Performance Evaluation for MIPv6 IN Pure IPv6 Networks vs. 6 TO 4 IP Mechanism Networks using OPNET

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Abstract

IPv6 protocol is the last protocol for IP protocol. IPv6 protocol based on 128 bits for addressing and has many features comparing with old one IP protocol (or which called IPv4 protocol) that is still using till now in many companies and based on 32 bits in addressing.

Mobile IPv6 is protocol that using for mobile nodes that moves from it home place to other places and depends on IPv6.

In our Study we will focus on implementing Mobile IPv6 MIPv6 in two networks, one is pure IPv6 network and another is mixed networks that consisting of IPv4 and IPv6 networks. We used in our study mechanism 6 to 4 to connect between IPv4 nodes and IPv6 nodes. In these two scenario Mobile node MN used MIPv6 between two access routers.

The aim of this paper is to study IPv6 traffic inside MN and IPv4 and IPv6 internet clouds and finally throughput for WLAN using many kinds of application in this topology like FTP, Email, Terminal server applications. Optimized Engineering Tools (OPNET) 14.5 is used to verify of topology and get the results.

The result of our study shows that working in pure IPv6 networks for MN and for Internet IPv6 clouds better than working in 6 to 4 networks. Although from these result, there is no different actually in IPv4 clouds when we using pure IPv6 and 6 to 4 IPv6 networks if we use it after IPv6 cloud.

Keywords: IPv6, MIPv6, 6 to 4 IP mechanism, IPv4, OPNET.

1- Introduction

The Internet has been growing at a very fast rate during the last ten years. The Internet runs over IP version 4 (IPv4), but this protocol was designed 30 years ago for a few hundred computers. The number of globally unique unicast IPv4 addresses still available is not enough to assign a different IP address to every new device to come. IP is considered by the market as the common denominator to converge different application layers such as data, voice, and audio. However, these new devices require many more IP addresses to interconnect all kinds of IP appliances besides just the computers currently interconnected on the Internet. The size of an IPv6 address [1] is 128 bits, 4 times bigger than an IPv4 address; 32 bits' address space allows up to 4.294.967.296 combinations, while the 128 bits of an IPv6 address allows up to 3,4 x 10^{38}, therefore it is obvious the increase in available addresses.

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In this paper, we focus on three important points :(1) Data traffics in Mobile node MN, (2) throughput in Wireless LAN and (3) traffics in IPv4 and IPv6 clouds in pure IPv6 network and 6 to 4 IP network and analysis.

This paper is organized as follows: Section 1 is introduction, where is section 2 is related works, then section 3 theatrical information. Then section 4 provides practical study scenarios and compared results in our evaluation. Finally, section 5, present results and conclusion.

2- Related works

Many research and books study the connection between IPv4 and IPv6 [2],[3] that explained 6 to 4 method is very useful especially that does not needs to changes routers for IPv6 configurations. Comparison using OPNET between IPv6 and 6 to 4 networks studied has done in [4] , but not for Mobile node (MN) it just for stationary and small company without take internet traffic in their considerations.[5]studies the scenarios to mobility between IPv4 and IPv6 networks without give any results or simulation on his works , we select in our research mobility between two nodes inside IPv6 routers.

3- Theatrical Information

3-1-IPv6 Address

IPv4 addresses are represented in dotted-decimal format. The 32-bit IPv4 address is divided along 8-bit boundaries. Each set of 8 bits is converted to its decimal equivalent and separated by periods. For IPv6, the 128-bit address is divided along 16-bit boundaries, and each 16-bit block is converted to a 4-digit hexadecimal number and separated by colons. The resulting representation is called colon hexadecimal.

The network prefix in an IPv6 address is represented in the same way that IPv4, for example, take the IPv4 address 192.168.1.0/27, this means that the first 27 bits are network's and the remaining 5 are which identify a device, thus in IPv6 the following address ffe:b00:c18:1::1/64 indicates that the first 64 bits identifies the network (3ffe:b00:c18:1) and the remaining 64 bits identifies the device in that network (::1).

