A Comparative study of IPv6 Statistical Approach

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Abstract :
The internet is the one of the greatest revolutionary innovation of the twentieth century.It made the 'global village utopia' a reality in a rather short span of time and the ways that computers communicate have, in many cases, changed dramatically. The main problem with IPv4 is its relatively small address space, a legacy of the decision to use only 32 bits for the IP address. The core problem, the 32-bit address space that is too small for the current and future size of the Internet, can only be addressed by moving to a larger address space. To speed up the transition IPV4 compatible IPV6 addressing scheme has been worked out. This was the primary motivating factor in creating the next version of the Internet Protocol, *IPv6*. IPv6 is destined to be the future of the Internet Protocol, and due to IP's critical importance, it will form the basis for the future of TCP/IP and the Internet as well. it's been under development since the middle of the last decade, and a real IPv6 internetwork has been used for testing for a number of years as well. Many vendors are now writing softwares for various computing environments to support IPV6 functionality.
Keywords : IPv4 , Address notation, Address space ,unicast

I .MAJOR CHANGES AND ADDITIONS IN IPV6

The following list provides a summary of the most important changes between IPv4 and IPv6, showing some of the ways that the IPv6 team met the design goals for the new protocol:

Larger Address Space: IPv6 addresses are 128 bits long instead of 32 bits. This expands the address space from around 4 billion addresses to, well, an astronomic number (over 300 trillion trillion trillion addresses).

Hierarchical Address Space: One reason why the IPv6 address size was expanded so much was to allow it to be hierarchically divided to provide a large number of each of many classes of addresses.

Hierarchical Assignment of Unicast Addresses: A special global unicast address format was created to allow addresses to be easily allocated across the entire Internet. It allows for multiple levels of network and subnetwork hierarchies both at the ISP and organizational level. It also permits generating IP addresses based on underlying hardware interface device IDs such as Ethernet MAC addresses.

Better Support for Non-Unicast Addressing: Support for multicasting is improved, and support is added for a new type of addressing: *anycast* addressing. This new kind of addressing basically says "deliver this message to the easiest-to-reach member of this group", and potentially enables new types of messaging functionality.

Autoconfiguration and Renumbering: A provision is included to allow easier autoconfiguration of hosts and renumbering of the IP addresses in networks and subnetworks as needed. A technique also exists for renumbering router addresses.

New Datagram Format: The IP datagram format has been redefined and given new capabilities. The main header of each IP datagram has been streamlined, and support added for easily extending the header for datagrams requiring more control information.

Support for Quality of Service: IPv6 datagrams include QoS features, allowing better support for multimedia and other applications requiring quality of service.

Security Support: Security support is designed into IPv6 using the authentication and encryption extension headers and other features.

Updated Fragmentation and Reassembly Procedures: The way that fragmentation and reassembly of datagrams works has been changed in IPv6, to improve efficiency of routing and better reflect the realities of today's networks.

Modernized Routing Support: The IPv6 protocol is designed to support modern routing systems, and to allow expansion as the Internet grows.

Transition Capabilities: Since it was recognized from the start that going from IPv4 to IPv6 is a big move, support for the IPv4/IPv6 transition has been provided in numerous areas. This includes a plan for interoperating IPv4 and IPv6 networks, mapping between IPv4 and IPv6 addresses and more.

II. TRANSITIONS FROM IPV4 to IPV6

The Internet Protocol is the foundation of the TCP/IP protocol suite and the Internet, and thus somewhat comparable to the foundation of a house in terms of its structural importance. Given this, changing IP is somewhat analogous to making a substantial modification to the foundation of your house. Since IP is used to connect together many devices, it is in fact, like changing not just your house, but every house in the world! While to most people IPv6 is something "new", the reality is that the planning and development of IPv6 has been underway for nearly a full decade, and if we were starting from scratch the protocol would have been ready for action years ago. However, there is a truly enormous installed base of IPv4 hardware and software. This means the folks who develop TCP/IP could not just "flip a switch" and have everyone move over to using IPv6. Instead, a *transition* from IPv4 to IPv6 had to be planned.

