporting up to 16 Ethernet interfaces. Ethernet wkstn_adv node This node is used to represent a workstation with client-server applications running over TCP/IP and UDP/IP.

B. Application_Config

This table lists various parameters and their descriptions for the different applications (i.e. web browser HTTP Heavy and FTP heavy applications). The specified application name is used while creating user profiles on the "Profile_Config" object.

C. Profile_Config

This is used to create user profiles. These user profiles can be specified on different nodes in the network to generate application layer traffic. The applications defined in the Application_Config are used by this object to configure profiles. Traffic patterns can be specified followed by the configured profiles and the applications.

Fig. 1.IPv4 network topology implemented in the study

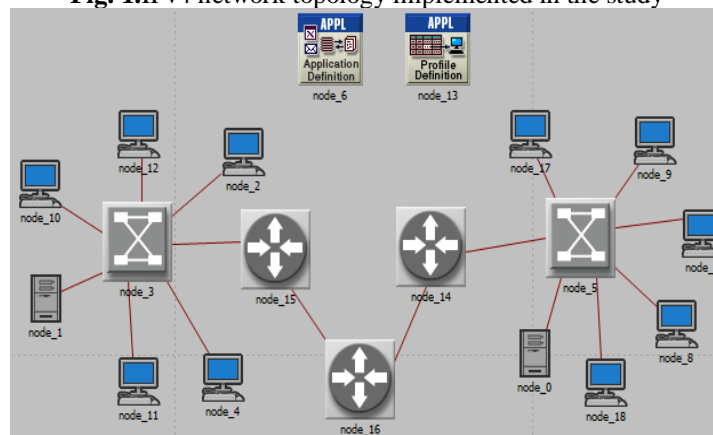


Fig. 2. IPv6 network topology implemented in the study

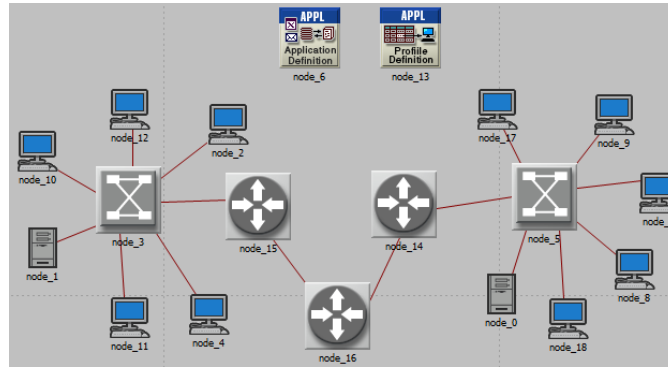
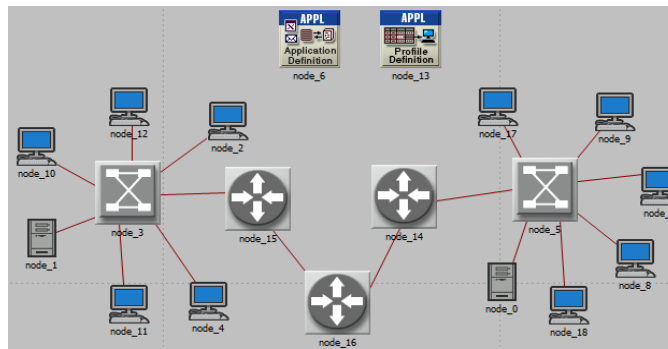


Fig. 3. Tunnelling network topology implemented in the study



III. Opnet Modeler

The Optimized Network Engineering Tools (OPNET) Modeler is an efficient way to provide a complete study for the network analysis. The graphical user interface (GUI) is simple to use and the result is shown as graphical and static. Furthermore, it does not require a programming knowledge, and this can be easily used. The OPNET analyses the network as a real life network which gives a complete view before building the network in real life. The OPNET contains a library of protocols and models which can be used as examples .

IV. Results And Discussion

The simulation ran for 1 hour (3600 sec), sufficient to gain an overview of the network’s behaviour. The results of the three network scenarios are shown in Fig. 4 – Fig 5 - Fig. 6; IPv4 represented in blue, IPv6 represented in red and Manual Tunnelling (6to4) represented in green.

