IPV6 - NEXT GENERATION IP

- IPv6 was evolved to solve address space problem and offers rich set of services.

- Some hosts and routers will run IPv4 only, some will run IPv4 and IPv6 and some will run IPv6 only.

DRAWBACKS OF IPV4

- Despite subnetting and CIDR(Classless Inter Domain Routing), address depletion is still a long-term problem.
- Internet must accommodate real-time audio and video transmission that requires minimum delay strategies and reservation of resources.
- Internet must provide encryption and authentication of data for some applications

FEATURES OF IPV6

- ***Better header format***
- ***New options***
- ***Allowance for extension***
- ***Support for resource allocation***

Additional Features

1. Need to accommodate scalable routing and addressing
2. Support for real-time services
3. Security support
4. Auto configuration - The ability of hosts to automatically configure themselves with such information as their own IP address and domain name.
5. Enhanced routing functionality, including support for mobile hosts
6. Transition from ipv4 to ipv6

ADDRESS SPACE ALLOCATION OF IPV6

- IPv6 provides a 128-bit address space to handle up to 3.4×10^{38} nodes.
- IPv6 uses *classless* addressing, but classification is based on MSBs.
- The address space is subdivided in various ways based on the leading bits.
- The current assignment of prefixes is listed in Table

Prefix	Use
00...0 (128 bits)	Unspecified
00...1 (128 bits)	Loopback
1111 1111	Multicast addresses
1111 1110 10	Link-local unicast
Everything else	Global Unicast Addresses

- A node may be assigned an "IPv4-compatible IPv6 address" by zero-extending a 32-bit IPv4 addressto128 bits.

ADDRESS NOTATION OF IPV6

- Standard representation of IPv6 address is $x:x:x:x:x:x:x:x$ where x is a 16-bit hexadecimal address separated by colon (:).
  For example,
  47CD : 1234 : 4422 : ACO2 : 0022 : 1234 : A456 : 0124

- IPv6 address with contiguous 0 bytes can be written compactly.
  For example,
  47CD : 0000 : 0000 : 0000 : 0000 : 0000 : A456 : 0124 → 47CD : : A456 : 0124

- IPv4 address is mapped to IPv6 address by prefixing the 32-bit IPv4 address with 2 bytes of 1s and then zero-extending the result to 128 bits.
  For example,
  128.96.33.81 → : : FFFF : 128.96.33.81
  This notation is called as CIDR notation or slash notation.

ADVANCED CAPABILITIES OF IPV6

- Auto Configuration
- Advanced Routing
- Additional Functions
- Security
- Resource allocation

ADVANTAGES OF IPV6

- ***Address space*** **—** IPv6 uses 128-bit address whereas IPv4 uses 32-bit address.

- Hence IPv6 has huge address space whereas IPv4 faces address shortage problem.

- ***Header format*** **—** Unlike IPv4, optional headers are separated from base header in IPv6. Each router thus need not process unwanted addition information.

- ***Extensible*** **—** Unassigned IPv6 addresses can accommodate needs of future technologies

- In IPv6 representation, we have three addressing methods :
- Unicast
- Multicast
- Anycast
- **Unicast Address:** Unicast Address identifies a single network interface. A packet sent to unicast address is delivered to the interface identified by that address

Multicast Address:

Multicast Address is used by multiple hosts, called as Group, acquires a multicast destination address. These hosts need not be geographically together. If any packet is sent to this multicast address, it will be distributed to all interfaces corresponding to that multicast address.

Anycast Address:

Anycast Address is assigned to a group of interfaces. Any packet sent to anycast address will be delivered to only one member interface (mostly nearest host possible).

PACKET FORMAT OF IPV6

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- ***Version*** — specifies the IP version, i.e., 6.
- ***Traffic Class*** — defines priority of the packet with respect to traffic congestion. It is either congestion-controlled or non-congestion controlled
- ***Flow Label*** — provides special handling for a particular flow of data. Router handles different flows with the help of a flow table.
- ***Payload Len*** — gives length of the packet, excluding IPv6 header.
- ***Next Header*** — Options are specified as a header following IP header. NextHeader contains a pointer to optional headers.
- ***Hop Limit*** — Gives the TTL value of a packet.
- ***Source Address / Destination Address*** — 16-byte addresses of source and destination host

PACKET FORMAT OF IPV6

IPv4	IPv6
IPv4 has a 32-bit address length	IPv6 has a 128-bit address length
It Supports Manual and DHCP address configuration	It supports Auto and renumbering address configuration
In IPv4 end to end, connection integrity is Unachievable	In IPv6 end-to-end, connection integrity is Achievable
It can generate 2^32 address space	The address space of IPv6 is quite large it can produce 2^128 address space
The Security feature is dependent on the application	IPSEC is an inbuilt security feature in the IPv6 protocol
Address representation of IPv4 is in decimal	Address Representation of IPv6 is in hexadecimal
Fragmentation performed by Sender and forwarding routers	In IPv6 fragmentation is performed only by the sender
In IPv4 Packet flow identification is not available	In IPv6 packet flow identification are Available and uses the flow label field in the header
In IPv4 checksum field is available	In IPv6 checksum field is not available

PACKET FORMAT OF IPV6

IPv4	IPv6
In IPv4 Encryption and Authentication facility not provided	In IPv6 Encryption and Authentication are provided
IPv4 has a header of 20-60 bytes.	IPv6 has a header of 40 bytes fixed
IPv4 can be converted to IPv6	Not all IPv6 can be converted to IPv4
IPv4 consists of 4 fields which are separated by addresses dot (.)	IPv6 consists of 8 fields, which are separated by a colon (:)
IPv4's IP addresses are divided into five different classes. Class A , Class B, Class C, Class D, Class E.	IPv6 does not have any classes of the IP address.
IPv4 supports VLSM(Variable Length subnet mask).	IPv6 does not support VLSM.
Example of IPv4: 66.94.29.13	Example of IPv6: 2001:0000:3238:DFE1:0063:0000:0000:FEFB