# IP ADDRESSING

## IN NETWORK LAYER OF OSI MODEL


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# What is IP Address?

A unique string of numbers separated by full stops/collons that identifies each Computer using the Internet Protocol to communicate over a network.

## There are two standards for IP addressing:-

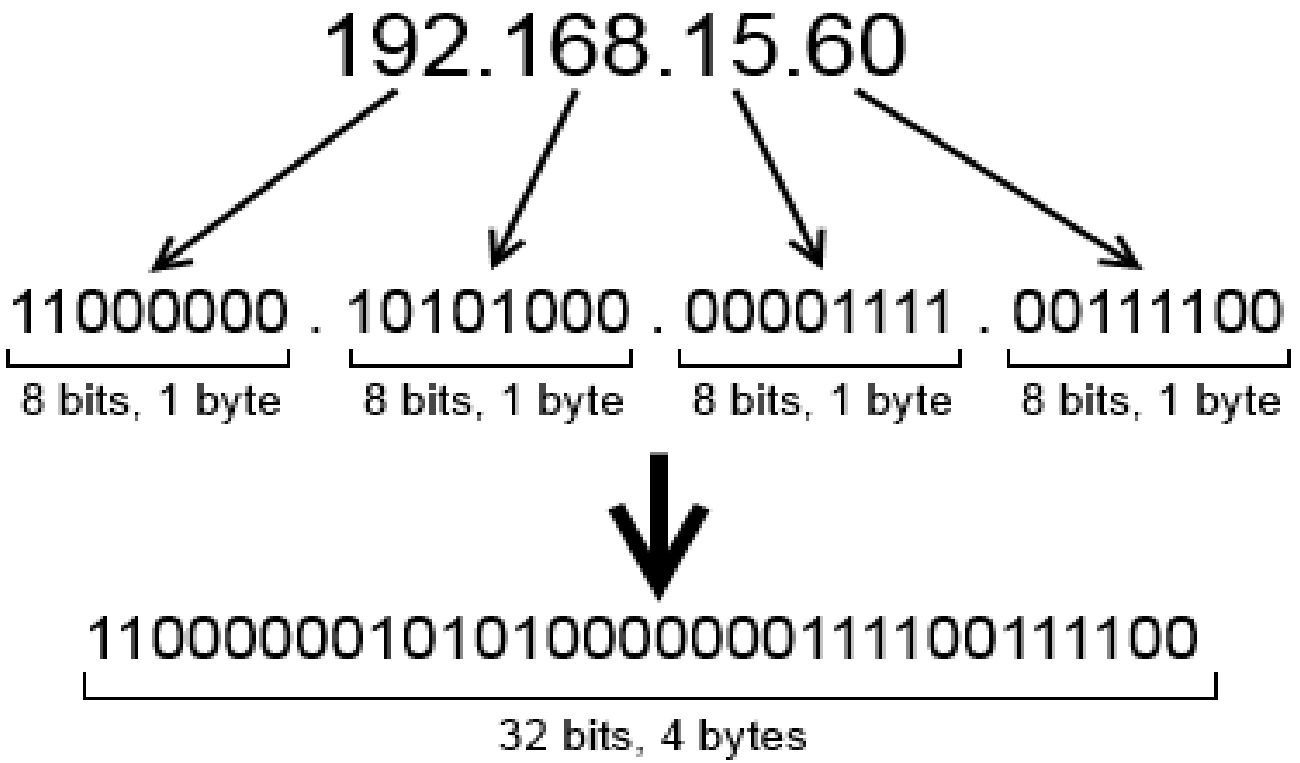
- ✓ IPv4 (Internet Protocol Version 4)
- ✓ IPv6 (Internet Protocol Version 6)

# IPv4

IPv4 (*Internet Protocol Version 4*) is the fourth revision of the Internet Protocol (IP) used to identify devices on a network through an addressing system.

