IPv4 to IPv6 Migration

Nousyba Hasab Elrasoul Abu Algasim, Dr.Amin Babiker A/Nabi Mustafa

***Abstract*— this paper aims to discuss a different issues About the IPv6 As the next generation of the internet protocol and to give a brief understanding of some of the most important migration mechanisms .these include Dual-Stack, Tunneling .the paper pays especial attention for tunneling mechanism, it tries to explore its related attempts in depth .**

***Index Terms*— IPv6, Dual-Stack, IPv4**

I. Introduction

To help ensure the continued rapid growth of the Internet as a platform for innovation, And Rescue The Internet, The Internet Engineering Task Force (IETF) developed IPv6 to deal with the long-anticipated IPv4 address exhaustion, and described Internet standard document RFC 2460, published in December 1998.

The Internet operates by transferring data in small packets that are independently routed across networks as specified by an international communications protocol known as Internet Protocol (IP). Each data packet contains two numeric addresses that are the packet's origin and destination devices. Since 1981, IPv4 has been publicly use version of the Internet Protocol, and currently the foundation for most Internet communications. The growth of the Internet has mandated a need for more addresses than are possible with IPv4. IPv6 allows vastly more addresses.

Internet Protocol version 6 (IPv6) is a version of the Internet Protocol (IP) that is designed for succeed IPv4.

II. Protocol Upgrades

An Internet protocol address is a unique numeric identifier for devices connected to the Internet; each address includes information about how to reach a network location via the Internet routing system. Every device directly connected to the Internet have an Internet protocol address. The purpose of this chapter is to describe the function of these addresses and the reasons the current system requires replacement. We will discuss the current situation concerning the new version of the Internet protocol, and the opportunities and challenges that accompany the new version.

The current system, known as Internet protocol version 4 (IPv4), is the fourth iteration of a system of Internet standards and the first version of the protocol to be widely deployed. Presently, it is the only standard protocol used on the Internet.

Manuscript received November 16, 2014.

Nousyba Hasab Elrasoul Abu Algasim,Alneelain University-Faculty of Engineering, Sudan- Khartoum

Dr.Amin Babiker A/Nabi Mustafa, Alneelain University- Dean of the Faculty of Engineering,Sudan- Khartoum

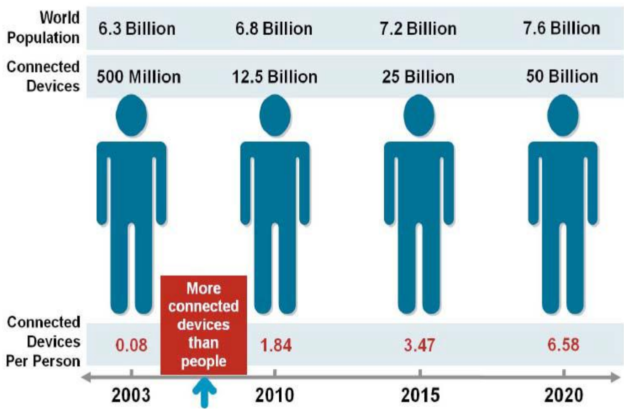
devolved In 1978 when the Office of the Secretary of Defense (OSD) mandated the use of IPv4 for all "host-to-host" data exchange now has serious challenges .By 1992 it was clear that a shortage of address space would limit further growth of the Internet ,There are just over 4 billion IPv4 addresses. While there are lots of IP addresses and it is not enough.

Consequently, the Internet Engineering Task Force (IETF) initiated in 1994 the development of a new protocol, known as Internet protocol version 6 (IPv6), to support expanding Internet usage and address security concerns.

III. The Problem with IPv4

Within the Internet, every host must have access to at least one interface to the network that can be uniquely identified through a globally unique IP address. Once you run out of IP addresses, you can't add any more nodes to the network. IPv4 has limit about 4 billion (4,000,000,000) unique addresses ,but in practice IPv4 is unlikely to support a sustainable population of no more than about 250 million uniquely addressed nodes. To many of those who fear the possibility we eventually do without the Internet, IPv6 would represents the last and the best hope for continued.

A study done by Cisco IBSG research estimates that there will be 25 billion devices connected to the Internet by 2015 and 50 billion by 2020. This is depicted in the following



The problems with IPv4 for which IPv6 is considered as a solution

-The exhaustion of IPv4 addressing space.

