

Introduction to IPv6 and Benefits of IPv6

Ammar Yasir Korkusuz

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Bogazici University, Electrical-Electronics Engineering Department

MSc. Student

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Abstract: IPv6 is a new internet protocol technology which is about to be used by the entire world. IPv4 is the current ip technology and it has a lot of weakness. In this work, IP and its history will be given, and then disadvantages of IPv4 will be mentioned. Finally, IPv6 technology and benefits of it over IPv4 will be discussed.

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1 Introduction to IP

IP is the internet protocol which is network layer protocol and the key element of Internet technology. The IP protocol is the protocol most used by computer systems to intercommunicate. The majority of higher-level applications or protocols (HTTP, SMTP, P2P, etc.) are based on this protocol for their functioning.

Computers and devices using the IP protocol are assigned a unique identifier called IP address to route the message through the different communication network nodes from source to destination. This identifier is a 32-bit integer number which is usually represented as four numbers, from 0 to 255, each separated by a dot, for its greater ease of handling.

IP was first announced by IETF (Internet Engineering Task Force) in 1970's. There are old versions, current version which is IPv4 and new version which is IPv6. [1]

IPv4 looks like this (Also it can be seen in Figure 1):

255.255.255.255

And IPv6 looks like this:

FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF

What Is My IP Address? (Now detects many [proxy servers](#))



IP Information: 46.104.173.207

ISP: Avea Iletisim Hizmetleri A.S.

Organization: Avea Iletisim Hizmetleri A.S.

Connection:

Services: [None Detected](#)

City: Istanbul

Region: Istanbul

Country: Turkey

46.104.173.207

[Additional IP Details](#)

What is an IP address?

Every device connected to the public Internet is assigned a unique number known as an Internet Protocol (IP) address. IP addresses consist of four numbers separated by periods (also called a 'dotted-quad') and look something like 127.0.0.1.

Figure 1: An example IP Address [2]

2 Old version of IP technology

2.1 IPv0, 1, 2, 3

In 1970's, IETF's workgroups were working on Internet protocol and they were firstly invented the old version of IP. IPv1, IPv2 and IPv3 were used to development of IPv4. They never used for public and they were always remained as experimental versions. [3]

2.2 IPv5

In 1979, Internet Stream protocol was invented. Its uniqueness was to transmit the video, audio and multimedia messages over the internet. This Internet Stream Protocol was called IPv5. It was never used for public and it never saw the light of day.

It is working on the same level with IPv4. However, it is using different header format than IP datagram is used. [4]

3 Disadvantages of Current IPv4

IPv4 has a lot of weakness and disadvantages. IPv4 inventers did not think that this technology will become this much popular and this much people work with it.

The first disadvantage of IPv4 is that the number of IP addresses. There is 2^{32} ip addresses which is around 4 billion. Today's world, it is not enough and the world needs more ip addresses.

The second problem is mobility problem. IPv4 doesn't support mobility and handover mechanisms. If the mobile goes form one network to another network, the connection need to be establish again.

Moreover, IPv4 uses NAT (Network Address Translation) to increase the number of IP addresses. It gives users private ip addresses then a lot of users enter the internet by using only one public IP address. However, NAT has a lot of problem.

Firstly, NAT causes problem in RTC (real time communication) protocol. This protocol is used for VoIP and multimedia communication.

Secondly, it causes security problems. Because it changes the IPSec headers and it damages the end-to-end security and data integrity.

Finally, it has peer-to-peer communication problems. Since everybody doesn't have a real IP address, the connection between users is hard to establish because of the public IP usage.

[5]

4 IPv6 Overview

After seeing the disadvantages of IPv4, Internet Engineering Task Force (IETF) had found IPng (Internet Protocol next generation) workgroup in 1990's. This group's aim was to find a new IP protocol to solve the problems on the current IPv4. It has a lot of people such as Industry professionals, universities and organizations and they worked together for 10 years.