3-2-MIPv6

Mobile IPv6 [6], allows mobile node to move from one link to another without changing the mobile node's "home address". Packets may be routed to the mobile node using this address regardless of the mobile node's current point of attachment to the Internet. The mobile node may also continue to communicate with other nodes (stationary or mobile) after moving to new link. The movement of a mobile node away from its home link is thus transparent to transport and higher-layer protocols and applications.

3-2-1- Mobile IPv6 Operation

When a mobile node is away from home, it sends information about its current location to the home agent. A node that wants to communicate with a mobile node uses the home address of the mobile node to send packets. The home agent intercepts these packets, and using a table, tunnels the packets to the mobile node's care-of address.

Mobile IPv6 uses care-of address as source address in foreign links. Also, to support natural route optimization, the Correspondent node uses IPv6 routing header than the IP encapsulation fig. (1).

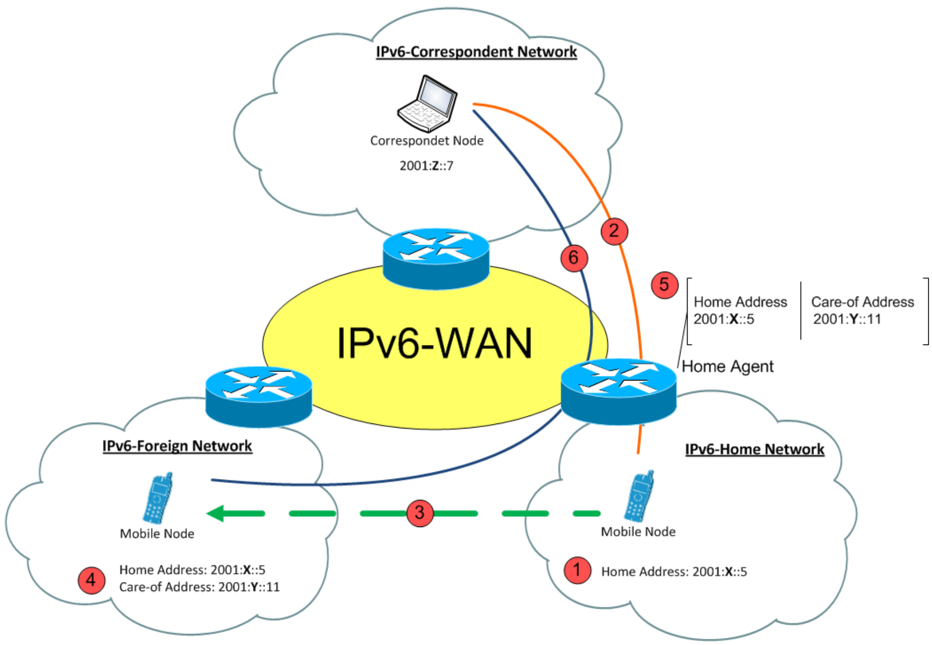

Figure 1 Movement in MIPv6 networks[7]

3-3- 6to4 Technique

6 to 4 technique [8] is an Internet transition mechanism for migrating from IPv4 to IPv6, a system that allows IPv6 packets to be transmitted over an IPv4 network (generally the IPv4 Internet) without the need to configure explicit tunnels. Special relay servers are also in place that allow 6to4 networks to communicate with native IPv6 networks.

6to4 is especially relevant during the initial phases of deployment to full, native IPv6 connectivity, since IPv6 is not required on nodes between the host and the destination. However, it is intended only as a transition mechanism and is not meant to be used permanently.

6to4 may be used by an individual host, or by a local IPv6 network. When used by a host, it must have a global IPv4 address connected, and the host is responsible for encapsulation of outgoing IPv6 packets and decapsulation of incoming 6to4 packets. If the host is configured to forward packets for other clients, often a local network, it is then a router.

3-3-1- 6to4 addressing

As defined by [9] , and for any 32-bit global IPv4 address that is assigned to a host, a 48-bit 6to4 IPv6 prefix can be constructed for use by that host by appending the IPv4 address to `2002::/16` fig (2).