- The collapse of the Internet routing structure due to explosive growth of the no default routing table.
- The problem of end-to-end interoperability across routing domains in which addresses may not be globally unique.
- End-to-end or transparency is what you get when endpoints in a network are able to interoperate without any knowledge of the interfering network and without any interference or interference from intermediate systems. Transparency makes network application development much simpler, for one thing. The developer need only program an application to interface with the network cloud; when transparency is absent,

the developer must deal with intermediate systems such as firewalls, NATs, and caching proxies. Security, in particular, is sensitive to transparency.

At the same time, IPv6 will likely never replace IPv4. It must somehow coexist with IPv4 as it gains ground. There will be no cutover date, with all IP nodes switching from IPv4 to IPv6; IPv4 and IPv6 will likely always coexist. The question is what share each protocol holds. While the Internet will never cutover from v4 to v6, there will certainly be smaller networks that do change all at once, and others that will make the complete switch more slowly. As that happens, those networks will either maintain a connection to the IPv4 Internet or just go on their own separate way. Should that happen, parallel IPv4 and IPv6 Internets could replace today‘s single interoperable and universal Internet.

IV. IPv6

The IETF chartered an Internet Protocol -Next Generation working group that in 1993, issued a white paper soliciting suggestions. The responses were considered in developing technical criteria for choosing the next generation Internet protocol. The working group stated seventeen criteria, including scale, transition, media independence, configuration, administration and operation, multicast, network service, and mobility. After considerable discussion, the IETF recommended a next generation Internet protocol, specifying the important features of IPv6 a larger address pool, enhanced routing capabilities, authentication and encryption, mobility, quality of service functions, and more.

IPv6 is the next generation Internet Protocol (IP) address standard intended to supplement, and eventually replace, the IPv4 protocol most Internet services use today. To help ensure the continued rapid growth of the Internet as a platform for innovation, IPv6 tackles some of IPv4's shortcomings of limited amount of remaining addresses. While the technical foundations of IPv6 are well established, significant work remains to deploy and begin using IPv6 capabilities.

Because IPv6 is central to the continued growth and stability of the Internet, the Internet Society is working with its members and other organizations to promote its deployment by sharing information and helping to build the required operational capability among the Internet community.

V. The New Internet Protocol

Accordingly, IPv6 is a new version of the protocol. It serves the same function as IPv4 does, but without the limitations of IPv4. According to IETF the changes from IPv4 to IPv6 fall primarily into the following categories:

1. Expanded Addressing Capabilities - IPv6 supports more levels of addressing hierarchy, a much greater number of addressable nodes, and simpler auto-configuration of addresses.
2. Header Format Simplification - Some IPv4 header fields have been dropped or made optional.
3. Improved Support for Extensions - More efficient forwarding, less stringent limits on the length of options, and greater flexibility for introducing new options in the future.
4. Options and Flow Labeling Capability – IPv6 enables the labeling of packets belonging to particular traffic "flows" for which the sender requests special handling, such as non-default quality of service or "real-time" service

VI. IPv6 QoS

IPV6 brings quality of service that is required for several new applications such as IP telephony, video/audio, interactive games or ecommerce. Whereas IPv4 is a best effort service, IPv6 ensures QoS, a set of service requirements to deliver performance guarantee while transporting traffic over the network.

For networking traffic, the quality refers to data loss, latency or bandwidth. In order to implement QoS marking, IPv6 provides traffic-class field (8 bits) in the IPv6 header. It also has a 20-bit flow label.

VII. How to Convert(Transition Mechanisms)

The transition between IPv4 and IPv6 will be processed in which both protocol versions will coexist. To avoid disruption of the Internet, the IETF has devised a number of transition techniques. The most important are dual stack operation and tunneling.

Dual stack operation is the notion that a host can run both IPv4 and IPv6 side by side which enables communication with both IPv4 and IPv6 nodes. The other mechanism is “IPv6 in IPv4 tunneling,” which enables the interconnection of an Internet protocol network. Tunneling allows IPv6 packets to cross that part of the network that supports only IPv4: the IPv6 packets are encapsulated inside IPv4 packets, and transmitted through that part of the network, and continue on their way over the IPv6 network. Another technique uses a translation mechanism. Translation is necessary when an IPv6-only host has to communicate with an IPv4–only host.

