A Simulation Based Analysis of Ipv4, Ipv6 Migration Techniques

Swati Sharma[1] Dr. Dinesh Kumar[2]

M-Tech Student[1], HOD. [2] & Department of CSE & Shri Ram College of Engg. & Mgmt
Palwal, Haryana, India

***Abstract*— The Internet Protocol Version 6 (IPv6) has achieve popularity with organizations, companies and ISPs (Internet service providers) because of its enhancements over IPv4 like (Ipv4 32bit compared to IPV6 (128 bit). During migration from IPv4 to IPv6, one should keep in mind about interruptions of service. In this paper, three mechanisms can be use to provide a smooth migration process. Optimized Network Engineering Tool (OPNET) version 16.0 network simulation tool is use to verify result.**

Keywords: ***IPV6, IPV4, OPNET, Dual Stack, Tunnelling, NAT-PT delay , packet loss, throughput***

I. INTRODUCTION

In today's communication network, the IPv4 (Internet Protocol Version 4) has a transition to IPv6 is imminent [1]. J. L. Shah et. al. [2] have mentioned advantages of IPv6 over IPv4 that contain, support for inbuilt stateless auto configuration, a larger address space (128 bits), inbuilt support for IPSec Security, smaller packet header size, better packet forwarding, efficient Support for Mobility, Real Time Multimedia and QoS support, support for Multicast and Any cast Traffic. The migration from IPv4 based systems is the main challenge for deployment of IPv6 systems [1]. The cost contain operational downtime cost as well as the migration for equipment cost. As discussed in [3-8], many techniques have been proposed to decrease these impacts to existing systems. In this paper, an overview of tunnelling, dual stack, and translation techniques will be provided. The open source OPNET network simulation tool is used to find performance of all the aforementioned techniques. Simulation results of the delay, network throughput, and packet loss characteristics will be presented and analyzed.

II. TRANSITION TECHNIQUES

There are three main type of transition techniques:

A. *Dual-stack techniques:*

In this technique, IPv4 and IPv6 coexist on the same network infrastructure and there is no requirement of encapsulation of Ipv4 inside Ipv6 (using tunnelling) or vice-versa. This technique is not use for large networks such as the cost to cover all the network nodes and internet due to its difficulty. This technique is use for smaller size networks that needs low management effort. The dual stack is the basis for inventing the two other techniques for transition between Ipv6 and Ipv4. Fig.1 shows such configuration.

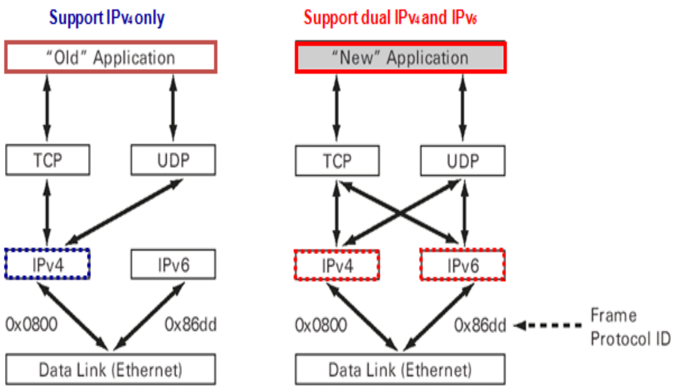

Fig. 1: The Dual Stack Architecture

B. *Tunnelling techniques:*

This technique use to transport IPv6 traffic over the existing IPv4 network infrastructure. Tunnelling techniques is used to maintain the basis IPv4 infrastructure such as when there is no support of IPv6 and can only reach IPv6 sites by encapsulating IPv6 packets within IPv4 link and use to deploy an IPv6 forwarding infrastructure. Fig.2 shows a figure of IPv6 packets carried over an IPv4 tunnel configuration.

