RECITAL INVESTIGATION OF IPv4 AND IPv6 USING WIRED NETWORKS IN OMNET++

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ABSTRACT-Internet protocol was designed with an objective that defines how computers will communicate over a network. Internet protocol plays a vital role over internet. Although IPv4 can easily implemented and interoperable, it did not look forward to the huge growth of internet and imminent exhaustion of IPv4 address space. To improve the addressing capacities of IPv4, IPv6 was developed by IETF as next generation of IP. In this research work, we will evaluate the performance of IPv4 and IPv6 in terms of some parameters like packet loss, latency, delay and throughput using wired networks in OMNeT++. In order to evaluate the performance of IPv4 and IPv6, we designed two network models that are configured with IPv4 and IPv6, respectively in OMNeT++, which is a well-liked simulation platform particularly suitable for the simulation of communication networks.

Keywords: IPv4, IPv6, OMNeT++, TCP

1. INTRODUCTION

A. Internet protocol

Internet protocol was designed with an objective that defines how computers will communicate over a network. Internet protocol plays a vital role over internet. Although IPv4 can easily implemented and TCP/IP has four layers instead of seven. It combines the upper three layers into a single layer called Application layer and also combine physical and data link layers into a single bottom layer called network interface layer.

Application layer
Transport Layer

interoperable, it did not anticipate the huge growth of internet and imminent exhaustion of IPv4 address space.

Vulnerable points of IPv4:- Major vulnerable points of IPv4 is its limiting addressing space, as its address consists of 32 bits which limits the total number of addresses to about two billion only, which is not enough for such a big network like internet. The exponential growth of internet leads shortage of IP addresses. To improve the addressing capacities of IPv4, IPv6 was developed by IETF as next generation of IP. In this 128 bits are used for addressing instead of 32, by that means making available an infinite pool of IP address.

Many more important features of IPv6 protocol are there, which plays an important role in internet likes:-

- New header format which helps to keep header overhead to minimum.
- Competent and hierarchical addressing and routing infrastructure.
- Stateless and stateful address configuration.
- Provides security as it supports IPsec.
- Can be easily extended for new features.

It is good to discuss TCP/IP model as we have to concentrate on IPv4/IPv6.

B. TCP/IP Model:

Internet
Physical + Data link (Network Interface)

Fig 1: TCP/IP model

Application layer: application programs using networks.

Transport layer: responsible for management of end-to-end message transmission, error checking.

Internet layer: congestion control, routing, both IP versions are found in this layer.

Network interface (Physical+ data link): responsible for reliable and cost effective data delivery, access to physical networks.

C. OMNeT++

OMNeT++ is an open source, component based discrete event simulation environment and is becoming very well-liked simulation platform in communication and networking.

OMNeT++ provides component architecture for models. It binds various small components which were programmed in C++ into larger components. Reusability of models comes for free [10]. OMNeT++ has extensive GUI support and due to its modular architecture, the simulation kernel (and models) can be embedded easily into any applications [10].

OMNeT++ itself is not a network simulator but it works as a network simulation platform. "Network" includes wired and wireless communication networks, on-chip networks, queuing networks, etc [10]. Domain-specific functionality such as support for sensor networks, wireless ad-hoc networks, Internet protocols, performance modelling, photonic networks, etc., is provided by model frameworks, developed as independent projects [10]. OMNeT++ offers an Eclipse-based IDE, a graphical runtime environment, and a host of other tools. There are extensions for real-time simulation, network emulation, alternative programming languages (Java, C#), database integration, Systemic integration, and several other functions [10].

2. DESCRIPTION OF IPv4 and IPv6 WIRED NETWORK IN OMNeT++

IPv4 based lan: The IPv4 based model is developed by taking INETMANET frame-work as project reference, which is an open-source communication networks simulation package for the OMNeT++ simulation environment and suited for simulations of wired, wireless and ad-hoc networks. A snapshot of the model in the graphical interface of OMNeT++ called IDE is shown in Figure2.