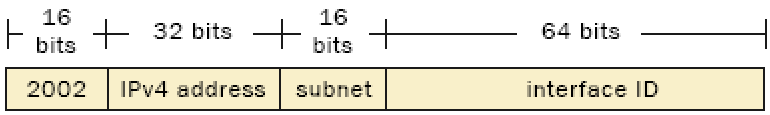

Figure 2: 6to4 scheme general address

For example, the global IPv4 address **`193.88.99.44`** has the corresponding 6to4 prefix `2002:`**`c158:632e`**`: :/48.or` it can be used without changing to hexadecimal like `2002:` **`193.88.99.44`**`: :/48` and full address in both cases when using subnet = 1 and interface Id =1 is like figure 3.

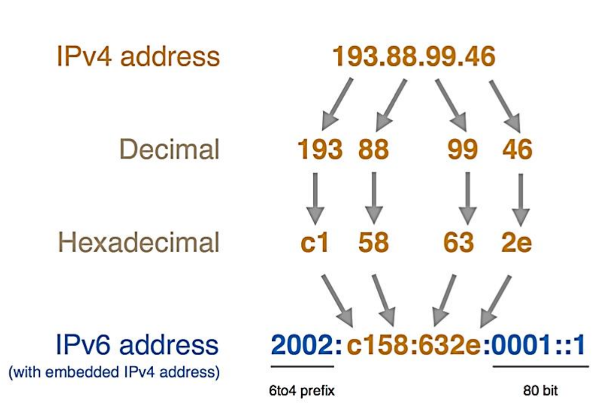

Figure 3: 6to4 address example [9]

4- Practical Study scenarios:

4-1- Practical working Scenarios:

We used OPNET 14.5 simulation to implement these scenarios:

4-1-1-Scenario 1 :MN (MIPv6) moves with IPv4 networks using 6 to 4

There are two 6to4 sites in the network, Site A and Site C. They are connected to the IPv4 backbone as shown in fig 4. 6to4 tunnels are configured on both Routers A and C enabling them to communicate with each other. The 6to4 addresses in Site A are created from the IPv4 address 192.0.4.1 which is the address of Router A interface that connects to the IPv4 backbone.

To communicate with non-6to4 IPv6 destinations, these sites use an ISP Relay (Site B). Both Routers A and C have a default route to Router B. So packets going from a 6to4 site (e.g. Site A) to a native IPv6 site (e.g. Site D) will be first tunnelled to Router B using 6to4 tunnelling and then forwarded to the eventual destination.

All routers in the native IPv6 network have a static route to the destination (2002::/16) with the next hop set to Router B. So if any of these routers receives a packet destined for a node in Sites A or C, it will be forwarded to Router B, who will be able to tunnel the packet correctly.

MN moves between Router D and Router F which located in native IPv6 using MIPv6 protocol.

All workstation nodes and mobile node MN in the network are running some application or the other.

