IPv6 Addressing

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Overview

To address the **limitation of IPv4**, the IPv6 address space will be used to replace it.

The migration has started **since 2000**, **Japan being the first country** to **integrate IPv6** in their networks. However, the transition will take a lot of years, because there are many IPv4 addresses allocated and not all devices are IPv6 capable yet.

Facts in Numbers (Huge)

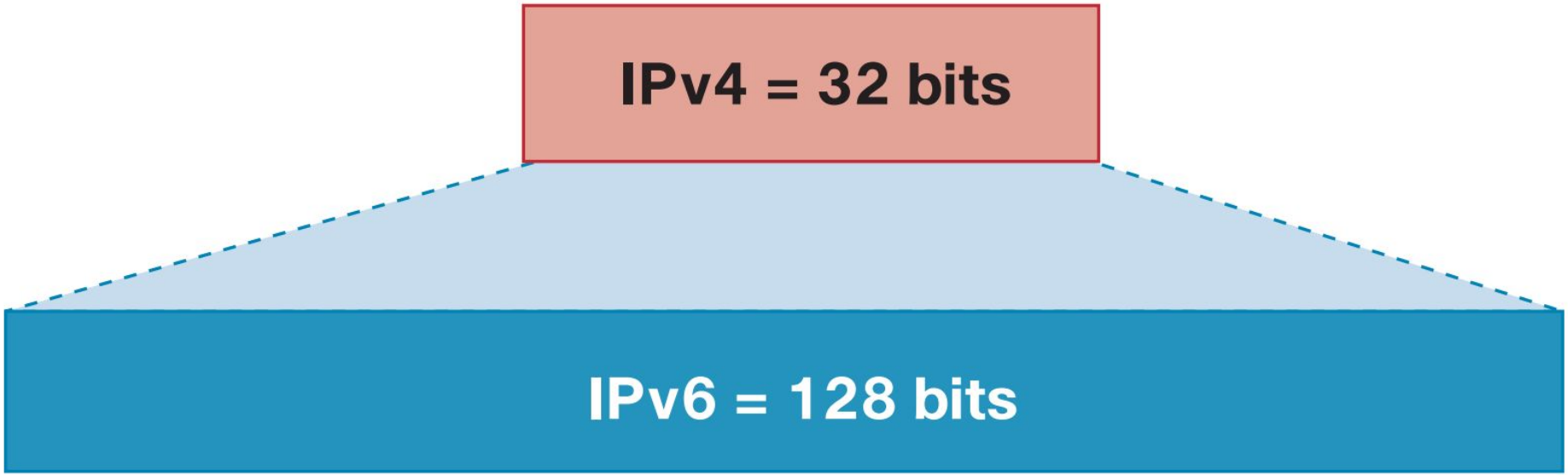
The IPv4 had only **4 octets**, allowing for 2^32 addresses.

The new IPv6 has **16 octets**, which allows for 3.4×10^38 IP addresses, totaling to 340,282,366,920,938,463,463,374,607,431,768,211,456 addresses.

This means, there are many trillions of addresses that can be allocated to every person being on the planet.

IPv6 brings is the exponentially larger address space. The following will outline the basic address architecture of IPv6.

Figure 1



Outlines

128-bit-long addresses :

Represented in hexadecimal format:

Uses CIDR principles: prefix/prefix length x:x:x:x:x:x:x:x, where x is a 16-bit hex field
The last 64 bits are used for the interface ID

Shorter Format of Addressing Scheme

2001:0DB8:C003:0001:0000:0000:0000:F00D

Can be represented in **shorter format** by **removing leading zeros**

2001:DB8:C003:1:0:0:0:F00D

#Further reduction by removing consecutive fields of zeros using the double-colon :: option Note the double-colon can be used only once

2001:DB8:C003:1::F00D

More Examples of IPv6

0:0:0:0:0:0:0:1 becomes ::1 (which is the loopback address)