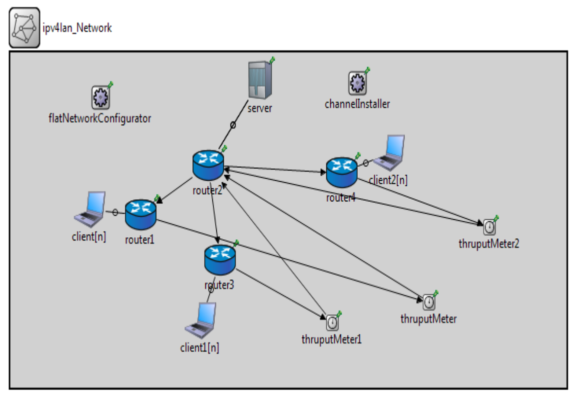


Fig 2: IPv4 based Lan network

In this network we uses various network components like flatNetworkConfigurator which configures IP addresses and routing tables. All hosts and routers will have the same network address and will only differ in the host part, channelinstaller, routers and large no. of hosts comprising a LAN. In end thrughputMeter is added into the network as to measure the throughput across the routers in the network.

When the network is run, it first reads all NED files which contain the network model topology, and then it reads a configuration file (usually called omnetpp.ini). This file contains settings that control how the simulation is executed, values for model parameters, etc.

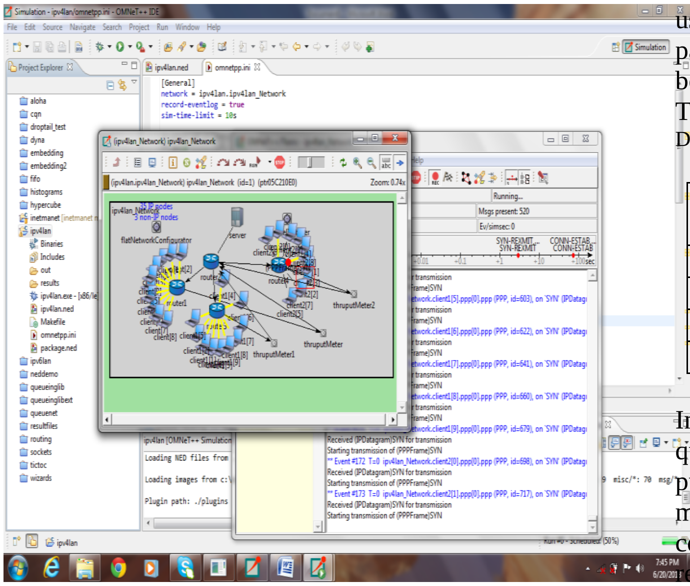


Fig 3: IPv4 lan network simulation model

Similarly, IPv6 based lan is developed by taking INETMANET frame-work as project reference in which we used flatNetwork Configurator6, router6, StandardHost6, server, channelInstaller and a throughput meter.

A. Performance Metrices

1. Throughput: Throughput is an important parameter as it helps to determine the rate at which total data packets are successfully sent and received through the channel. The throughput is usually measured in bits/sec.

2. Latency: Latency is measured as delay of traffic through a router or known as RTT (Round Trip Time). It is very important in case of real time application. Better latency means protocol would perform better for real time applications.

3. Packet loss: Packet loss refers to the number of packets lost during transmission that is number of packets dropped by the queue.

3. RESULT AND ANALYSIS

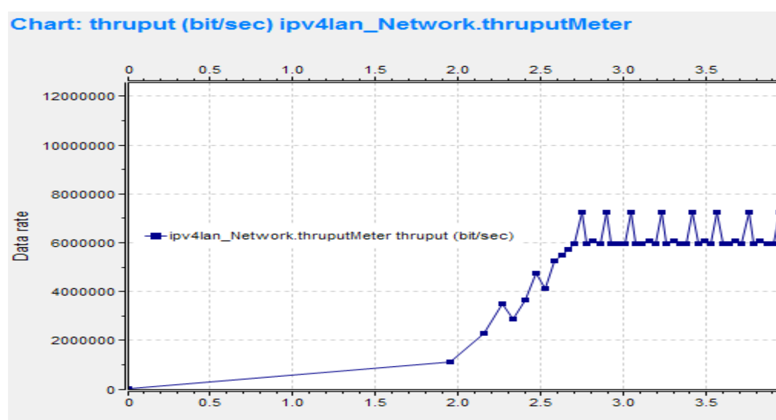
In this, we present a comparative analysis of IPv4 and IPv6. There are two network models, which we had configured and run 1st by using IPv4 and 2nd by using IPv6 alone. We had set delay and data rate parameters same for both network models as given below:

TABLE1: ATTRIBUTES WHICH ARE SET FOR DIFFERENT DATA RATE CHANNEL CONNECTION

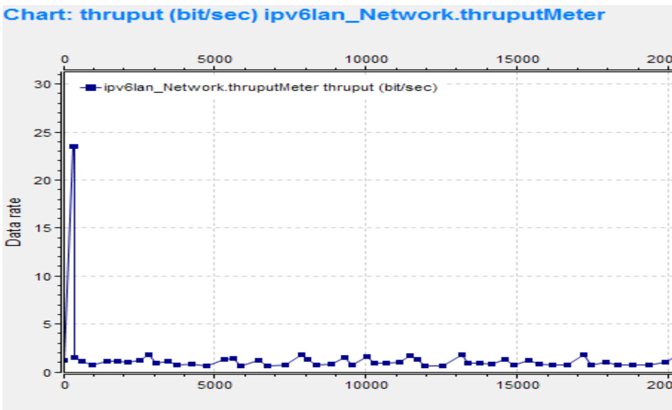
DataRateChannel connection	Delay	Data Rate
Client→Router	0.1ms	100Mbps
Router→Router	10ms	10Mbps
Router→Server	10ms	100Mbps
Router→ThrughputMeter	10ms	100Mbps

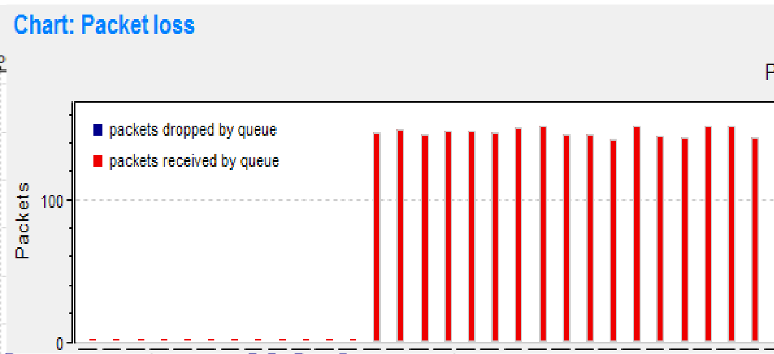
In this section, graphed results for defined quantitative parameters are presented such as through put, latency, packet loss, etc. for both network models based on IPv4 and IPv6 respectively and then compared with each other which includes graphical results of various network elements like routers, clients, etc.

A. THROUGHPUT RESULTS FOR IPv4 and IPv6 based networks



Graph1: Throughput result for IPv4 LAN at router1 to router2





Graph8: Packet dropped by queue at router1 in IPv6 LAN

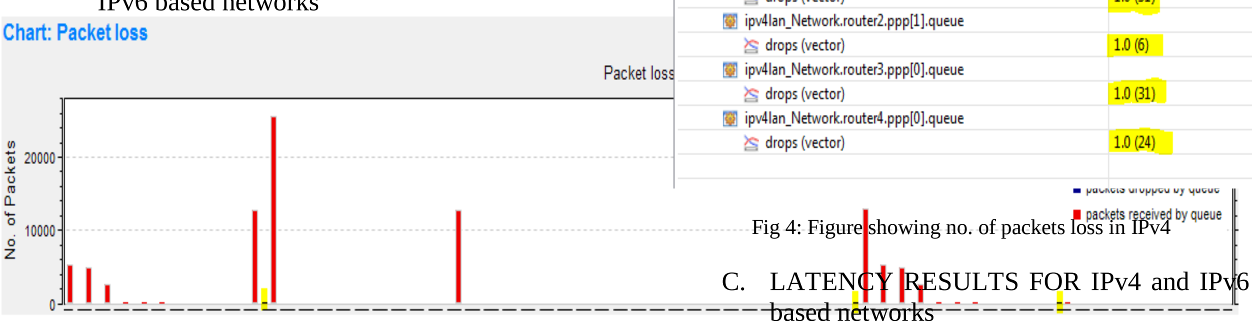
Graph2: Throughput result for IPv6 LAN at router1 to router2