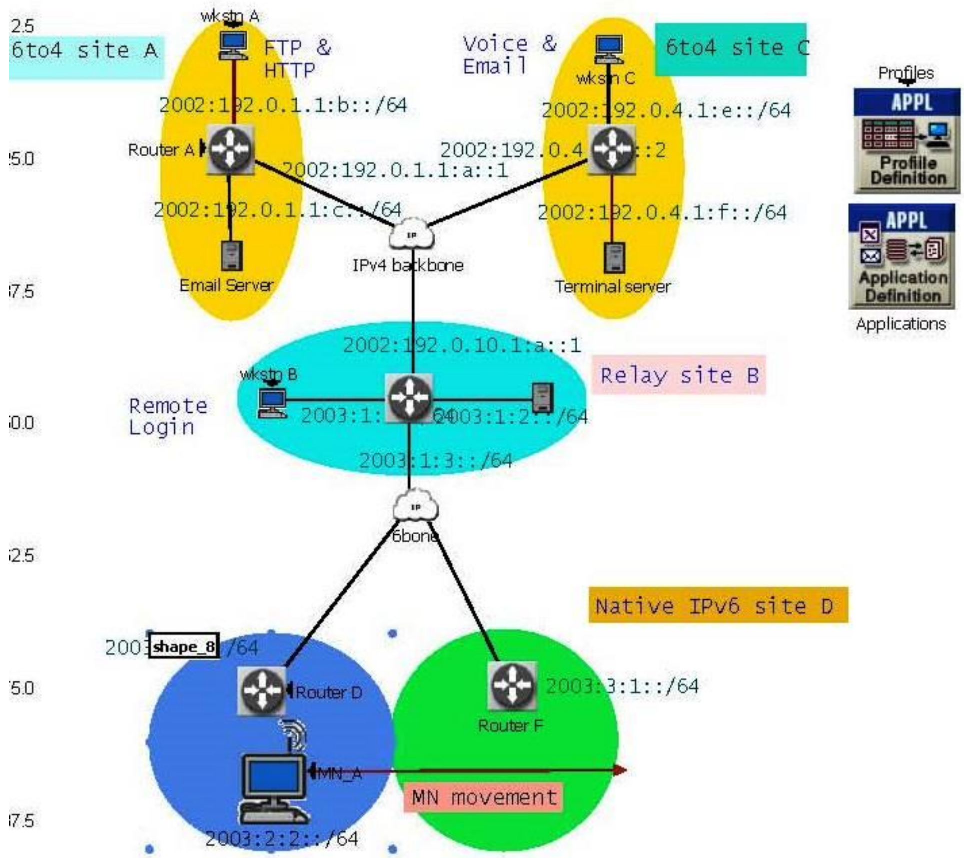

Figure 4: 6to4 address example

<u>4-1-2-Scenario 2</u>:MN (MIPv6) moves with pure IPv6 networks

In this case we use in all sites A, B, C, and D IPv6 networks and MN moves between Router D (HA router) to Router F using MIPv6 protocols. Like first scenario all workstation nodes and mobile node MN in the network are running some application or the other.

4-2- Practical working Hypothesis:

- **IP addresses**: All IP explained figure 4**.**
- **Applications**: Email (TCP connections), FTP (heavy FTP), Voice

(Telephone voice), Remote login .

- **IP cloud characters (IPv4, 6 bone): we** using last load on the internet using [10] fig (5) between 24-11-2016 until 24-12-2015.

