Evolution of new version of internet protocol (IPv6) : Replacement of IPv4

Nargish Gupta*
Sumit Gupta**
Munna Pandey***

Abstract

Taking into consideration today's scenario internet is becoming a vital part of modern life. The basic functioning of Internet is based on Internet Protocol (IP). As we were using IPv4 but it has resulted in an unwanted growth issue. The reason behind its detonation is the brisk use of network addresses which leads to the decrement in the performance for routing. So in the coming years the unease of the internet will not decrease and the increase cannot be imagined with so much advancement in the technology. So to achieve this evolution in Internet there is a need for transition from IPv4 to IPv6. IPv4 address spaces has finally drained and IANA (Internet Assigned Numbers Authority) is left with no choice as to move towards the transition from IPv4 to IPv6. This paper reevaluates the main issue and the complications in IPv4- IPv6 transition and proposes the principles of tunneling and translation techniques. In this we surveys the mainstream tunneling and translation mechanisms, it new mechanism, techniques, pros and cons and appropriateness.

Keywords: Internet Protocol, IPv4, IPv6, Routing.

I. Introduction

Since the very early stage of the Internet IPv4 [1] has been used as the network layer protocol. No one has thought at the designing time of the protocol that the span of IPv4 Internet can be so bigger [2]. It was actually unexpected. The set of obstacles which are currently coming in IPv4 Internet is the exhaustion, routing scalability, and broken end-to-end property. IANA (Internet Assigned Numbers Authority) had been depleted with IPv4 address pool in Feb 2011, so as per the status we will soon be exhaust their IPv4 address space [3]. On the other hand, the technology is growing as fastest as possible especially the number of mobile users and it will continue. Thus resulting in the excessive demand for new IP address allocation which is difficult to gratify with IPv4. ChinaTelecom is among the biggest telecom ISPs (Internet Service Providers), as per them by the end of 2012, they will use up all the IPv4 addresses. Besides, the prefix de-aggregation caused by address block subdivision, multihoming and traffic engineering has caused a burst in Global IPv4 RIB (Routing Information Base) and FIB (Forwarding Information Base). Scalability problem is the biggest issue with which Internet is suffering. The basic end-to-end property all over the Internet has been broken down with the ample use of NAT.

Nargish Gupta*
IITM Janakpuri, New Delhi
Sumit Gupta**
LNCT Bhopal
Munna Pandey***
IITM Jankpuri, New Delhi

II. Challenges of IPv4

Since the advancement of technology our life style is become easier but there are various things under consideration. Now the new technology immersed which is internet of things means thing will communicate with each other. Due to this every device needs a unique address to identify uniquely this leads to various challenges on existing IP protocol i.e. IPv4 listed below:

- ***IP Address Depletion:***

In IPv4 limited number of unique public address are available (i.e. 4 billion) and IP enabled device are increases day by day. So every device needs a unique

IP address which immerses the some extra IP address especially for always on devices. IPv4 are not able to fulfill the IP demands.

- *Internet Routing Table Expansion:*

Routing table is used by routers to make best path so network and entities connected to internet increases so does the number of network routes. These IPv4 routes consume a great deal of memory and processor resources on internet routers. Which will increases the complexity of the network as well as takes lots of space.

- *Lack of end to end Connectivity:*

Due to better use of IP address IANA introduce public and private addressing. By using private address multiple devices are able to connect through the internet by single IP address. But it needs translation between public address to private ip address as well as private to public IP address. Network Address Translation (NAT) is an technology commonly implemented within IPv4 network NAT provide a way for multiple devices to share a single public IP address. This is an overhead which leads to increase complexity of the network and increases the possibility of error [4].

III. Improvement that IPv6 Provides

In early 1990's the internet engineering task force(IETF) grew concerned about the issues with IPv4 and began to look for replacement this activity leads to development of IP version 6. IPv6 overcome the limitation of IPv4 some are listed below:

- *Internet address space:*

It increases address space 128 bit long instead of 32bit which is in IPv4. Due to increases the size it has more number of addresses which is sufficient to present as well as future scenario. IPv6 can allot 340 undecillion addresses to unique devices which is sufficient to handle present traffic.

- *Improved Packet Handling:*

Ipv6 packet has eliminated the un required field which is not required from IPv4 and include required fields which is not present in the IPv4 header. IPv6 simplified with fewer fields this improve packet handling by intermediate routers and also provides support for extensions and options for increased scalability.

- *Eliminates need of NAT:*

As mention earlier IP version4 does not have sufficient Ip addresses. So this problem is solved by Public and Private addresses. But use of private addresses required NATing which is an overhead. In IPv6 NATing concept is eliminated because of large number of IPv6 addresses.

- *Integrated Security:*

IPv4 is the first IP version which is mostly focuses on the how we can transfer data from two or more devices. This requirement was successfully accomplished by IPv4. But as an technology increases chance to theft also increases. Ipv4 does not provide any security fields. By keeping in a mind IPv6 has integrated security. It provides authentication and privacy capabilities.

IV. Internet Protocol Version 6 (IPv6)

On Monday Jan 31 2011 IANA allocated the last two /8 IPv4 address block to Regional internet registries (RIR) so IANA implement IPv6. The packet format of IPv6 kept simple by adding fewer fields. All Fields of IPv6 are described in the packet format in figure 1.