FF01:0:0:0:0:0:0:1 becomes FF01::1

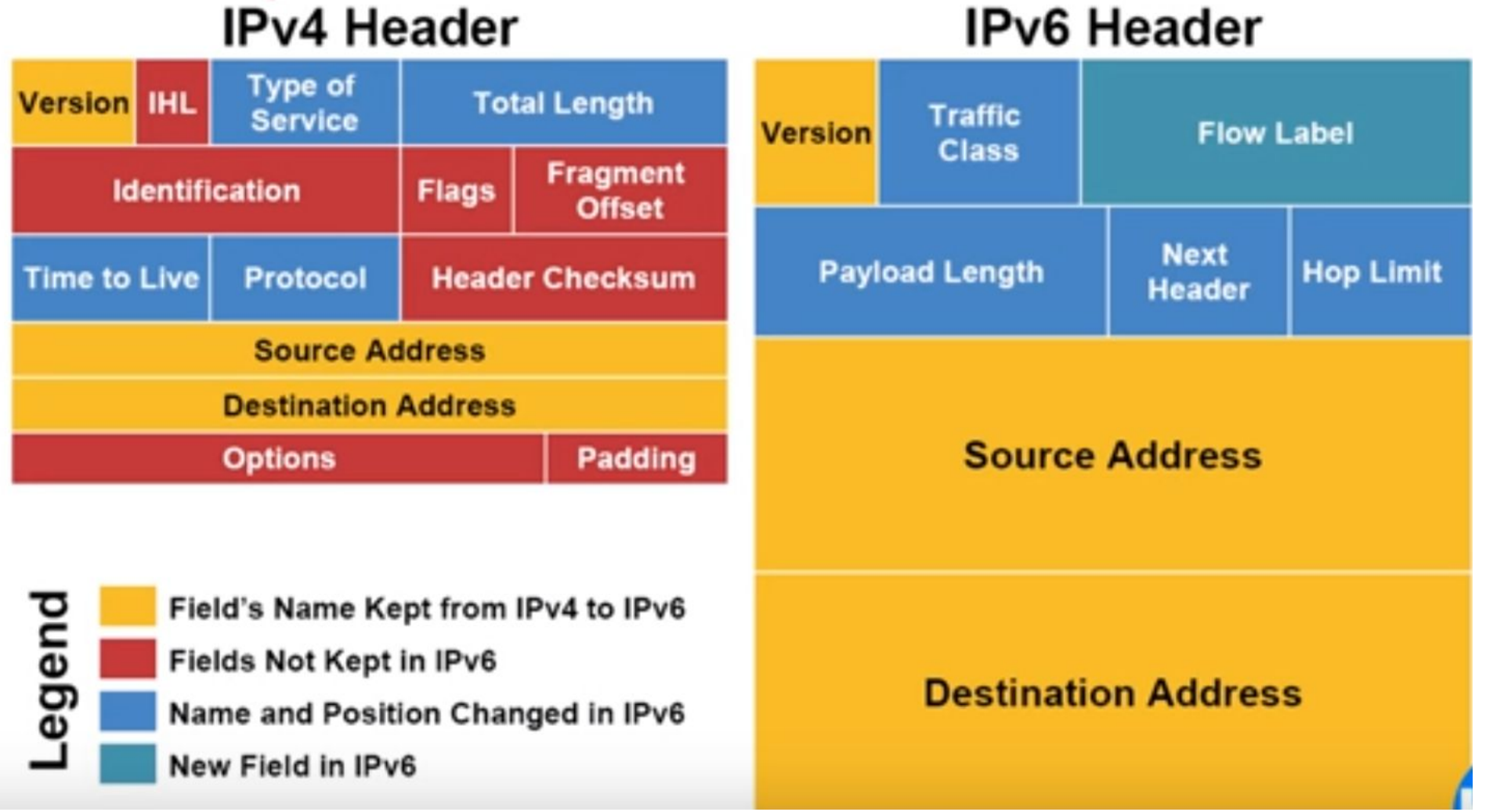
3FFE:0501:0008:0000:0260:97FF:FE40:EFAE becomes 3FFE:501:8:0:260:97FF:FE40:EFAE