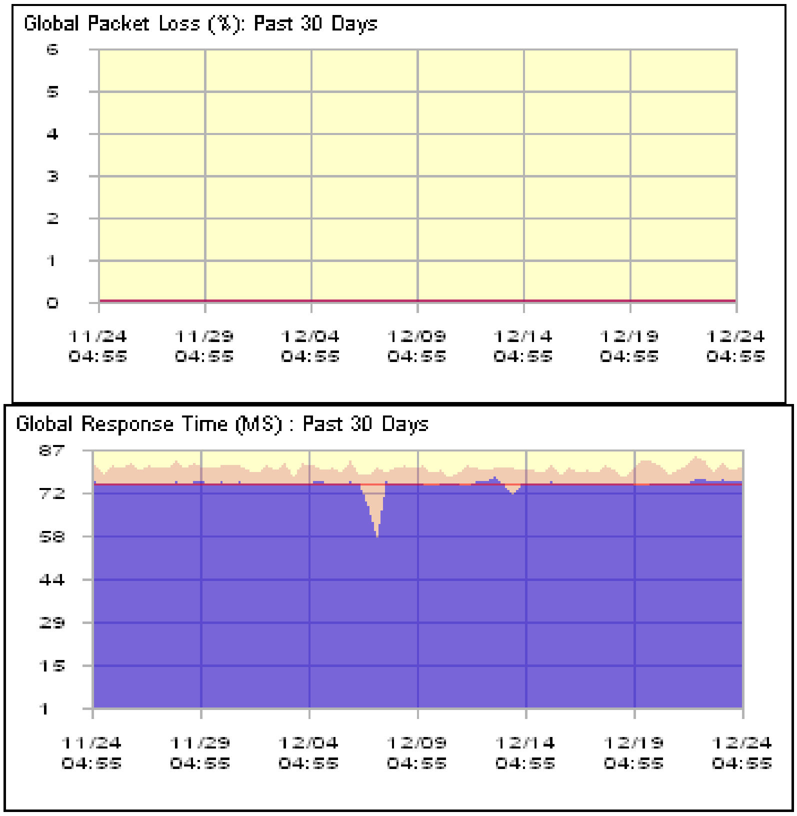

Figure 5: Internet traffic reports [10]

4-3- Measured Parameters:

Vary parameters for different nodes has measured to get many resulted in two scenarios

4-3-1- MN:

1- IPv6 Traffic Dropped:

From Fig 6 we can a traffic dropped which is the number of IPv6 datagrams dropped per second by MN node across all IP interfaces is the same but in IPv6 networks needs more traffic controls especially for neighbour discovery process.

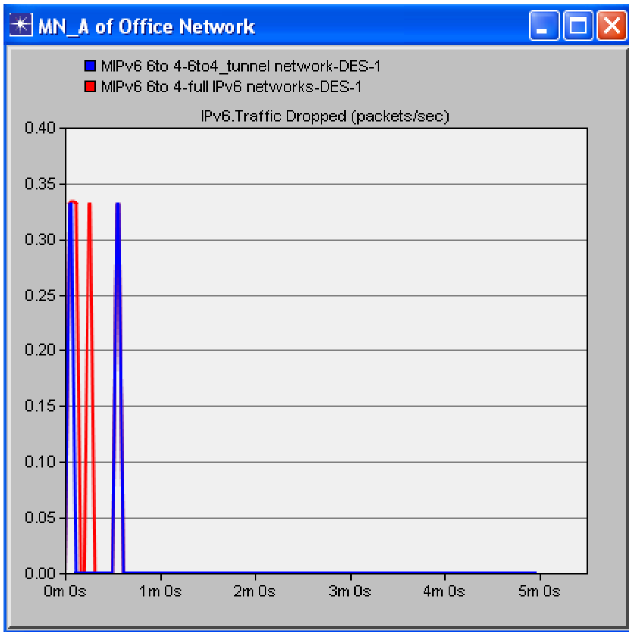

Figure 6: Traffic Dropped

2- IPv6 Traffic Sent /Received:

From fig 7 below we can see that MN in pure IPv6 Networks receive and sent data bigger than 6to 4 network about 150 %. This is because of avoiding packets tunnelling in IPv4 networks.