For the last 5 years, IPv6 starting time was suspicious. Network experts were making predictions about starting time of IPv6 but mostly they were wrong.

Finally, at 6 June 2012, IPv6 was officially started. The major companies started to use IPv6 and a lot of others are expected to join them. [6]



**THE WORLD IS DIFFERENT NOW
SEE WHAT PEOPLE ARE SAYING...**

PARTICIPANTS

THIS TIME IT IS FOR REAL

Major Internet service providers (ISPs), home networking equipment manufacturers, and web companies around the world are [uniting to redefine the global Internet and permanently enable IPv6 for their products and services](#) on 6 June 2012.

AKAMAI COMCAST FREE TELECOM KDDI TIME WARNER CABLE	AT&T D-LINK GOOGLE LIMELIGHT XS4ALL	CISCO FACEBOOK INTERNODE MICROSOFT BING YAHOO!
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Figure 2: The list of companies which started to use IPv6

5 Benefits of IPv6 over IPv4

There are a lot of difference and benefits of IPv6 over IPv4. In this chapter, the difference and advantages of IPv6 will be given by comparing with IPv4.

5.1 Headers of IPv6 and IPv4

There are a lot of differences between IPv4 headers and IPv6 headers. Some fields name are the same, some fields was not even taken for IPv6. Some field's name or position is changed and there is also one new field which is Flow Label.

In Figure 3, the header comparison of the IPv4 and IPv6 can be seen.

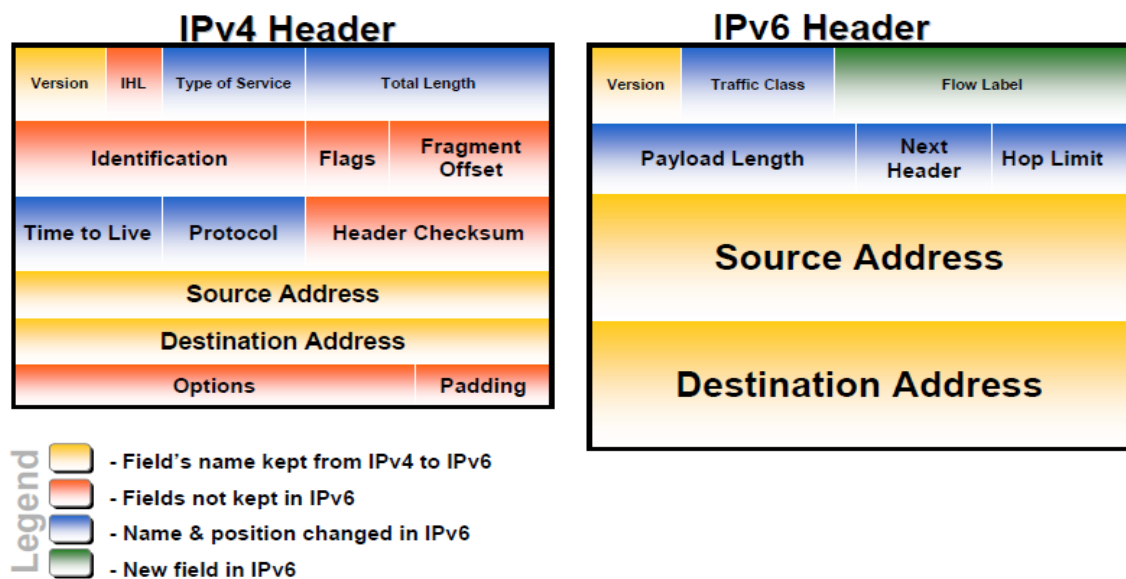


Figure 3: Headers of IPv6 and IPv4 [5]

5.2 Number of IP Address

In today's world, everything goes IP such as PDA, mobile phones, Tablet Computers, Washing Machines, Air Conditions, Security Systems. All of these devices need an IP address for communication.