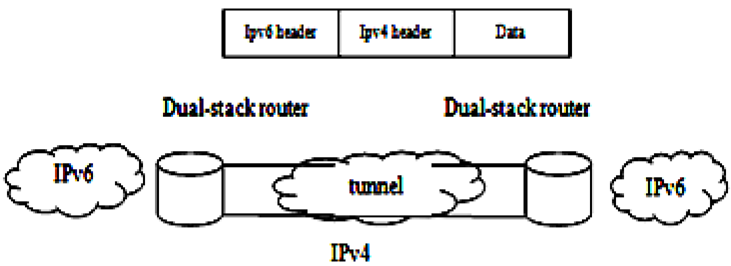

Fig. 2: The IPv6 over IPv4 Tunnel Architecture

ISSN: 2278 – 7798

c. Translation techniques:

This technique supports the Ipv4-only nodes to communicate with Ipv6-only nodes. Translation is a way which is use to make a connection between networks having different protocols; it translates Ipv4 traffic to Ipv6 or vice versa as required. Network Address Translation— Protocol (NAT-PT) is one of the translation methods in which translation can be configured dynamically or statically to translate Ipv4 address to Ipv6 or vice versa. It is noted that these techniques can be used in combination with one another.

III. Simulation Setup

In this paper, OPNET (Optimized Network Engineering Tool) version 16.0 network simulation tool is used to run simulations on 3 techniques as mentioned earlier. OPNET simulator tool is use to simulate and analyse the network performance parameters like packet loss, delay and throughput. The components used in the network models that run on OPNET 16.0 device are six clients, two switches, and three routers. The label switch (ethernet16_layer4) and label router (tr2_slip8_gtwy_adv_6upgarte) are used to represent an IP-based gateway running and supporting up to two Ethernet interfaces at a selectable data rate. The IP packets reaching on the input interface are routed to the output interface with the help of packet destination IP address. The setup having the following models and configurations and for the purpose described below:

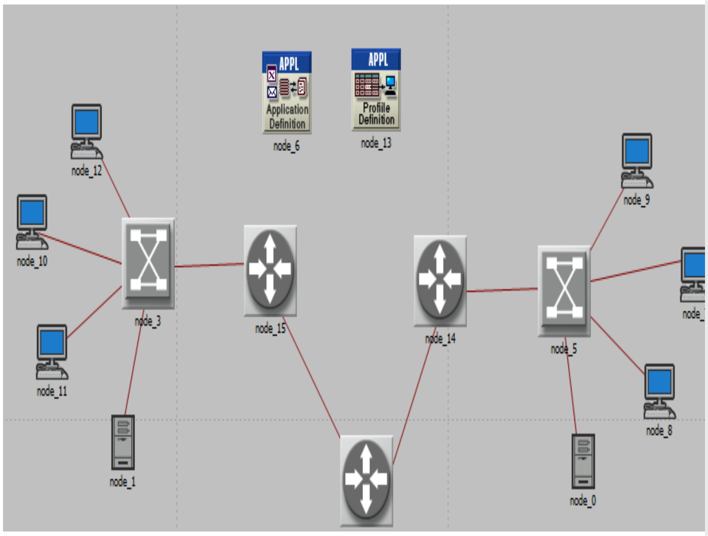

Fig 3. WiMAX Scenario in OPNET simulator

- **The ethernet16_switch node model** is used to represent a switch that is supporting up to 16 Ethernet interfaces.

- **The Ethernet wkstn _adv node model:** It is used to show a workstation with client-server applications that run over UDP/IP and TCP/IP.

- **The Application_ Config:** It includes a name and a description table that tells about different parameters for the various applications (like FTP heavy applications and web browser HTTP Heavy). While creating user profiles on "Profile_ Config" object , the specified application name is used.

- **The Profile_ Config:** It is helps to create user profiles. These user profiles can be use on various nodes in the network to create application layer traffic. Object uses the applications defined in the Application_ Config to configure profiles. Traffic patterns can be achieve by following the applications and configured profiles.

IV. Results and Analysis

A simulation period of 1 min (60 sec) is select to identify the network performance.

A. Ethernet delay Performance:

Fig. 4 represents a plot of Ethernet delay against time for the NAT-PT, dual stack, and tunnelling configurations. The graph represent that all three configuration having transient state that changes into steady state for simulation time that is more than 30% or (20s). The lowest delay values of approx 75ms is calculated by the tunnelling configuration towards the end of simulation period. Both NAT-PT and dual-stack exhibited longer delay time of approx 85-90ms.