A. Ethernet Delay

Figure 4 below shows the comparison of delay The IPv6 has a higher Delay than IPv4 because IPv6 has a larger header field , 6to4 the delay is higher than IPv4 because the packets are not transferred directly.. IPv4 has a smaller header field and the packet frame.

$$\text{Delay}_{6to4} < \text{Delay}_{IPv6} < \text{Delay}_{IPv4}$$

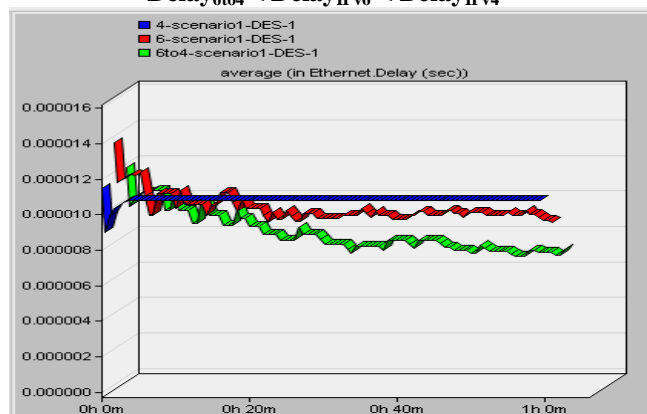


Fig 4. Ethernet Delay

B. Throughput

Figure 5 below shows the comparison of throughput between IPv4 ,IPv6 and tunnelling and shows also three types of theoretical have transient state and steady state station . the IPv6 has high throughput stated time if we compare it with tunnelling and IPv4.

throughput : IPv6 < 6to4tunnel < IPv4

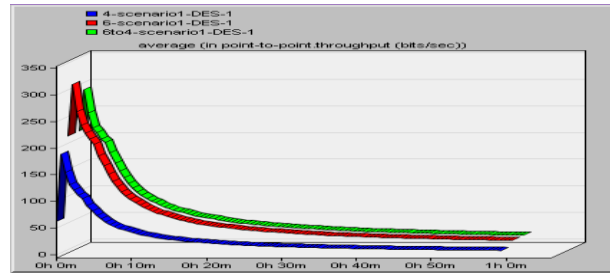


Fig 5.Throughput

Table 1 Average Networks Throughput

Phase	Data Rate	Throughput(bytes/sec)
IPV4	64 MBPS	185.7778
IPV6	64 MBPS	316.8889
TUNNEL (6TO4)	64 MBPS	310.8889

C. Packet loss

Figure 6 below shows the comparison of packet loss between IPv4, IPv6 and tunnelling and shows also three types of theoretical have transient state and steady state station . the IPv6 has high packet loss stated time if we compare it with tunnelling and IPv4.

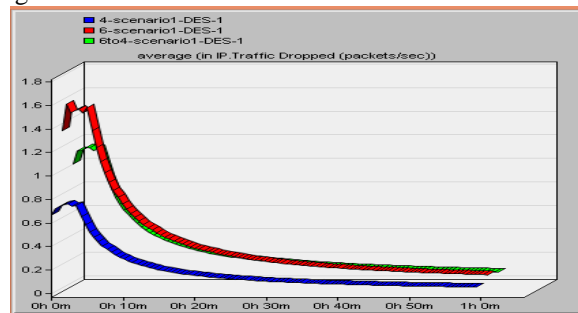


Fig 6 Packet loss

Packet Loss : IPv6 < 6to4 tunnel < IPv4

V. Conclusion

In this paper, we have evaluated the delay ,packet loss and throughput performance on simulation and analytical methods in The network topology was configured in three scenario as IPv4, IPv6, and tunnel(6to4). The statistical analysis was done to provide suitable results and to show that the network’s performance varied International The throughputs of the three network simulations were analyzed by using byte .

References

- [1]. Ghaida A.Y ALgadi & Amin B. A Mustafa comparison Throughput performance comparison between IPv4 and using Op-net simulator, IOSR Journal of Engineering (IOSR. JEN) volume 4, issue 08, august 2014.
- [2]. Nousyba Hasab Elrasoul Abu Algasim & Amin B. A Mustafa IPv4 To IPv6 migration International Journal of engineering and technology research (IJETR.(& Communications (IJCNC) Issue 11, Volume2 , November 2014 .
- [3]. Ghaida A.Y ALgadi & Amin B. A Mustafa , Evaluation and Comparisons of Migration Techniques From IPv4 To IPv6 Using GNS3 Simulator, IOSR Journal of Engineering (IOSR. JEN) volume 4, issue 08, august 2014 .
- [4]. Nousyba Hasab Elrasoul Abu Algasim & Amin B. A Mustafa MPLS Vs IP routing and its Impact on QoS parameters , International Journal of engineering and technology research (IJETR.(& Communications (IJCNC) Issue 11, Volume2 , November 2014 .
- [5]. Mutasim abdel Gaffar Mohamer & Amin B. A Mustafa performance Analysis of Mobile IPv6 Based on OPNET model , International Journal of Advanced research (IJAR) Issue 11, Volume2 , November 2014 .
- [6]. Mutasim abdel Gaffar Mohamer & Amin B. A comparison between IPv4 and IPv6 QoS Based on OPNET modeler QoS parameters , International Journal of Advanced research (IJAR) Issue 11, Volume2 , November 2014 .
- [7]. Ali Albkerat and Biju Issac . ANALYSIS OF IPV6 TRANSITION TECHNOLOGIES , International Journal of Computer Networks & Communications (IJCNC) Vol.6, No.5, September 2014.