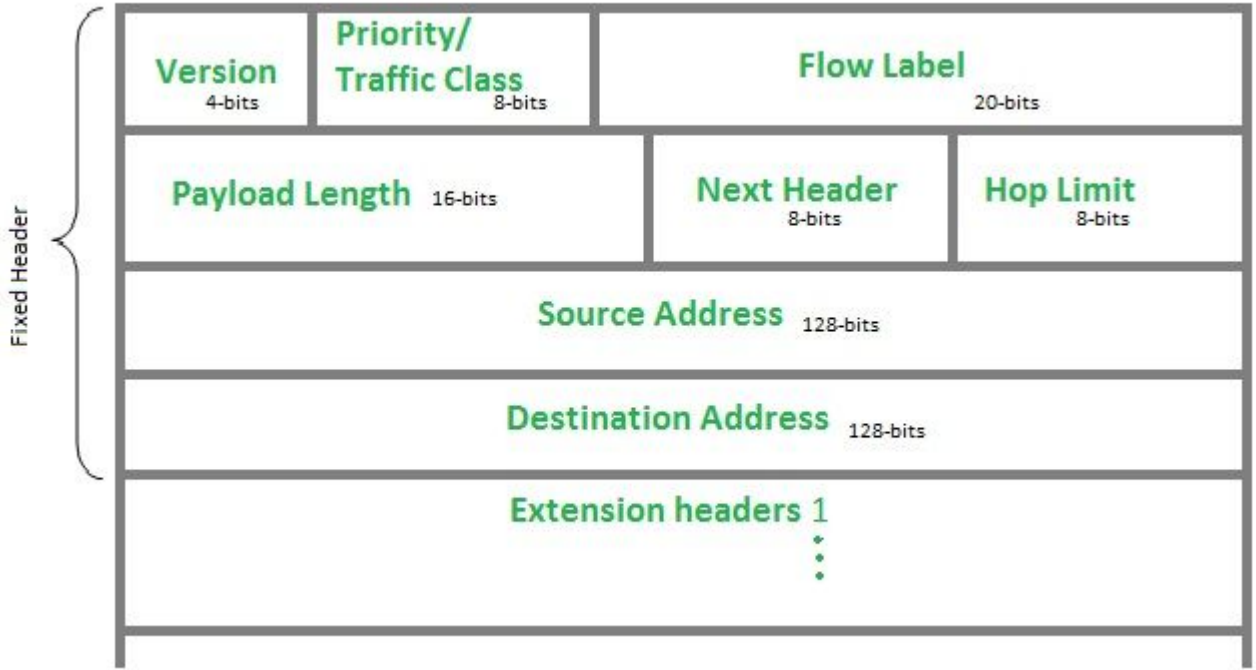
In IPv6, the **loopback address is 0:0:0:0:0:0:0:1** which is also noted as “::1”

FE80:0000:0000:0000:5400:04FF:FEDD:53F8

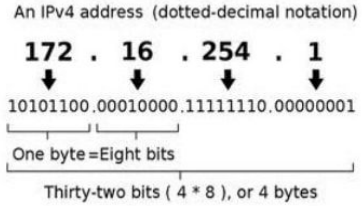
1. Groups of ZEROs can be abbreviated with a double colon (can be done only once per IP Address)
2. Leading ZEROs can be omitted

FE80::5400:4FF:FEDD:53F8


IPv4 Header
Version
IHL
Type of Service
Total Length
Identification
Flags
Fragment Offset
Time to Live
Protocol
Header Checksum
Source Address
Destination Address
Options
Padding
IPv6 Header
Version
Traffic Class
Flow Label
Payload Length
Next Header
Hop Limit
Source Address
Destination Address
Legend
Field's Name Kept from IPv4 to IPv6
Fields Not Kept in IPv6
Name and Position Changed in IPv6
New Field in IPv6

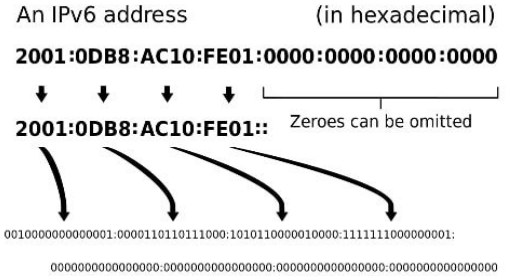

Fixed Header
Version
4-bits
Priority/
Traffic Class
8-bits
Flow Label
20-bits
Payload Length
16-bits
Next Header
8-bits
Hop Limit
8-bits
Source Address
128-bits
Destination Address
128-bits
Extension headers 1

IPv4 V/S IPv6



*IPv4 – Internet Protocol version 4 is the IP address that has a string of four values. These are separated by dots. The values range from 0 to 255. Thus the IP address ranges between 0.0.0.0 and 255.255.255.255 in any combination.

This means that you can make 4,294,967,296 possible IPv4 addresses, after which you cannot make any more combinations.