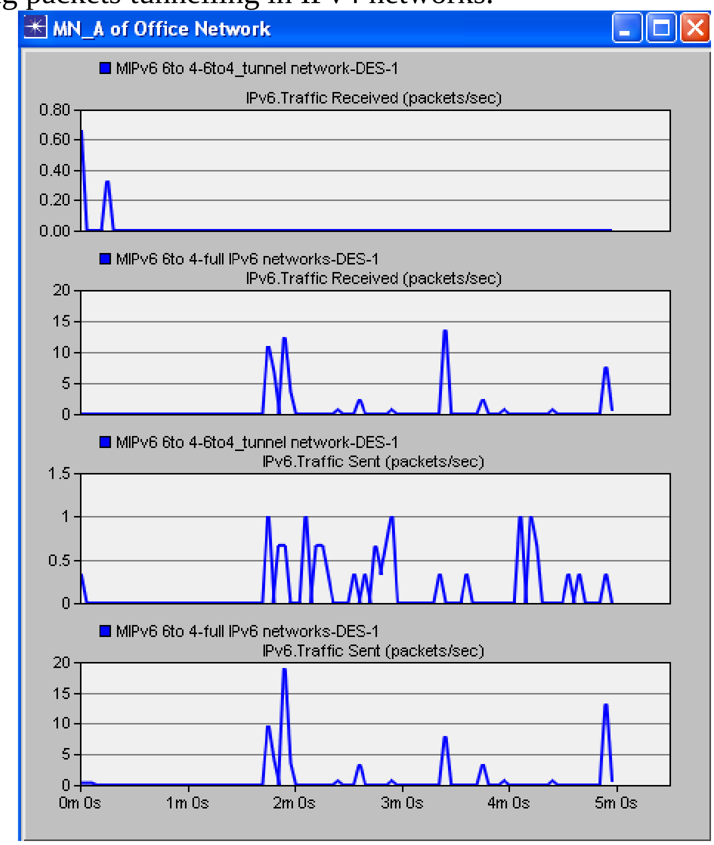

Figure 7: IPv6 Traffic Sent /Received in MN

4-3-2- Internet clouds (IPv4 and IPv6 clouds):

Fig 8 below shows that traffic sent and receive in IPv6 cloud (6 bone) and IPv4 clouds. Figure 8 shows that IPv6 datagram that sent and received in pure IPv6 scenario is bigger than ones in 6 to 4 scenario about 20 times. We can explain that because of pure IPv6 network does not need to change IP datagram’s addresses between IPv4 and IPv6. Otherwise in IPv4 clouds there is no major changes between two scenarios because all converting operations between IPv6 to IPv4 process before in IPv6 cloud.