IPv4 uses 32-bit addresses

## FOR EXAMPLE

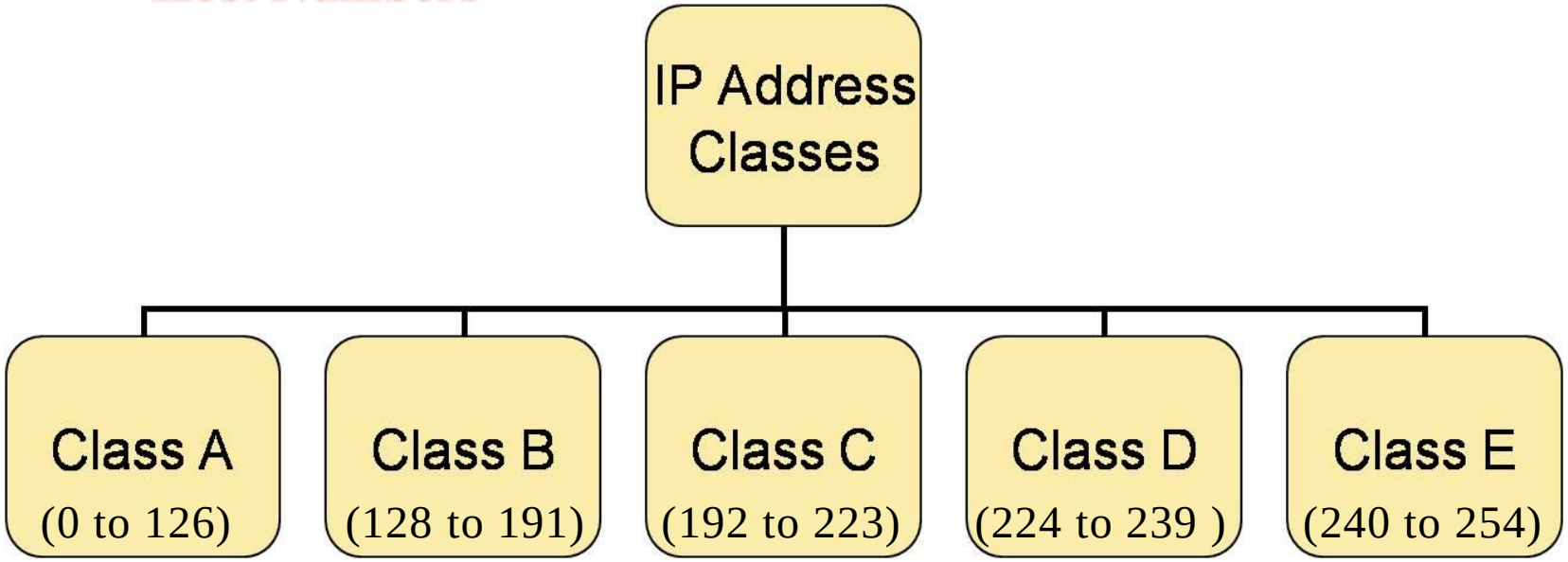


# IPv4 Classes

The Internet Assigned Numbers Authority (IANA) organizes IPv4 addresses into classes. The number of hosts that a network has determines the class of addresses that is required.

**In classification of IP addresses, IP address is divided into two parts:-**

- ✓ **Network Numbers**
- ✓ **Host Numbers**



| Class | 1st Octet Decimal Range | 1st Octet High Order Bits | Network/Host ID (N=Network, H=Host) | Default Subnet Mask | Number of Networks | Hosts per Network (Usable Addresses) |
|---|---|---|---|---|---|---|
| A | 1 – 126* | 0 | N.H.H.H | 255.0.0.0 | 126 ($2^7 - 2$) | 16,777,214 ($2^{24} - 2$) |
| B | 128 – 191 | 10 | N.N.H.H | 255.255.0.0 | 16,382 ($2^{14} - 2$) | 65,534 ($2^{16} - 2$) |
| C | 192 – 223 | 110 | N.N.N.H | 255.255.255.0 | 2,097,150 ($2^{21} - 2$) | 254 ($2^8 - 2$) |
| D | 224 – 239 | 1110 | Reserved for Multicasting | | | |
| E | 240 – 254 | 1111 | Experimental; used for research | | | |

## Class A

| | |
|---|---|
| Range:- | 1 to 126 decimal number |
| Begins with:- | 0 |
| Number of Network Bits:- | 8 |
| Number of Host Bits:- | 24 |
| Number of Networks:- | 126 |
| Number of Hosts:- | 16,777,214 |

0.0.0.0. to 127.0.0.0 ip

**NOTE:** 127.0.0.0 refers to loopback address.

The loopback interface has no hardware associated with it, and it is not physically connected to a network

## Class B

| | |
|---|---|
| Range:- | 128 to 191 decimal number |
| Begins with:- | 10 |
| Number of Network Bits:- | 16 |
| Number of Host Bits:- | 16 |
| Number of Networks:- | 16,382 |
| Number of Hosts:- | 65,534 |

**For example, the 131.107.0.0 network is allocated to Microsoft Corporation.**

**169.254.0.0 APIPA (automatic private ip address)**

## Class C

| | |
|---|---|
| Range:- | 192 to 223 decimal number |
| Begins with:- | 110 |
| Number of Network Bits:- | 24 |
| Number of Host Bits:- | 8 |
| Number of Networks:- | 2,0,97,150 |
| Number of Hosts:- | 254 |

192.168.0.0. private ip

## Class D

| | |
|---|---|
| Range:- | 224 to 239 decimal number |
| Begins with:- | 1110 |
| Number of Network Bits:- | n/a |
| Number of Host Bits:- | n/a |
| Number of Networks:- | n/a |
| Number of Hosts:- | n/a |