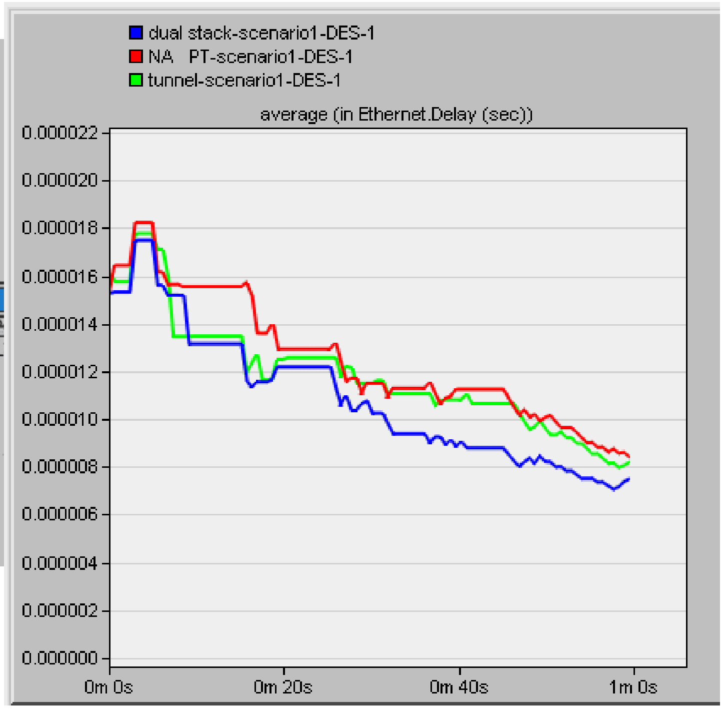

Fig. 4 Ethernet delay for the three techniques.

B. Throughput Performance:

The throughput is the amount of data packet received by the

ISSN: 2278 – 7798

target node and it is measured in bits per second. Fig.5 represents the throughput results between NAT-PT, dual stack, and tunnelling techniques. Results of the simulation exhibit a transient behaviour for a short time period at the beginning of the simulation period (~5ms). It is done by a steady state behaviour where throughput values set to 100bits/sec for NAT-PT and dual-stack techniques, while tunnelling throughput set to 200bis/sec. It is noted that the throughput values of all techniques become comparable as the simulation time approaches the end.

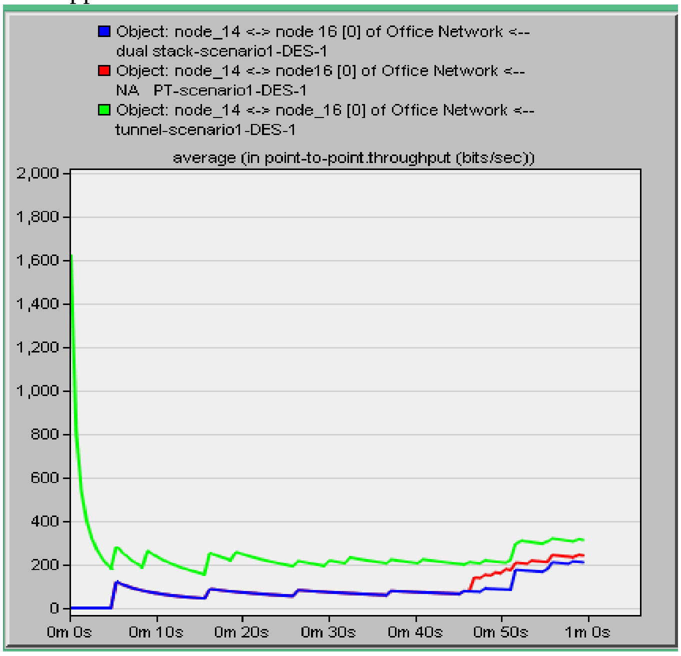

Fig. 5 Throughput performance of Dual-stack, NAT-PT, and Tunnelling configurations