A. IPv4-IPv6 Transition: Differences of Opinion:

The transition is already underway, though most people don't know about it. As I said, development of IPv6 itself is pretty much complete, though work continues on refining the protocol and also on development of IPv6-compatible versions of other protocols. The implementation of IPv6 began with the creation of development networks to test IPv6's operation. These were connected together to form an experimental IPv6 internetwork called the *6BONE* (which is a contraction of the phrase "IPv6 backbone".) This internetwork has been in operation for several years.Experimental networks are well and good, but of course the big issue is transitioning the "real" Internet to IPv6—and here, opinion diverges rather quickly. In one camp are the corporations, organizations and individuals who are quite eager to transition to IPv6 quickly, to gain the many benefits it promises in the areas of addressing, routing and security. Others are taking a much more cautious approach, noting that the dire predictions in the mid-1990s of IPv4's imminent doom have not come to pass, and arguing that we should take our time to make sure IPv6 is going to work on a large scale. The move towards adoption of IPv6 as a *production* protocol is being spearheaded by a number of groups and organizations. IPv6 has a lot of support in areas outside the United States, many of which are running short of IPv4 addresses due to small allocations relative to their size. Even here, however, IPv6 got a major "shot in the arm" in July 2003 when the United States Department of Defense (DoD) announced that starting in October of that year, it would only purchase networking products that included compatibility with IPv6. The DoD—which of course was responsible for the development of the Internet in the first place—hopes to be fully transitioned to IPv6 by 2008. This will likely have a big impact on the plans of other governmental and private organizations in the United States. IPv6 is not compatible with IPv4 because the addressing system and datagram format are different. Yet the IPv6 designers knew that since the transition would take many years, it was necessary that they provide a way for IPv4 and IPv6 hosts to interoperate. even when most of the Internet is IPv6 there will still likely be some devices that are still on IPv4 because they were never upgraded. Due to the many differences between IPv4 and IPv6, and the fundamental importance of the Internet Protocol to TCP/IP, an orderly *transition* has been planned from IPv4 to IPv6 over a period of many years.

B. IPv4-IPv6 Transition Methods

Due to the time that change takes, IETF has been working on specific provisions to allow a smooth transition from version 4 to version 6, and hardware and software interoperability solutions to let newer IPv6 devices access IPv4 hosts. A technique was included in IPv6 to allow administrators to embed IPv4 addresses within IPv6 addresses. Special methods are defined to handle interoperability, including:

"Dual Stack" Devices: Routers and some other devices may be programmed with both IPv4 and IPv6 implementations to allow them to communicate with both types of hosts.

IPv4/IPv6 Translation: "Dual stack" devices may be designed to accept requests from IPv6 hosts, convert them to IPv4 datagrams, send the datagrams to the IPv4 destination and then process the return datagrams similarly.

IPv4 Tunneling of IPv6: IPv6 devices that don't have a path between them consisting entirely of IPv6-capable routers may be able to communicate by encapsulating IPv6 datagrams within IPv4. In essence, they would be using IPv6 on top of IPv4; two network layers. The encapsulated IPv4 datagrams would travel across conventional IPv4 routers.

III.IPV6 ADDRESSING

The primary motivation for creating IPv6 was to rectify the addressing problems in IPv4. More addresses were required, but more than this, the IPv6 designers desired a way of interpreting, assigning and using them that was more consonant with modern internetworking. Based on this, it's no surprise that many of the changes in IPv6 are associated with IP addressing. The IPv6 addressing scheme is similar in general concept to IPv4 addressing, but has been completely overhauled to create an addressing system capable of supporting continued Internet expansion and new applications for the foreseeable future.This section describes the concepts and methods associated with addressing under IPv6. Let begin with a look at some addressing generalities in version 6, including the addressing model, address types size and address space and also discuss the unique and sometimes confusing representations and notations used for IPv6 addresses and prefixes and how addresses are arranged and allocated into types, beginning with an overall look at address space composition and then the global unicast address format. Addressing under IPv6 is outlined in the main IPv6 RFC, RFC 2460 (Internet Protocol, Version 6 (IPv6) Specification). However, most of the details of IPv6 addressing are contained in two other standards: RFC 3513 (Internet Protocol Version 6 (IPv6) Addressing Architecture) and RFC 3587 (IPv6 Global Unicast Address Format).