# Class E

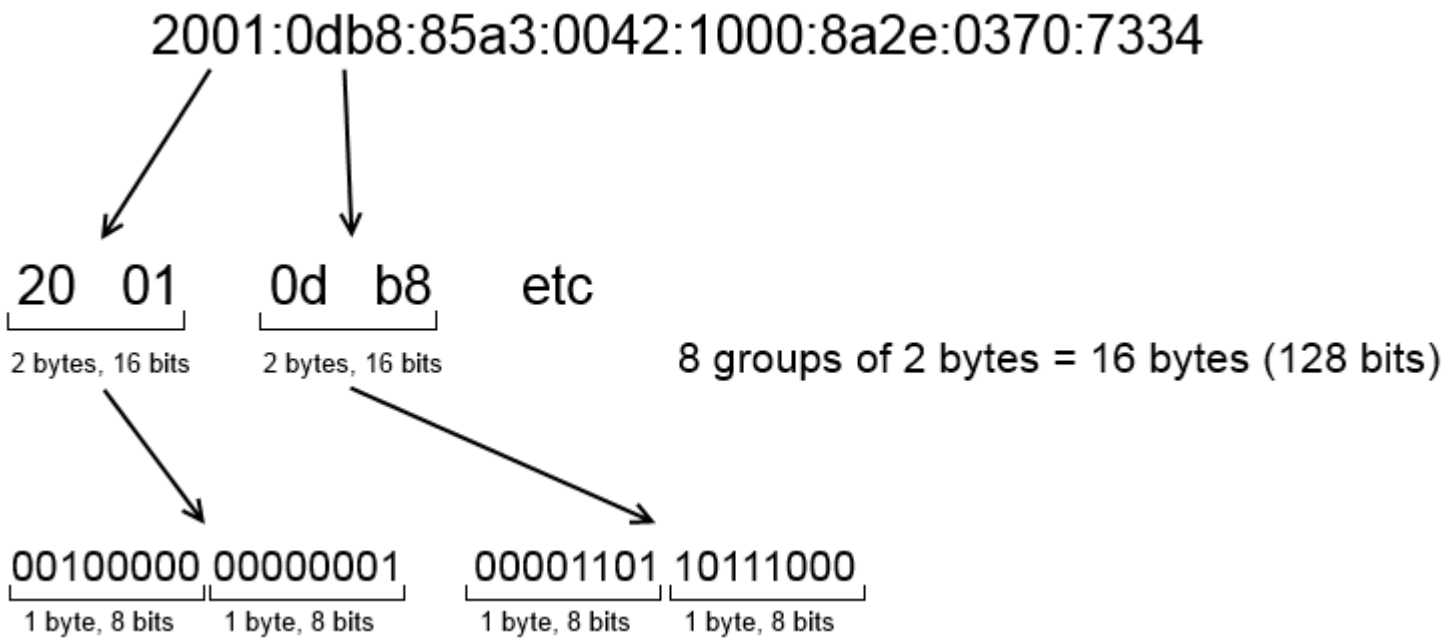
| | |
|---|---|
| Range:- | 240 to 254 decimal number |
| Begins with:- | 1111 |
| Number of Network Bits:- | n/a |
| Number of Host Bits:- | n/a |
| Number of Networks:- | n/a |
| Number of Hosts:- | n/a |

# Limitations of IPv4

- ✓ Shortage of IPv4 Addresses
- ✓ Security Related Issues
- ✓ Address configuration related issues

# IPv6

Internet Protocol Version6 is also called Internet Protocol next generation (IPng )and it is the newest version of the Internet Protocol (IP) reviewed in the IETF (Internet Engineering Task Force) standards committees to replace the current version of IPv4.
IPv6 uses 128 binary bits addresses.