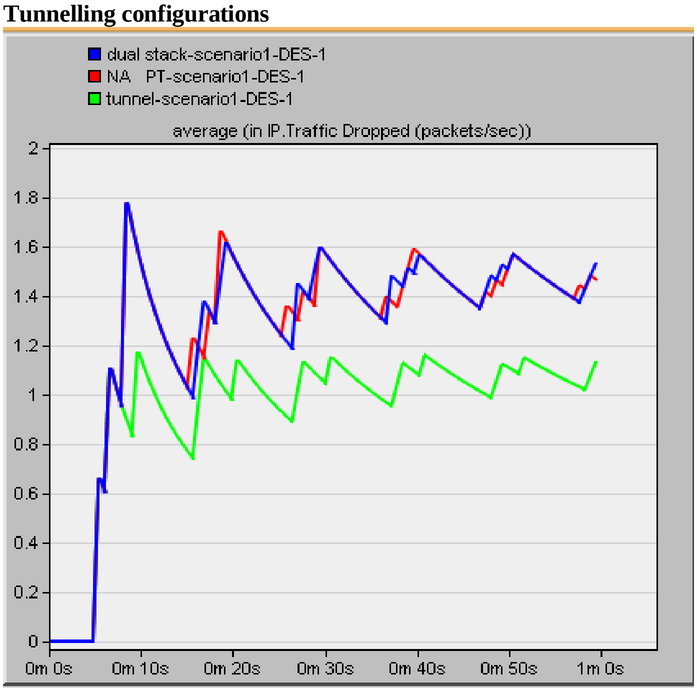

Fig. 6 packet drop (packet loss) for the dual-stack, tunnelling and NAT-PT techniques

C. Packet loss (traffic drop) Performance:

The packet loss which shows the traffic drop results are represent in Fig. 6 for the NAT-PT, dual-stack, and tunnelling configurations. All the configuration having a zero packet drop for initial (~5ms), then the drop amount increases with an overshoot behaviour. The drop settles to steady values, as time progresses. When compared to the NAT-PT and dual-stack techniques, the tunnelling techniques having smaller drop packet values of about 1(packet/sec) that represent about a drop of about 1.4(packet/sec).

Conclusions

An investigation of performance of network on NAT-PT translation, dual-stack, and tunnelling techniques as part of migration investigation of IPv4 to IPv6 infrastructure. The OPNET V17.5 is used to the study simulation for throughput, Ethernet delay, and drop packet for each technique. A transient behaviour is examined on all quantities of the network performance initially and they set to steady state. Simulation of throughput represents values of 200bit/sec for the tunnelling and 100bits/sec for the NAT-PT and dual-stack techniques. For the packet drop, it was observed that while the NAT-PT and dual-stack techniques exhibited a packet drop of about 1.4(packet/sec),the tunnelling techniques exhibited a packet drop about 1.0(packet/sec).

REFERENCES

[1] K. Salah, P. Calyam, and M. Buhari, "Assessing readiness of IP networks to support desktop videoconferencing using OPNET," Journal of Network and Computer Applications, vol. 31, no. 4, pp. 921–943, 2008.

[2] J. Moy, "OSPF Version 2," RFC 2328 (Standard), Internet Engineering Task Force, Apr. 1998, updated by RFC 5709. [Online]. Available: http://www.ietf.org/rfc/rfc2328.txt

[3] R. Coltun, D. Ferguson, J. Moy, and A. Lindem, "OSPF for IPv6," RFC 5340 (Proposed Standard), Internet Engineering Task Force, Jul. 2008. [Online]. Available: http://www.ietf.org/rfc/rfc5340.txt

[4] P. Chimento and J. Ishac, "Defining Network Capacity," RFC 5136 (Informational), Internet Engineering Task Force, Feb. 2008. [Online]. Available: http://www.ietf.org/rfc/rfc5136.txt

[5] K. Salah, P. Calyam, and M. Buhari, "Assessing readiness of IP networks to support desktop videoconferencing using OPNET," Journal of Network and Computer Applications vol. 31, no. 4, pp. 921–943, 2008.

[6] O. Balci, "Principles and techniques of simulation validation, verification, and testing," in Simulatio Conference Proceedings, 1995. Winter. IEEE, 2002, pp 147–154.

ISSN: 2278 – 7798

[7] K. Pawlikowski, H. Jeong, J. Lee et al., "On credibility o simulation studies of telecommunication networks," IEE Communications Magazine, vol. 40, no. 1, pp. 132–139, 2002.

[8] Wu, P., Cui, Y., Wu, J., Liu, J. and Metz, C. (2013). Transition from IPv4 to IPv6: A state-of-the-art survey, IEEE Communications Surveys & Tutorials, 15(3), pp.1407--1424.