Above graphs 1 and 2 shows the rate at which total data packets are successfully sent by router1 to router2 through the data rate channel in IPv4 and IPv6 based LAN respectively.

Similarly, throughput is measured for router3 to router2 and router4 to router2 by using another throughput meters in the network.

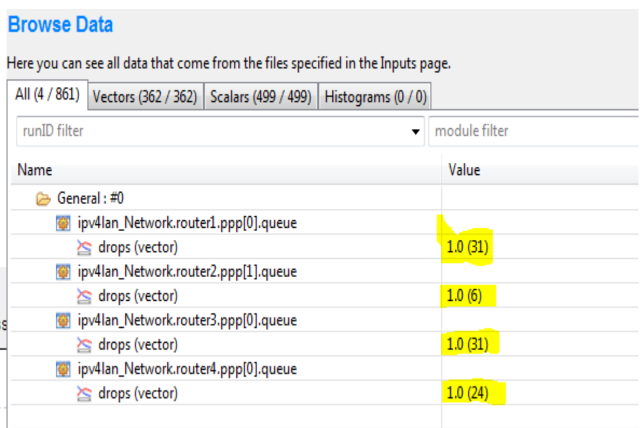
As we were able to see during the results of the throughput experiments, is that throughput declines somewhat faster in IPv6 than IPv4 under high levels of set traffic. This is because IPv6 has less number of packets per second as compared with IPv4.

B. PACKET LOSS RESULTS FOR IPv4 and IPv6 based networks



Graph7: Packet dropped by queue at router1 in IPv4 LAN

Above graphs 7 and 8 shows number of packets dropped by queue in IPv4 and IPv6 based LAN respectively. It is observed that there is no packet loss in case of IPv6 but in IPv4 some packets were dropped by queue represented by purple and highlighted using yellow color, as it's very small in number that's why we can't visualize clearly in graph. At about 50 Mbps there is no packet loss but if load on network exceed, packet loss increases, it is clearly visualize from table given below where highlights shows the no. of packets dropped.


Browse Data

Here you can see all data that come from the files specified in the Inputs page.

All (4 / 861) | Vectors (362 / 362) | Scalars (499 / 499) | Histograms (0 / 0)

Name	Value
General : #0	
ipv4lan_Network.router1.ppp[0].queue	
drops (vector)	1.0 (31)
ipv4lan_Network.router2.ppp[1].queue	
drops (vector)	1.0 (6)
ipv4lan_Network.router3.ppp[0].queue	
drops (vector)	1.0 (31)
ipv4lan_Network.router4.ppp[0].queue	
drops (vector)	1.0 (24)

Fig 4: Figure showing no. of packets loss in IPv4

C. LATENCY RESULTS FOR IPv4 and IPv6 based networks

Latency can be measured as time taken by the packet while transmitting over the network that is Round trip time (RTT). When compared, it is found that latency values for both the protocol are nearly equal. Very little variation is found depending upon the size of packet.

4. CONCLUSION

In this paper we evaluate the performance parameters of both the protocols i.e IPv4 and IPv6 based on wired networks in OMNeT++. We found that throughput parameter of IPv4 is much superior to those of IPv6. It declines somewhat faster in IPv6 as compared to IPv4. Whereas in case of packet loss we found that it is more in IPv4 as compared with IPv6. When we talked about latency it was found that IPv4 and IPv6 versions of IP protocol behave roughly the same, with difference in overhead due to large header format of IPv6 may be because IPv6 is still in developing phase.

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