# Features of IPv6

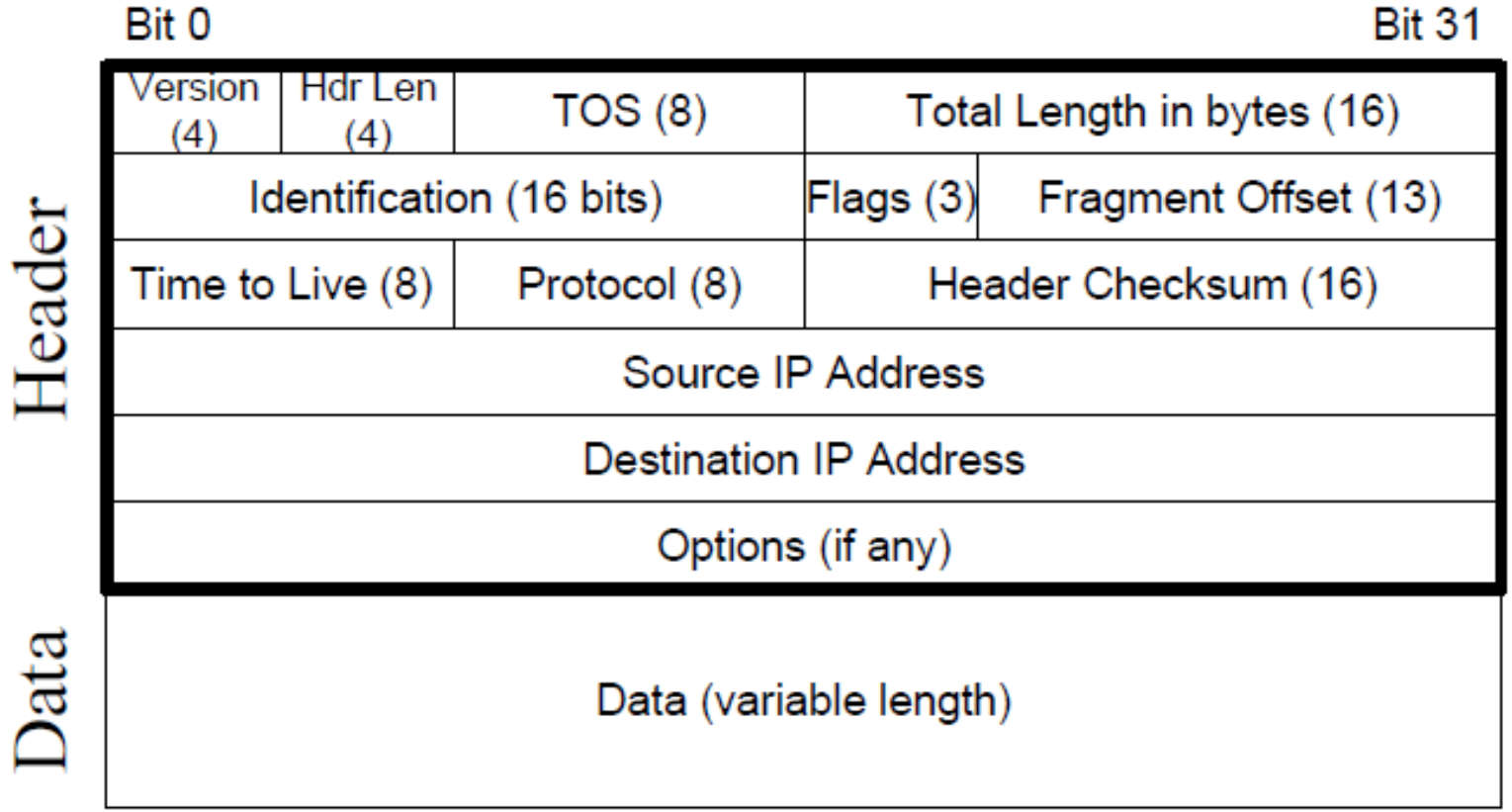
- ✓ New Packet Format and Header
- ✓ Large Address Space
- ✓ Statefull and Stateless IPv6 address configuration
- ✓ Multicast
- ✓ Internet Protocol Security (IPSec)
- ✓ Neighbor Discovery Protocol
- ✓ Extensibility

# Difference Between IPv4 and IPv6

- ✓ Address Length
- ✓ External Data Representation
- ✓ Address Resolution
- ✓ Transmission Modes
- ✓ Multicast Addresses
- ✓ checksum
- ✓ Ipsec
- ✓ Packet Size
- ✓ ISP Address Allocation
- ✓ Network Auto-Configuration