Ipv4 has 2^{32} IP address which is 4294967296 – around 4,2 billion . However, Ipv6 has 2^{128} IP address which is 340.282.366.920.938.463.463.374.607.431.768.211.456 - too much to read.

The number of IPv6 IP address is quite enough for communication for the next 20 years.

[5]

5.3 Security

In the beginning of IPv4, security wasn't thought so much. The only interest was to invent a protocol which allows everyone to communicate with anyone they wish. Security mechanisms of IPv4 (IPSec, Authentication) are added lately and this is not in IPv4's natural feature.

However, IPv6 has IPSec mechanism which is embedded. This makes the communication more secure comparing with IPv4 communication security. [4]

5.4 Quality of Service (QoS)

QoS mechanism is the priority mechanism for multimedia packets, such as audio or video packets. In IPv4, QoS mechanism is done on the network devices and it makes load for the routers.

However, in IPv6, there is a field for QoS mechanism in the IPv6 header and this makes not only router's job easier but also communication more efficient. [7]

5.5 Auto configuration

In IPv4, configuration of IP address is difficult to manage. There is 2 way to allocate IP addresses to the users. The first way is using DHCP server which is an addition cost. The second way is to give each user a unique IP and expect people to enter these addresses to the computers which is quite hard procedure for some users.

In IPv6, there is address auto-configuration which is quite easy. A router will send the prefix of the local link in its router advertisements then a host can generate its own IP address by appending its link-layer (MAC) address. [4]

5.6 Mobility

In IPv4, nodes have to take a different IP address for different Networks. This causes connection drops when moving from one network to another network.

However, in IPv6, it won't matter where in the world a device goes, it can be contacted using the same global IP address. [8]

5.7 Routing and Packet Processing

In IPv6 networks, fragmentation is handled by the source device, rather than the router, this reduces router load.

IPv6's contains no IP-level checksum, so the checksum does not need to be recalculated at every router hop, link-layer technologies and transport layers already contain checksum and error-control capabilities. [4]

5.8 Multicast

IPv6 supports multicast rather than broadcast. It allows data to be sent only multiple selected destinations rather than to be sent all the devices on the network. This saves network bandwidth. [7]

5.9 Peer-to-Peer Connections

In IPv6, every device will have its own IP address. This will allow people to have peer-to-peer connections more easily Such as Remote Desktop Connections.

It means that, people will not have any problem to connect the other computers even though they are not on the same network. [7]

5.10 The summary of IPv4 and IPv6 differences

It can be seen the summary of IPv4 and IPv6 differences in Figure 4 below.

IPv4	IPv6
Addresses are 32 bits (4 bytes) in length.	Addresses are 128 bits (16 bytes) in length
IPSec is optional and should be supported externally	IPSec support is not optional
Header does not identify packet flow for QoS handling by routers	Header contains Flow Label field, which Identifies packet flow for QoS handling by router.
Both routers and the sending host fragment packets.	Routers do not support packet fragmentation. Sending host fragments packets
Header includes a checksum.	Header does not include a checksum.
ARP uses broadcast ARP request to resolve IP to MAC/Hardware address.	Multicast Neighbor Solicitation messages resolve IP addresses to MAC addresses.
Configured either manually or through DHCP.	Does not require manual configuration or DHCP.

Figure 4: IPv4 and IPv6 differences [9]

6 REFERENCES

- 1- Report On The Security Implications Of Implementing Ipv6, The National Institute of Communication Technologies, 2010.
- 2- www.whatismyip.com
- 3- Internet Protocol, Wikipedia
- 4- IP Protokolü Nedir, Tübitak-Ulakbim, www.ipv6.net.tr
- 5- IPv6 Tutorial, SANOG V Dhaka, Bangladesh , 2005
- 6- www.worldipv6launch.org/
- 7- Why IPv6 Matters to Your Station, Glenn Davies, 2011
- 8- IPv6 - The Next Generation Internet, Kaushik Das, 2008
- 9- Differences IPv4 Vs IPv6, Techsutram, 2009