[9] Wu, Y. and Zhou, X. (2011). Research on the IPv6 performance analysis based on dual-protocol stack and Tunnel transition, Proceedings of the 6th International Conference on Computer Science & Education (ICCSE), pp.1091--1093.

[10] Chen, J., Chang, Y. and Lin, C. (2004). Performance investigation of IPv4/IPv6 transition Mechanisms, Proceedings of the 6th International Conference on Advanced Communication Technology, pp.545--550

[11] Narayanan, A., Mohideen, M. and Raja, M. (2012). IPv6 Tunnelling Over IPV4, International Journal of Computer Science Issues (IJCSI), 9(2), pp.599-604.

[12] Xiaodong, Z. and others, (2009). Research on the Next-generation Internet transition technology, Proceedings of Second International Symposium on Computational Intelligence and Design (SCID '09), pp.380-382

[13] A. Law, W. Kelton, and W. Kelton, Simulation modelin and analysis. McGraw-Hill New York, 1991, vol. 2.

[14] Y. Wang, S. Ye, and X. Li, "Understanding Current IPv6 Performance: A Measurement Study," in 10th IEEE Symposium on Computer Communications, Jun. 2005.

[15] X. Zhou, R. E. Kooij, H. Uijterwaal, and P. van Mieghem, "Estimation of Perceived Quality of Service for Applications on IPv6 Networks," in ACM PM2HW2N'06, Oct. 2006.

[16] D. P. Pezaros, D. Hutchison, F. J. Garcia, R. D. Gardner, and J. S. Sventek, "Service Quality Measurements for IPv6 Inter-networks," in 12th IEEE IWQoS, Jun. 2004.

[17] T.-Y. Wu, H.-C. Chao, T.-G. Tsuei, and Y.-F. Li, "A Measurement Study of Network Efficiency for TWAREN IPv6 Backbone," International Journal of Network Management, vol. 15, no. 6, pp. 411–419, Nov. 2005.

[18] K. Cho, M. Luckie, and B. Huffaker, "Identifying IPv6 Network Problems in the Dual-Stack World," in ACM SigComm Network Troubleshooting Workshop, Sep. 2004.

[19] S. Zeadally and L. Raicu, "Evaluating IPv6 on Windows and Solaris," IEEE Internet Comput., vol. 7, no. 3, pp. 51–57, May/Jun. 2003.

[20] R. Sargent, "Verification and validation of simulation models," in Proceedings of the 37th conference on winter simulation. Winter Simulation Conference, 2005, pp. 130–143

[21] A. Law, "Statistical analysis of simulation output data: the practical state of the art," in Simulation Conference, 2007 Winter. IEEE, 2008, pp. 77–83.

[22] OPNET, Modeler Release, 14th ed. [Online]. Available: http://www.opnet.com/solutions/network_rd/modeler.html

[23] Grosse, E. and Lakshman, Y. (2003). Network processors applied to IPv4/IPv6 transition, IEEE Network, 17(4), pp.35-39.

[24] Ali, A. (2012). Comparison study between IPv4 & IPv6, International Journal of Computer Science Issues (IJCSI), 9(3), pp.314-317

[25] Batiha, K. (2013). Improving IPv6 Addressing Type and Size, International Journal of Computer Networks & Communications (IJCNC), 5(4), pp.41-51

[26] I. Parra, J. (2014). Comparison of IPv4 and IPv6 Networks Including Concepts for Deployment and Interworking, INFOTECH Seminar Advanced Communication Services (ACS), pp.1-13

[27] Sailan, M., Hassan, R. and Patel, A. (2009). A comparative review of IPv4 and IPv6 for research test bed, Proceedings of International Conference on Electrical Engineering and Informatics (ICEEI '09), Malaysia, pp.427-433.

[28] Ahmad, N. and Yaacob, A. (2012). IPSec over Heterogeneous IPv4 and IPv6Networks: Issues and Implementation, International Journal of Computer Networks & Communications (IJCNC), 4(5), pp. 57-72

[29] Arafat, M., Ahmed, F. and Sobhan, M. (2014). On the Migration of a Large Scale Network from IPv4 to IPv6 Environment, International Journal of Computer Networks & Communications (IJCNC), 6(2), pp.111-126.

ISSN: 2278 – 7798