A. Addressing Model and Address Types

The overall model used for IP addressing in IPv6 is pretty much the same as it was in IPv4; some aspects have not changed at all, while others have changed only slightly.

Unchanged Aspects of Addressing in IPv6 : Some of the general characteristics of the IPv6 addressing model that are basically the same as in IPv4:

Core Functions of Addressing: The two main functions of addressing are still network interface identification and routing. Routing is facilitated through the structure of addresses on the internetwork.

Network Layer Addressing: IPv6 addresses are still the ones associated with the network layer in TCP/IP networks, and are distinct from data link layer (also sometimes called *physical*) addresses.

Number of IP Addresses Per Device: Addresses are still assigned to network interfaces, so a regular host like a PC will usually have one (unicast) address, and routers will have more than one, for each of the physical networks to which it connects.

Address Interpretation and Prefix Representation: IPv6 addresses are like classless IPv4 addresses in that they are interpreted as having a network identifier part and a host identifier part, but that the delineation is not encoded into the address itself. A prefix length number, using CIDR-like notation, is used to indicate the length of the network ID (prefix length).

Private and Public Addresses: Both types of addresses exist in IPv6, though they are defined and used somewhat differently.

B. IPv6 Address Size and Address Space

Of all the changes introduced in IPv6, easily the most “celebrated” is the increase in the size of IP addresses, and as a result, the increase in the size of the address space as well. It's not surprising that these sizes were increased compared to IPv4—everyone has known for years that the IPv4 address space was too small to support the future of the Internet. What's remarkable is just how much the increase is, and what the implications are for how Internet addresses are used.

IPv6 Address Size : In IPv4, IP addresses are 32 bits long; these are usually grouped into four octets of eight bits each. The theoretical IPv4 address space is 2^{32}, or 4,294,967,296 addresses. To increase this address space we simply increase the size of addresses; each extra bit we give to the address size doubles the address space. Based on this, some folks expected the IPv6 address size to increase from 32 to 48 bits, or perhaps 64 bits. Either of these numbers would have given a rather large number of addresses.

However, IPv6 addressing doesn't use either of these figures; instead, the IP address size jumps all the way to 128 bits, or sixteen 8-bit octets/bytes. This represents a truly remarkable increase in the address size, which surprised a lot of people.

IV.IPV6 ADDRESS and ADDRESS NOTATION AND PREFIX REPRESENTATION

A.. Ipv6 addressing

IPv6 ADDRESSING IPv6 uses 128 bit addressing mode We can have
340,282,366,920,938,463,463,374,607,431,768,211,456
addresses in scientific notation as about 3.4*10 ^38
addresses That’s about 340 trillion, trillion, trillion ddresses .IPv6 addresses are 128-bit identifiers for interfaces and sets of interfaces. There are three types of addresses:

Unicast: An identifier for a single interface. A packet sent to a unicast address is delivered to the interface identified by that address.

Anycast: An identifier for a set of interfaces (typically belonging to different nodes). A packet sent to an anycast address is delivered to one of the interfaces identified by that address (the "nearest" one,according to the routing protocols' measure of distance).