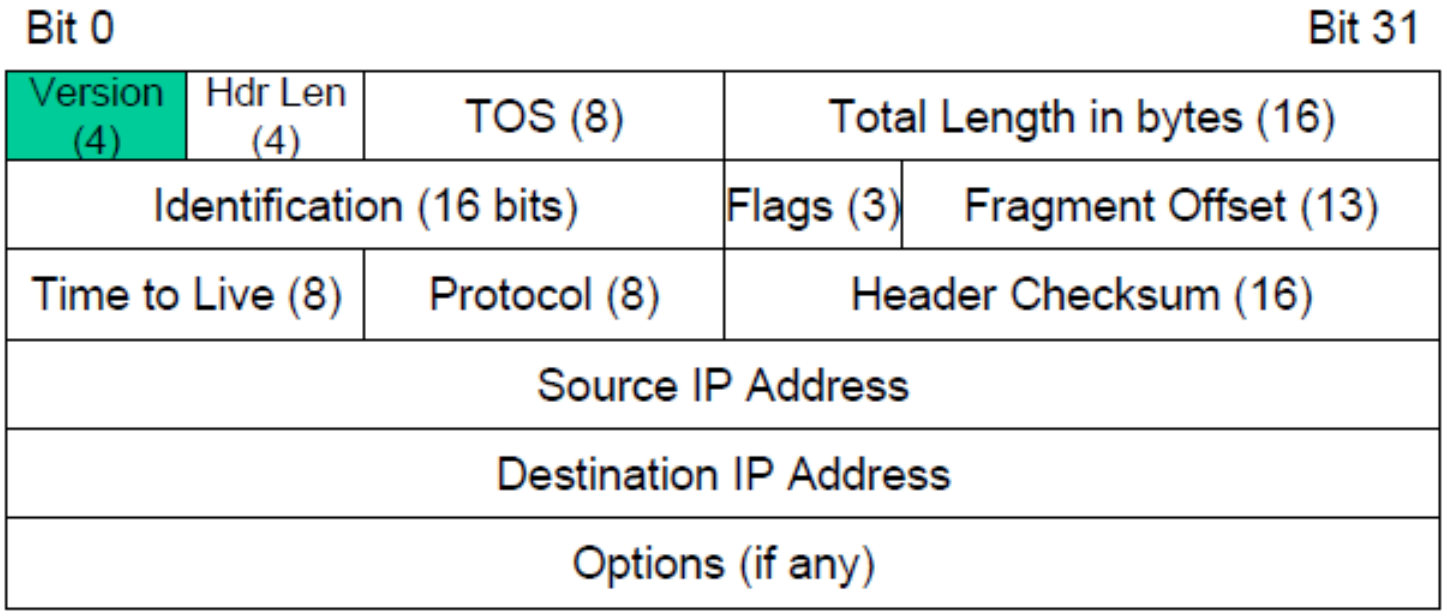
# IP PACKET FORMAT

A *packet header* is the portion of an Internet protocol. Internet protocol divides data streams into datagrams and these are routed independent of each other. The format used bye the ip datagrams that carries the data message in the network is called the ip packet format.



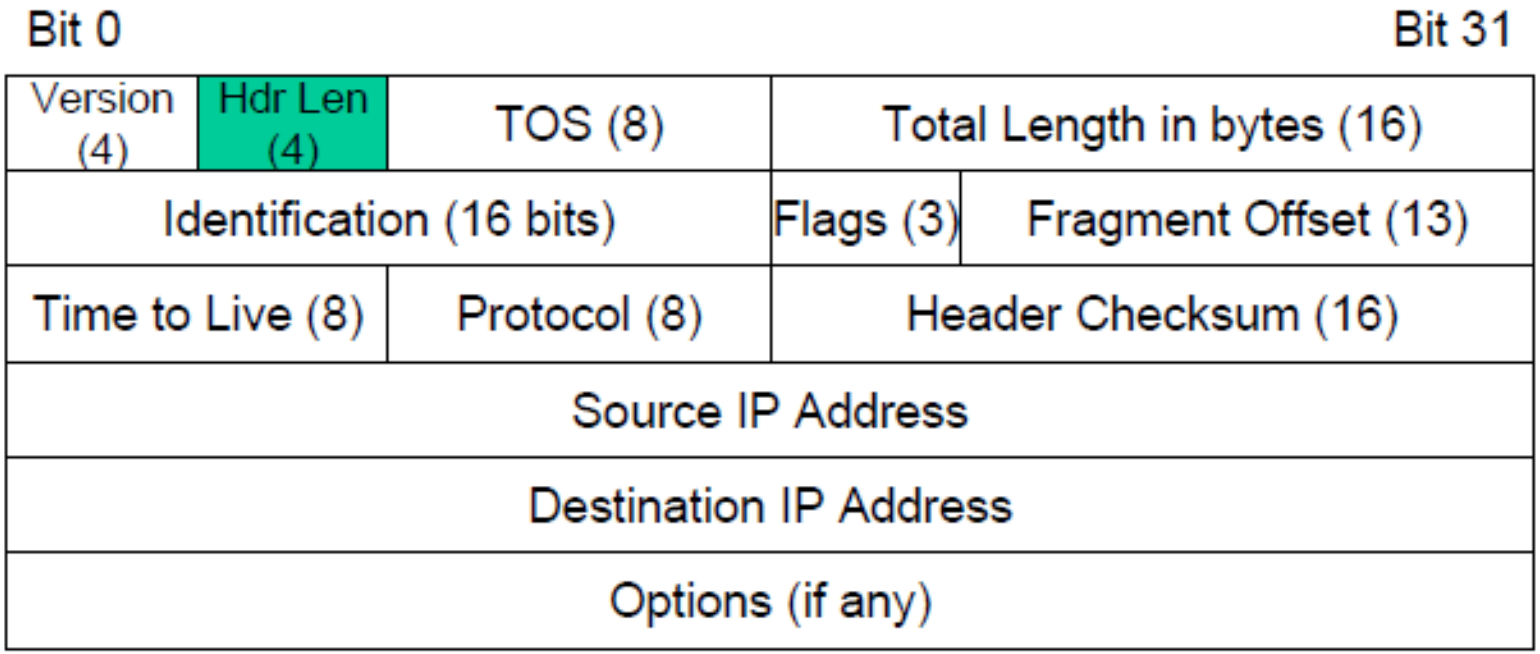
# Version

– Version number of IP protocol
– Current version is Version 4
– Version 6 has different header format



