Differences between IPv4 and IPv6

- IPv4 and IPv6 are internet protocol version 4 and internet protocol version 6, IP version 6 is the new version of Internet Protocol, which is way better than IP version 4 in terms of complexity and efficiency.

IPv4 vs IPv6

Why IPv6?

- Need for larger address space
  - IPv4 has 32-bit address field

- Support for new applications like real-time audio and video that require network guarantees in the network
  - header format helps speed processing/forwarding
  - header changes to facilitate QoS
  - new "anycast" address: route to "best" of several replicated servers

- An anycast address is an address allocated to a set of interfaces that typically belong to different routers.

- When a packet is destined to an anycast address, it is delivered to the closest interface that has this anycast address, where the term "closest" is determined by the routing protocol.

- An anycast address must be assigned to a router not a host and cannot be used as a source address.

- Since anycast addresses are unicast addresses, when an interface is configured with an anycast address it must be explicitly configured on the router owning that interface.

- This is done because anycast addresses cannot be distinguished from any other unicast addresses.

IPv6 Rationale

- Larger address space
- Efficient address allocation
- Simpler header processing
- Autoconfiguration
- Support for QoS
- Support for security
- Header TCP Payload

IPv4 Address Space Exhaustion
Currently, about 75% of the total IPv4 address space is either assigned or reserved.

IPv6: Benefits : Address length

- 32 bits in IPv4 , 128 bits in IPv6
- 340282366920938463463374607431768211456 addresses
- restores end-to-end transparency
- New possibilities for applications (p2p, voip, . .)
- Static network assignments for every customer
- dynamic addresses still possible (privacy reasons)
- IPSec
- QoS capabilities
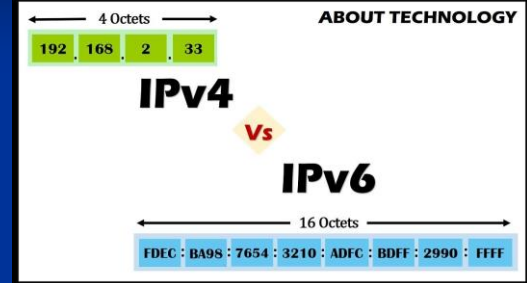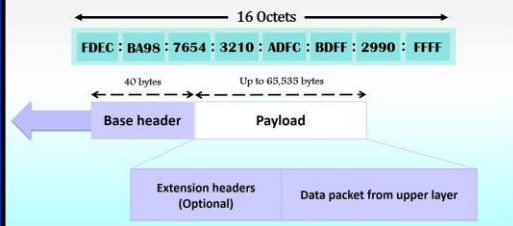
IPv6: new address format

- IPv4:
- 32 bits, 4 x 8 bits, decimal notation, separated by '.'
- { examples: 203.178.141.194, 195.30.0.2, 10.0.0.1
- IPv6:
- { 128 bits, 8 x 16 bits, hexadecimal notation, separated by ':'
- { leading zeroes can be left away (':0123:0001' = ':123:1')
- { exactly one series of zeroes can be reduced to '::'
- { examples:
- 2001:200:0:8002:203:47ff:fea5:3085
- 2001:608::2
- fe80::210:60ff:fe80:3a16

Translation

- ⊚ IP header translation
  - ⊚ Similar to the NAT mechanism ⊚
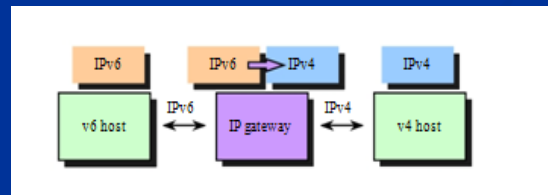
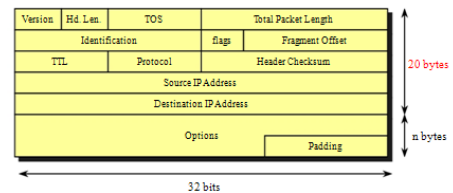## Following are the important differences between IPv4 and IPv6 Protocols

Sr. No.	Key	IPv4 Protocol	IPv6 Protocol
1	Address Configuration	IPv4 protocol has address length of 32-bit represented in decimal format and it supports Manual and DHCP configuration.	On other hand IPv6 has 128-bit address length represented in hexadecimal format and supports Auto-configuration and renumbering configuration.
2	Address Space	In case of IPv4 4.29 x 10^9 addresses could get generated.	On other hand in case of IPv6 3.4 x 10^38 which is much greater than as compared to that of in IPv4 case.
3	Secure	IPv4 is being used as less secure protocol as its security section is dependent on application i.e., it is proportional to the security that is provided or implemented at application level.	IPv6 has its inbuilt security feature named as IPSEC (Internet Protocol Security) which provide additional security feature along with the security provided or implemented at application level.
4	Fragmentation	In case of IPv4 fragmentation is performed by both Sender and Forwarding routers.	On other hand in case of IPv6 the fragmentation is performed only by sender routers.
5	Authentication	In IPv4 Encryption and Authentication facility not provided.	In other hand in IPv6 both Encryption and Authentication facility are available.
6	Header Size	In IPv4 the request header is not fixed and may be between of 20-60 bytes size.	On other hand in IPv6 the request header is of fixed 40 bytes size and could not be get varied.

Difference Between IPv4 and IPv6:

IPV4	IPV6
IPv4 has 32-bit address length	IPv6 has 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 4.29×109 address space	Address space of IPv6 is quite large it can produce 3.4×1038 address space
Security feature is dependent on application	IPSEC is inbuilt security feature in the IPv6 protocol
Address representation of IPv4 in decimal	Address Representation of IPv6 is in hexadecimal

Fragmentation performed by Sender and forwarding routers	In IPv6 fragmentation performed only by sender
In IPv4 Packet flow identification is not available	In IPv6 packetflow identification are Available and uses flow label field in the header
In IPv4 checksumfield is available	In IPv6 checksumfield is not available
It has broadcast Message Transmission Scheme	In IPv6 multicast and any cast message transmission scheme is available
In IPv4 Encryption and Authentication facility not provided	In IPv6 Encryption and Authentication are provided

IPv4 Header

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IPv4 Header Field	IPv6 Header Field
Version	Same field but with different version numbers.
Internet Header Length	Removed in IPv6. IPv6 does not include a Header Length field because the IPv6 header is always a fixed size of 40 bytes. Each extension header is either a fixed size or indicates its own size.
Type of Service	Replaced by the IPv6 Traffic Class field.
Total Length	Replaced by the IPv6 Payload Length field, which only indicates the size of the payload.
Identification Fragmentation Flags Fragment Offset	Removed in IPv6. Fragmentation information is not included in the IPv6 header. It is contained in a Fragment extension header.
Time to Live	Replaced by the IPv6 Hop Limit field.
Protocol	Replaced by the IPv6 Next Header field.
Header Checksum	Removed in IPv6. In IPv6, bit-level error detection for the entire IPv6 packet is performed by the link layer.
Source Address	The field is the same except that IPv6 addresses are 128 bits in length.
Destination Address	The field is the same except that IPv6 addresses are 128 bits in length.
Options	Removed in IPv6. IPv4 options are replaced by IPv6 extension headers.

IPv6 Header