VIII. Transition Mechanisms Dual Stack vs Tunneling

	Dual Stack	**Tunneling**
Description	In Dual stack the equipment is implementing both IPv4 and IPv6. It is Mechanism in which an application, a node, a device or any other network entity supports both IPv4 and IPv6 simultaneously	is the mechanism in which encapsulates IPv6 packets within IPv4 packets for traversal over an IPv4 network. As the network becomes IPv6 dominant, the remaining few IPv4 applications could use the reverse mechanism by which IPv4 packets are encapsulated in IPv6 packets.
Architecture	Simple and flexible and easy to use	Complicated
Security	Ipv6 network security like ipv4 networks	More secure
Cost	cheap	Expensive

Algorithm	two routing tables and two routing processes may be required	
Protocol	Both IPv4 and IPv6 run independent of each other	Tunnels carry one protocol inside another, tunnels take IPv6 packets and encapsulate them in IPv4 packets to be sent across portions of the network
OS	Additional CPU memory	Additional CPU memory load to encapsulation /de-capsulation
Access	Native IPv4/IPv6 services between aggregation and end users.	High volume deployment of IPv6 while underlying infrastructure is still IPv4
WAN	IPv4 and IPv6 services available from ISP.	IPv6 services between large number of sites acrossIPv4 infrastructure.
	Clients and Servers have to support both IPv4 and IPv6	Great for using older legacy equipments
Scalability	Easy to implement, but complex management	Easy to implement over existing IPv4 infrastructure
Performance	Can be slow with stacked protocol on the network	Depend on tunnel speed(performance)
IPSec	IPSec	IPSec(security)

IX. Conclusion

In this paper, we presented a QoS service that we have implemented on IPv6 network and examined its correctness. The QoS mechanisms that were used widely in order to make sure that they work well and additionally to investigate their performance.

Reference

[1] Wikipedia. (2009). *IPv4* [online]. Available from: http://en.wikipedia.org/wiki/IPv4 [Accessed April 2009].

[2] van Beijnum, I. (2008). ARIN: It‘s time to migrate to IPv6. *Ars Technica* from: http://arstechnica.com/news.ars/post/20070521-arin-its-time-to-migrate-to-ipv6.html

[3] Das, K. (2008). *IPv6--The history and timeline* [online]. Available from: http://www.ipv6.com/articles/general/timeline-of-ipv6.htm.

[4] Beijnum I. (2009). *The year in IPv4 addresses: almost 200 million served* Available from:http://arstechnica.com/business/news/2009/01/the-year-in-ipv4-addresses-almost-200-million-served.ars [Accessed April 2009].

[5] Intec NetCore, Inc. (2009). *IPv4 Exhaustion Counter* [online] Available from: http://inetcore.com/project/ipv4ec/index_en.html

[6] Anonymous. (no date). *IPv4 address report* [Available from: http://www.potaroo.net/tools/ipv4/ .

[7] Patrizio, A. (2008). IPv4 addresses expected to run out in 2010. *Internetnews.com*. Available from: http://www.internetnews.com/infra/article.php/3680121

[8] Reza Tadayoni & ,Anders Henten,. (2012). Transition from IPv4 to IPv6 , Center for Communication, Media and Information technologies (CMI) Aalborg University Copenhagen , 23rd European Regional ITS Conference

[9] Miller, M. A. (2008). *IPv6--ready for prime time? Part I: history and design criteria* Available from: http://www.enterpriseitplanet.com/networking/features/article.php/3655801

[10] IEFT (1998). *Internet Protocol, Version 6 (IPv6), Specification* Available from: http://tools.ietf.org/html/rfc2460

[11]Ernest BYARUHANGA, & Brice ABBA , & Hisham IBRAHIM ,IPv6 for Engineer , Afrinic -17 Khartoum Sudan 24-29 November 2012

[12] Gilligan, R. E. and Nordmark, E. (1996). *Transition mechanisms for IPv6 hosts and routers* Available from: http://www.ietf.org/rfc/rfc1933.txt

[13] Carmes, E. (2002). *The transition to IPv6* [online]. Available from: http://www.isoc.org/briefings/006/

[14 Carmes, E. (2002). *The transition to IPv6* [online]. Available from: http://www.isoc.org/briefings/006/

[15] Anonymous. (no date). *IPv6 deployment challenges and risks* [online]. Available from: http://www-dsg.stanford.edu/papers/triad/node24.html.