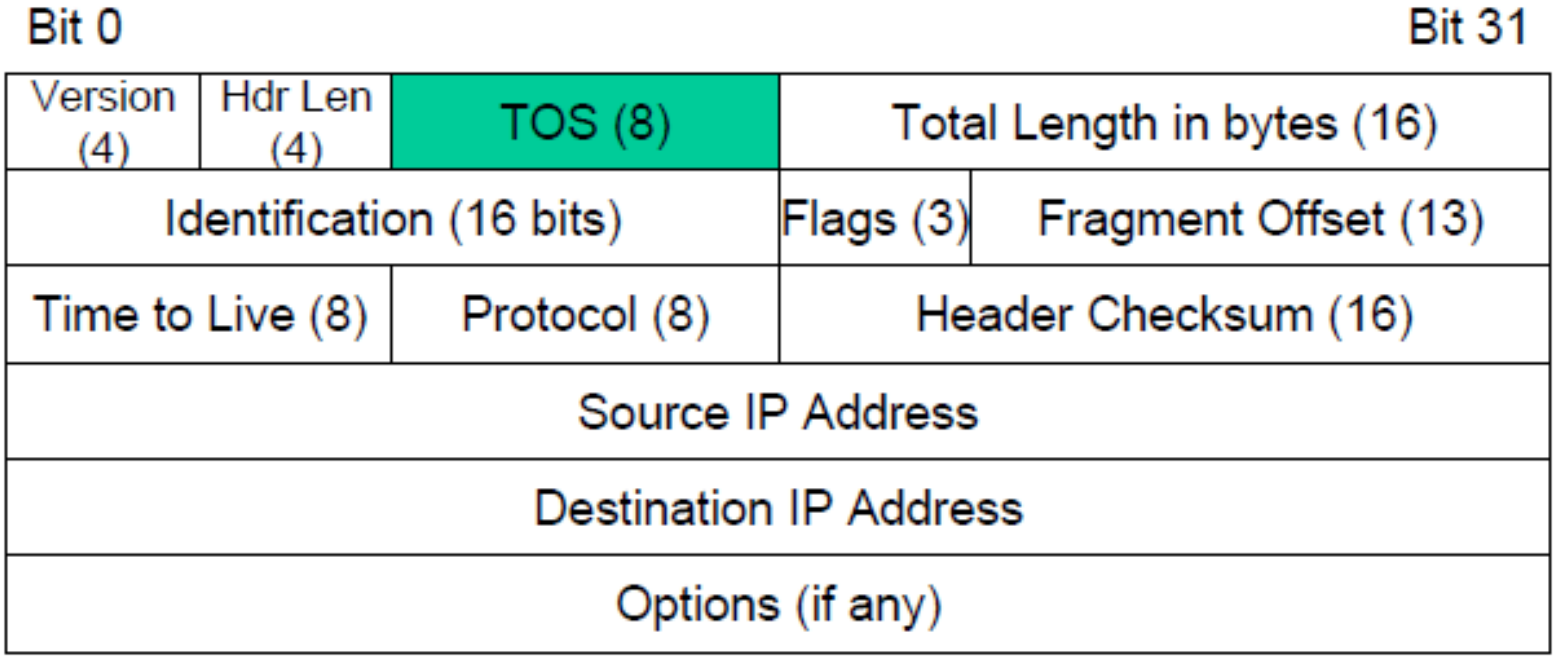
## • Header Length (in 32 bit words)

- ✓ It vary between 20 to 60 bytes .
- ✓ It inform network about the length of header.