IPv6 – Internet Protocol version 6. As compared to IPv4 addresses, there are many more IPv6 addresses available. This becomes clear when you see how IPv6 is formatted. While IPv4 is formatted like 000.000.000.000, IPv6 is formatted like 0000:0000:0000:0000:0000:0000:0000:0000.

Breakdown of IPv6

2001:0DB8:0234:AB00:0123:4567:8901:ABCD

- 2 Global Unicast Address Indicator
- 001 Region
- 0DB8 Local Internet Registry (LIR) or Internet Service Provider (ISP)
- 0234 Customer
- AB00 Subnet
- 0123:4567:8901:ABCD The 64-bit Extended Unique Identifier (EUI-64TM)

The IP addresses in case of IPv6 can be truncated by simply removing the leading 0s of each group. Next, consecutive zeroes can also be removed and replaced by putting in a double colon, ::, but this can be done only once per address.

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Address types are:

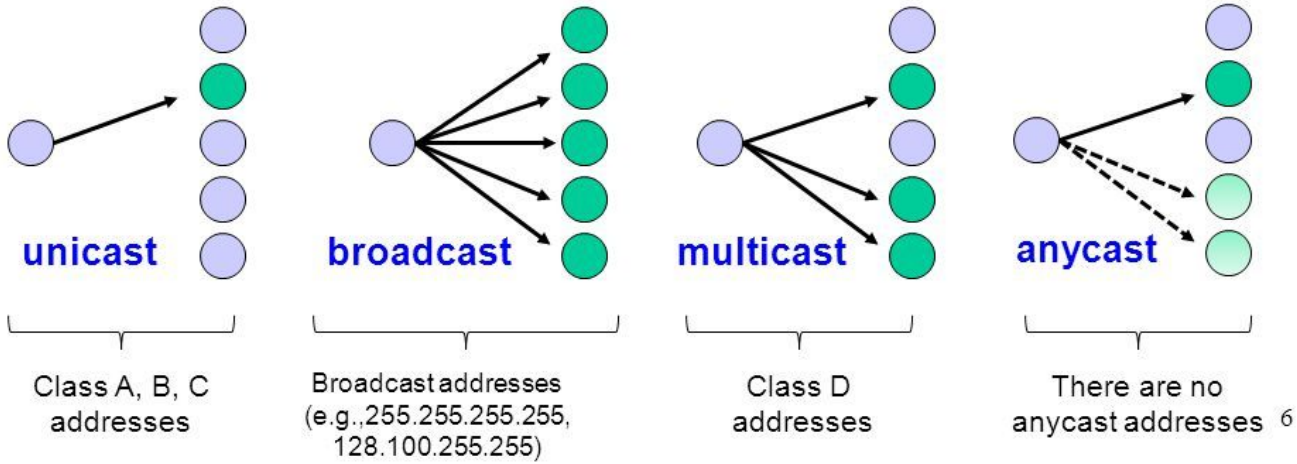
Unicast: one-to-one (global, link local, unique local, compatible)

Anycast: one-to-nearest (allocated from Unicast)

Multicast: one-to-many (also replaces broadcast addresses)

Delivery modes

- Supported by IPv4
  - one-to-one (unicast)
  - one-to-all (broadcast)
  - one-to-many (multicast)
- Not supported by IPv4:
  - one-to-any (anycast)



Data is transported over a network by three simple methods i.e. Unicast, Broadcast, and Multicast. So let's begin to summarize the difference between **these three:**

- **Unicast**: from one source to one destination i.e. One-to-One
- **Broadcast**: from one source to all possible destinations i.e. One-to-All
- **Multicast**: from one source to multiple destinations stating an interest in receiving the traffic i.e. One-to-Many

Unicast: traffic, many streams of IP packets that move across networks flow from a single point, such as a website server, to a single endpoint such as a client PC. This is the most common form of information transference on networks.

Broadcast: Here, traffic streams from a single point to all possible endpoints within reach on the network, which is generally a LAN. This is the easiest technique to ensure traffic reaches to its destinations.

Multicast: In this method traffic recline between the boundaries of unicast (one point to one destination) and broadcast (one point to all destinations). And multicast is a “one source to many destinations” way of traffic distribution, means that only the destinations that openly point to their requisite to accept the data from a specific source to receive the traffic stream.

Assessment Question will post soon.....