<table>
<tr><td>Version
(4bit)</td><td>Traffic Class
(8 bit)</td><td colspan="2">Flow Control
(20 bit)</td></tr>
<tr><td colspan="2">Payload Length
(16 bit)</td><td>Next Header
(8 bit)</td><td>Hop Limit
(8 bit)</td></tr>
<tr><td colspan="4">Source IP Address
(128 bit)</td></tr>
<tr><td colspan="4">Destination IP Address
(128 bit)</td></tr>
</table>

Figure 1: Packet format of IPv6

Table 1: Comparison of Internet Protocol version 4 and Internet Protocol version 6

Characteristic Factor	IPv4	IPv6
Header Length	It is of 32 bit long	It is of 128 bit long
IP Security	It does not have any security	It provides integrated authentication and privacy capabilities
Address Resolution and Address Auto Configuration	It has ICMPv4 which does not includes address resolution and address auto configuration	ICMPv6 which includes address resolution and address auto configuration
NATing	Here we need Network Address Translator(NAT)	Due to large number of address space no need of NATing
Header	!2 basic header field not including option and padding field	Simplified with 8 fields this improve packet handling
Octets	20 (Up to 60 bytes if option field used)	40 (Large because of the length of source and destination)

Version: Version is same as IPv4 which is used to identify the version of the packet. It is of 4 bit long field. For IPv6 always set version field to 0110 and 0100 for IPv4.

Traffic Class: This field is same as type of service field in IPv4. It is of 8 bit long field used for real time application. It can be used to inform router and switches to maintain same path for the packet flow so that packet are not reordered.

Payload Length: Payload length field is 16 bit long field. It is equivalent to total length field in IPv4. Define entire packet size including header and optional extensions [5].

Next header: Next Header field is 8 bit long field which is similar to time to live field of IPv4. These values are decremented by one by each router that forwards the packets when value reaches zero packet is discarded and ICMPv6 message is forwarded to sending host indicate that packet did not reach to destination.

Source Address: It is of 128 bit long. This is used to specify the address of the sender who tries to send the message.

Destination Address: It is of 128 bit long. This address is used to specify the destination address that to sender wants to sends the message.

IPv6 packet might also contain extension header (EH) which provides optional network layer information. EH are optional and are placed between IPv6 header and payload. EH are used for fragmentation, for security, to support mobility and more [6].

V. IPv4 and IPv6 Coexistence

There is not a single date to move IPv6. Both Ipv4 and Ipv6 will coexist. The transition is expected to take years. IETF (Internet engineering task force) has created various protocols and tools to help network administrator migrate their network to IPv6. These migration techniques are divided into three categories:

Dual Stack: It allows Ipv4 and IPv6 to coexist on the same network. Dual stack devices run both IPv4 and IPv6 protocol stack simultaneously.

Tunneling: It is method to transporting IPv6 packet over an IPv4 network. IPv6 packet is encapsulated inside an IPv4 packet similar to other type of data.

Translation: NAT64 allows IPv6 enabled device to communicate with IPv4 enabled device using a translation technique similar to NAT for IPv4

VI. Comparision and Analysis

IPv6 provides 340 undecillion addresses roughly equal to every grain of sand on earth. Some field are renamed same. Some field from IPv4 is not used. Some field changed name and position. In addition new field has been added to IPv6 which is not IPv4 [7]. The detailed comparison between Internets Protocol version 4 and

Version 6 are shown in Table 1. In Table 1 first column shows the various characteristic factor bases on these two are differ. While second column is for IPv4 and third column is for IPv6 [8].

VII. Conclusion

IPv6 and IPv4 both are the Internet Protocols which we are currently used. Definitely IPv6 is the best among two because it comes after the IPv4 so it eliminate the drawbacks of IPv6. IPv4 is the popular protocol which we use since long time due to this both protocol keeps their equal importance. In this paper we can clearly see that the IPv6 is better replacement of IPv4 which will take time to overcome the IPv4.

References

1. W. Stalling, Data and Computer Communication, 5th Edition,upper saddle river, NJ: Prentice Hall, 2012.
2. M. Mackay and C. Edwards, "A Managed IPv6 Transitioning Architecture for Large Network Deployments," IEEE Internet Computing, vol. 13, no. 4, pp. 42 –51, july-aug. 2009.
3. S. Bradner and A. Mankin, IPng: internet protocol next generation reading, MA: Addision-Wesley, 2011.
4. R. Gillign and R. allon ,"IPv6 Transition mechanism overview" Connexions, oct 2002.
5. E. Britton, J. Tavs and R. Bournas, "TCP/IP: The next generation", IBM sys, J.No. 3, 1995.
6. C. Huitema, IPv6 the new internet protocol, Upper saddle river, NJ. Prentice Hall, 1996
7. R. Hinden,"IP next generation overview" connexions, Mar 1995.
8. Fernandez, P. Lopez, M. A. Zamora, and A. F. Skarmeta, "Lightweight MIPv6 with IPSec support (Online First, DOI: 10.3233/MIS-130171)," Mobile Information Systems, http://iospress.metapress.
9. G. Huston, "IPv4 Address Report," Tech. Rep., Sep. 2010. [Online]. Available: http://www.potaroo.net/tools/ipv4
10. S. Deering and R. Hinden, "Internet Protocol, Version 6 (IPv6) Speci- fication," 1998, IETF RFC 2460.
11. S. Thomson, T. Narten, and T. Jinmei, "IPv6 Stateless Address Autoconfiguration," 2007, IETF RFC 4862
12. R. Hinden and S. Deering, "IP Version 6 Addressing Architecture," 2006, IETF RFC 4291