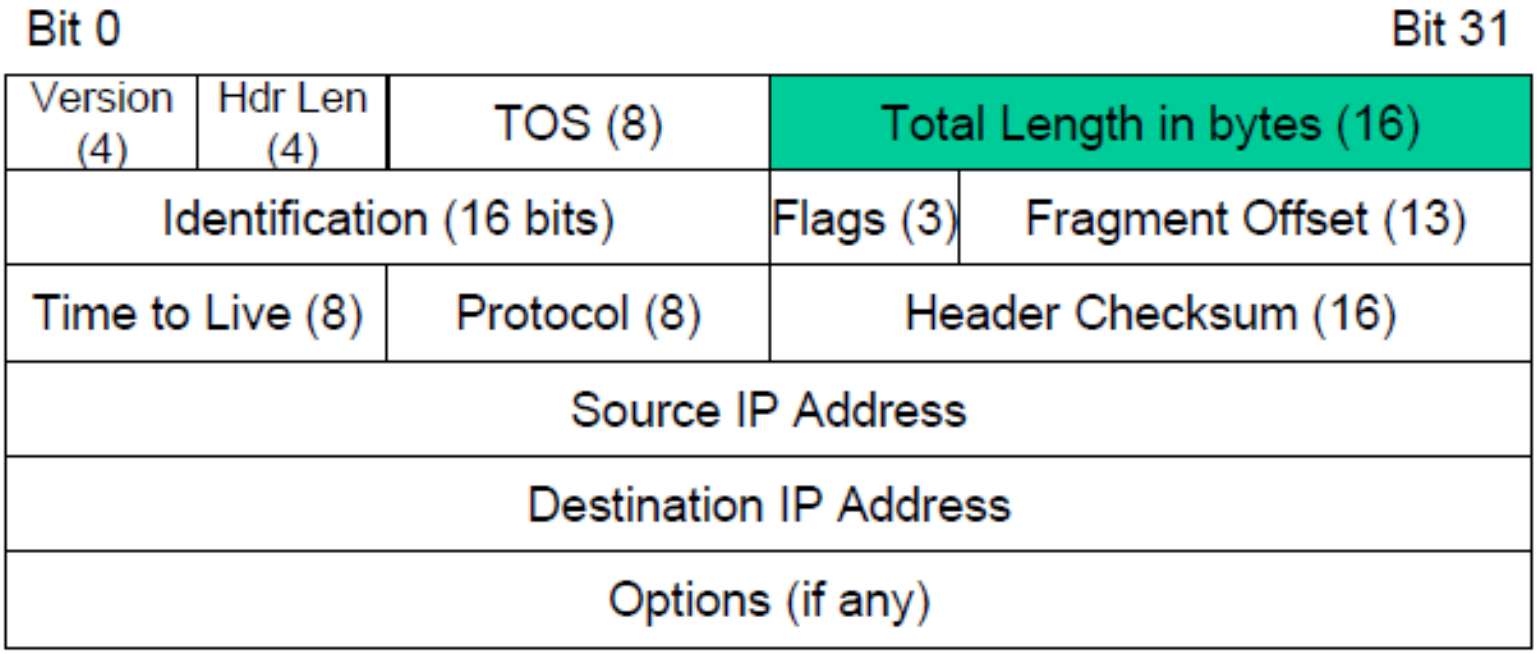
# Type of Service (TOS)

- ✓ Allows different types of service to be requested
- ✓ Currently being defined



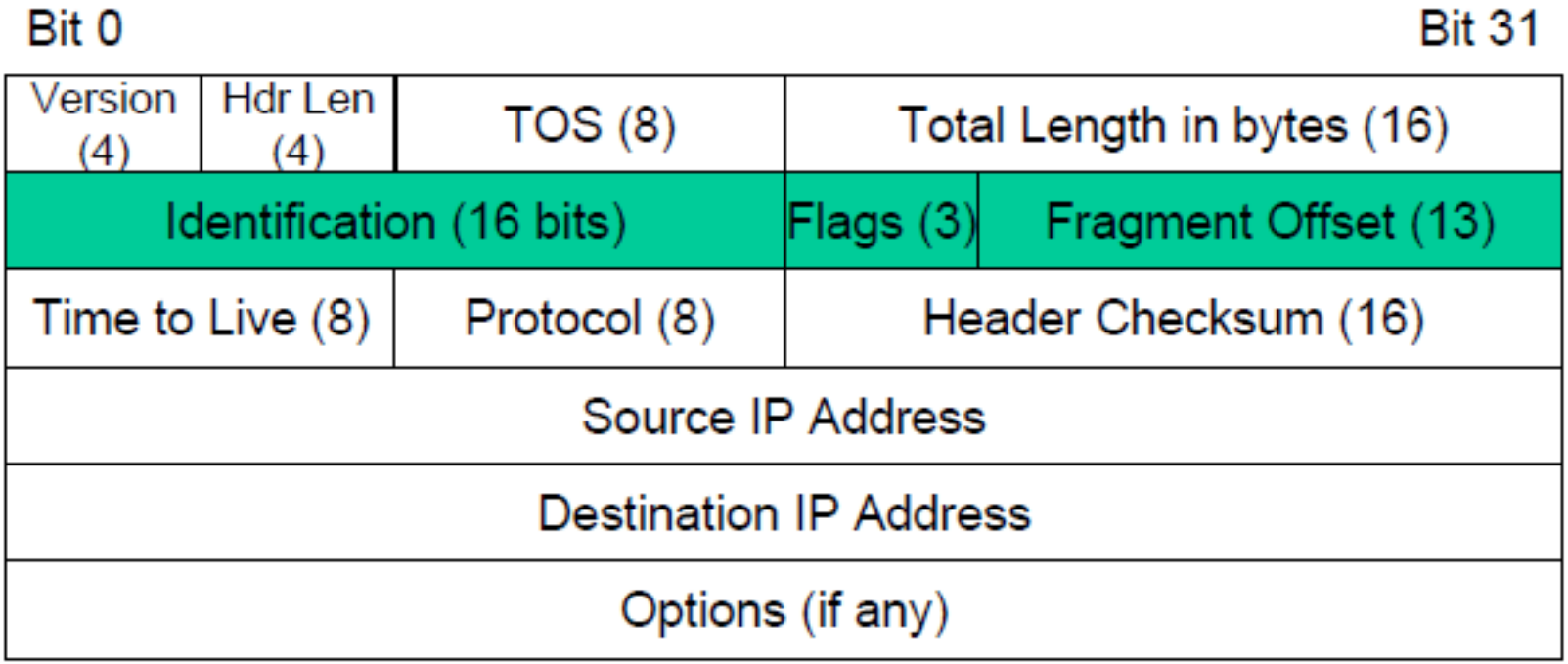
# Packet Length (in Bytes)