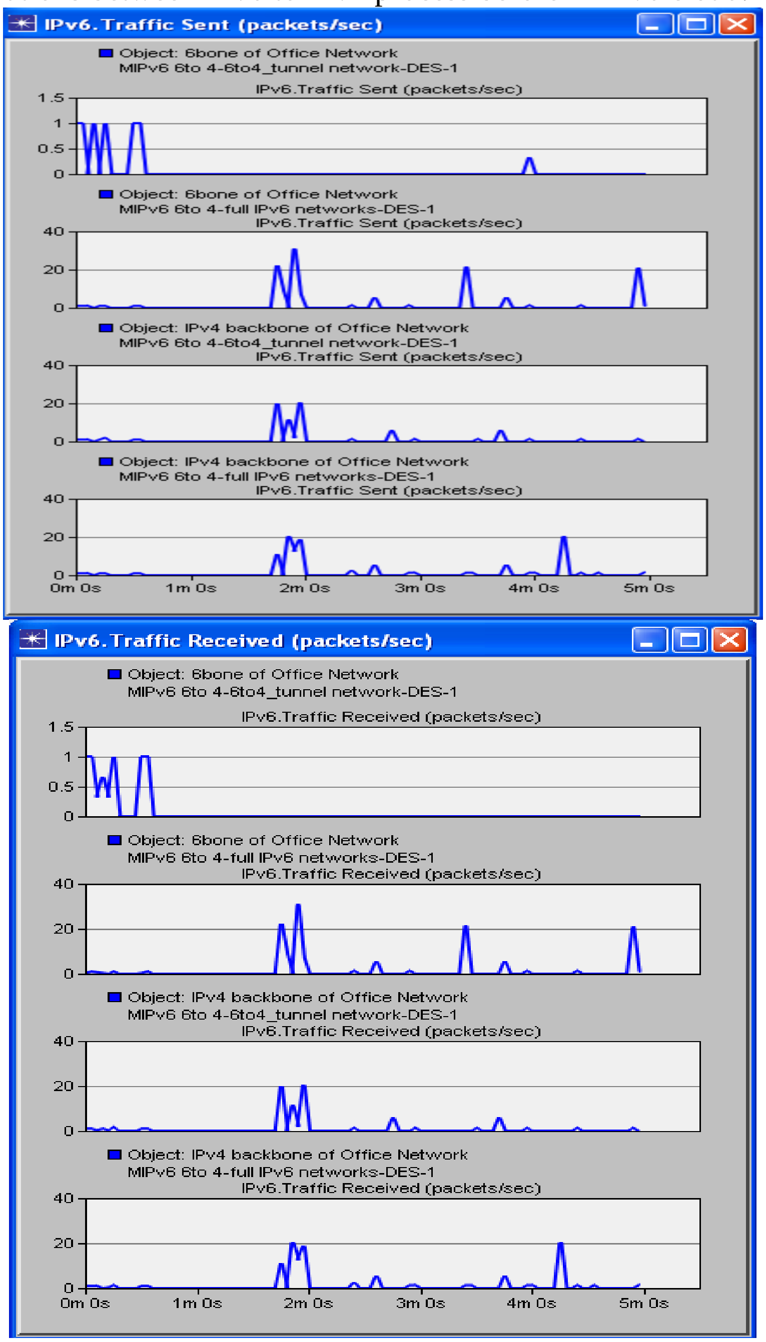

Figure 8: IPv6 Traffic Sent / Receive in IPv4 and IPv6 clouds

4-3-3- Wireless LAN:

Throughput:

According to Blum [11]: Throughput is one of the most common metrics used in the study of network performance evaluation. It helps to understand the amount of data travel across a network connection or between two network hosts.

Fig 9 shows that throughput in pure IPv6 networks is bigger than 6 to 4 networks with about 150% and there is no load consistently like 6 to 4 IPv6 scenario.

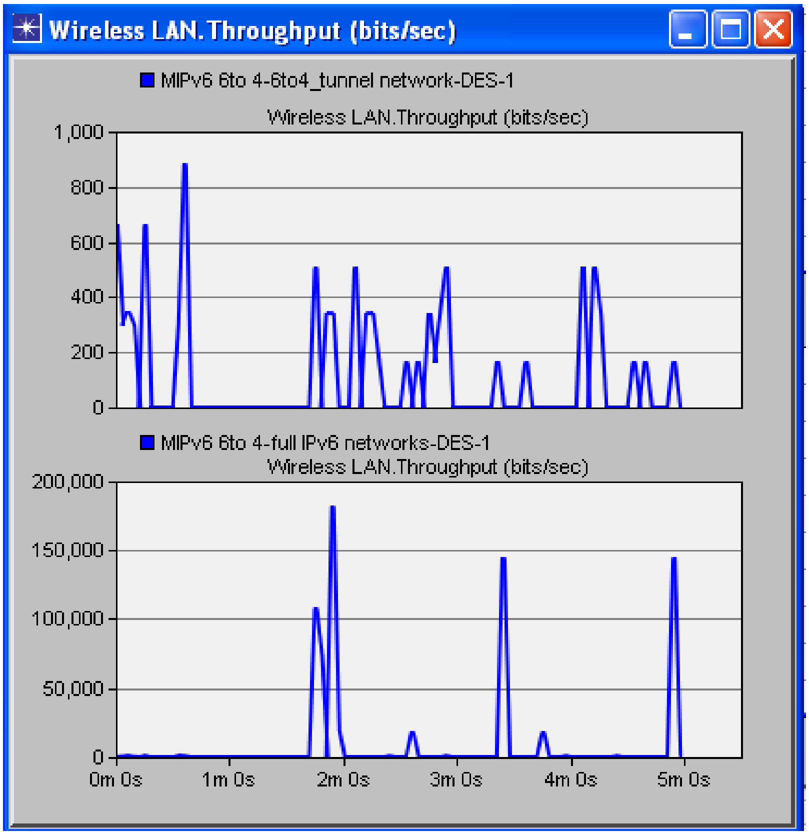

Figure 9: Throughput in WLAN

5- Results and conclusion:

In this paper we have evaluated traffic sent/received and data dropped for MN inside two different kids on networks pure IPv6 and 6 to 4 IP networks. Other important parameters related to IPv6 has been noticed is throughput inside WLAN and Finally traffic load inside IPv6 internet cloud and IPv4 internet cloud which is connected to IPv6 internet clouds (6bone).

The results show that working in pure IPv6 network with heavy application is better than working with IPv4/IPv6 networks that uses 6 to 4 mechanism to connect between different kinds of network with about 150%.

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