Multicast: An identifier for a set of interfaces (typically belonging to different nodes). A packet sent to a multicast address is delivered to all interface identified by that address

IPv6 ADDRESSING we would split the 128 bits into 16 octets and represent each with a decimal number from 0 to 255. A typical IPv6 address in this notation would appear as follows:

128.91.45.157.220.40.0.0.0.0.252.87.212.200.31.255
128.91.45.157.220.40.0.0.0.0.252.87.212.200.31.255 :
128.91.45.157.220.40.0.0.0.0.252.87.212.200.31.255

Increasing the size of IP addresses from 32 bits to 128 bits expands the address space to a gargantuan size, ensuring that we will never again run out of IP addresses, and allowing us flexibility in how they are assigned and used. Unfortunately, there are some drawbacks to this method, and one of them is that 128-bit numbers are very large, which makes them awkward and difficult to use.

B. IPV6 Notation and representation :

IPv6 Addresses: Too Long For Dotted Decimal Notation
Computers work in binary, and they have no problem dealing with long strings of ones and zeroes, but humans find them confusing. Even the 32-bit addresses of IPv4 are

cumbersome for us to deal with, which is why we use dotted decimal notation for them unless we need to work in binary (as with subnetting). However, IPv6 addresses are so much larger than IPv4 addresses that even using dotted decimal notation becomes problematic. To use this notation, we would split the 128 bits into 16 octets and represent each with a decimal number from 0 to 255. A typical IPv6 address in this notation would appear as follows:

128.91.45.157.220.40.0.0.0.0.252.87.212.200.31.255

The binary and dotted decimal representations of this address are shown near the top of Figure -1. In either case, the word “elegant” doesn't exactly spring to mind.

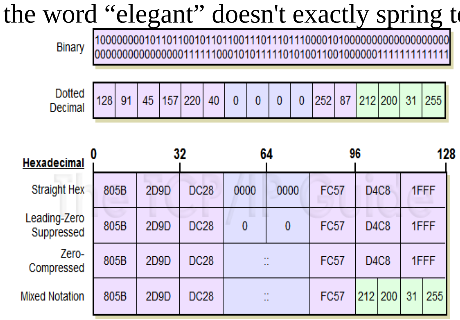

Figure -1

The top two rows show binary and dotted decimal representations of an ipv6 address , neither is commonly used.

V.IPV6 Address with Embedded IPv4 Address:

The IPv6 transition mechanisms [TRAN] include a technique for hosts and routers to dynamically tunnel IPv6 packets over IPv4 routing infrastructure. IPv6 nodes that utilize this technique are assigned special IPv6 unicast addresses that carry an IPv4 address in the low- order 32-bits. This type of address is termed an "IPv4- compatible IPv6 address" and has the format:

A type of IPv6 address which holds an embedded IPv4 address is also defined. This address is used to represent the addresses of IPv4-only nodes (those that *do not* support IPv6)as IPv6 addresses. This type of address is termed an "IPv4-mapped IPv6 address" and has the format:

```
|          80 bits          | 16 |    32 bits     |
+--------------------------------------+--------------------------+
|0000..............................0000|FFFF|   IPv4 address    |
+--------------------------------------+----+---------------------+
```

CONCLUSIONS

IPv6 is destined to be the future of the Internet Protocol, and due to IP's critical importance, it will form the basis for the future of TCP/IP and the Internet as well. In fact, it's been under development since the middle of the last decade, and a real IPv6 internetwork has been used for testing for a number of years as well. Pv6 Addressing scheme overview Unicast Global aggregatable Site local Link local IPv4 compatible Anycast Multicast No more broadcast! There are no broadcast addresses in IPv6, their function being superseded by multicast addresses. or protocols to acquire its own IPv4 address. The node uses this address as its IPv4 address. Advantages to IPv6 Larger address space Reduce end-to-end delay Higher level of security Mobility No fragmentation Network auto configuration .Conclusion Yet as a knowledgeable network professional we need to know about IPv6 issues. Now there is only 8% of IPv4 address are free In near future not more than one & half year IPv4 will be filled We don’t get address shortage in future with IPv6 IPv6 to IPv4 NAT is just an iterim solution, will not work with all protocols.

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