- ✓ It indicate the total length of the datagram.
- ✓ This length include the length of the header and data.
- ✓ Max packet size = 216 = 65,535 Bytes
- ✓ This 16-bit field defines the entire packet size in bytes, including header and data. The minimum size is 20 bytes (header without data) and the maximum is 65,535 bytes.



These three fields for Fragmentation Control.

Identification:
This field is an identification field and is primarily used for uniquely identifying the group of fragments of a single IP datagram.



# Flags

A three-bit field follows and is used to control or identify fragments. They are (in order, from most significant to least significant):

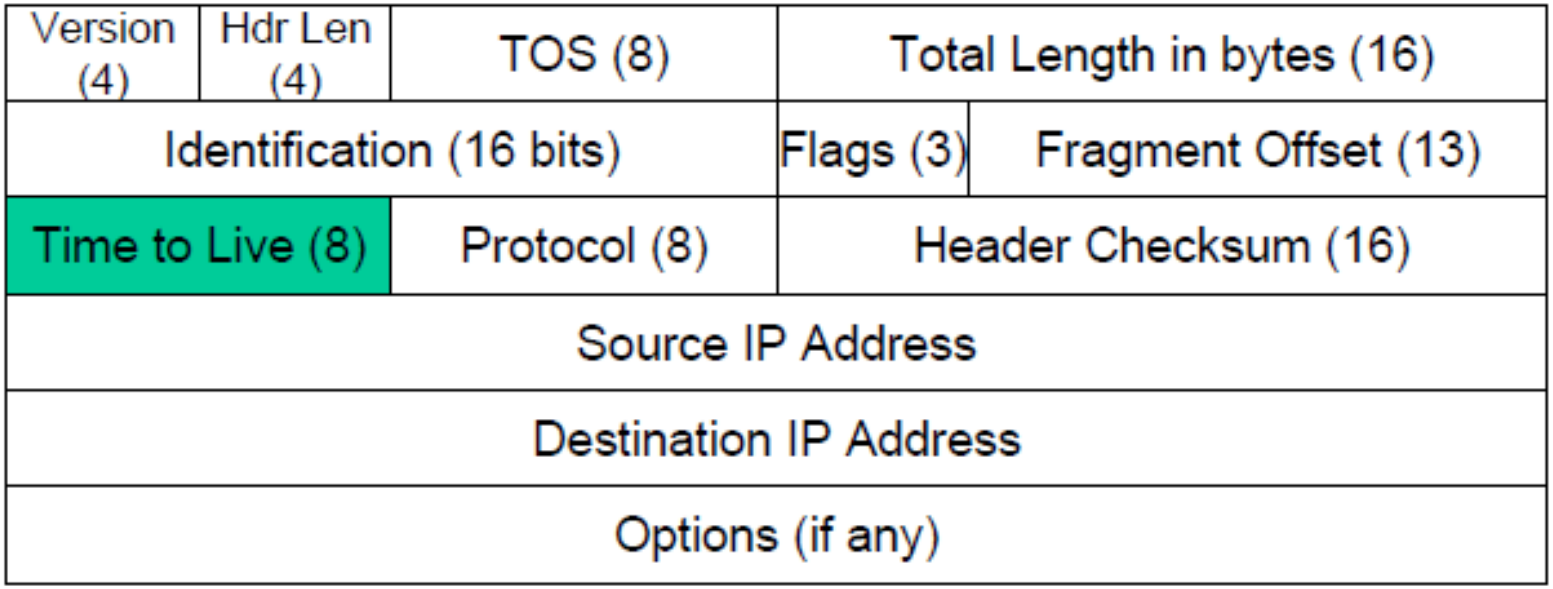
- bit 0: Reserved; must be zero.
- bit 1: Don't Fragment (DF)
- bit 2: More Fragments (MF)

# Fragment Offset

The fragment offset field is measured in units of eight-byte blocks. It is 13 bits long and specifies the offset of a particular fragment relative to the beginning of the original unfragmented IP datagram.

# Time to Live

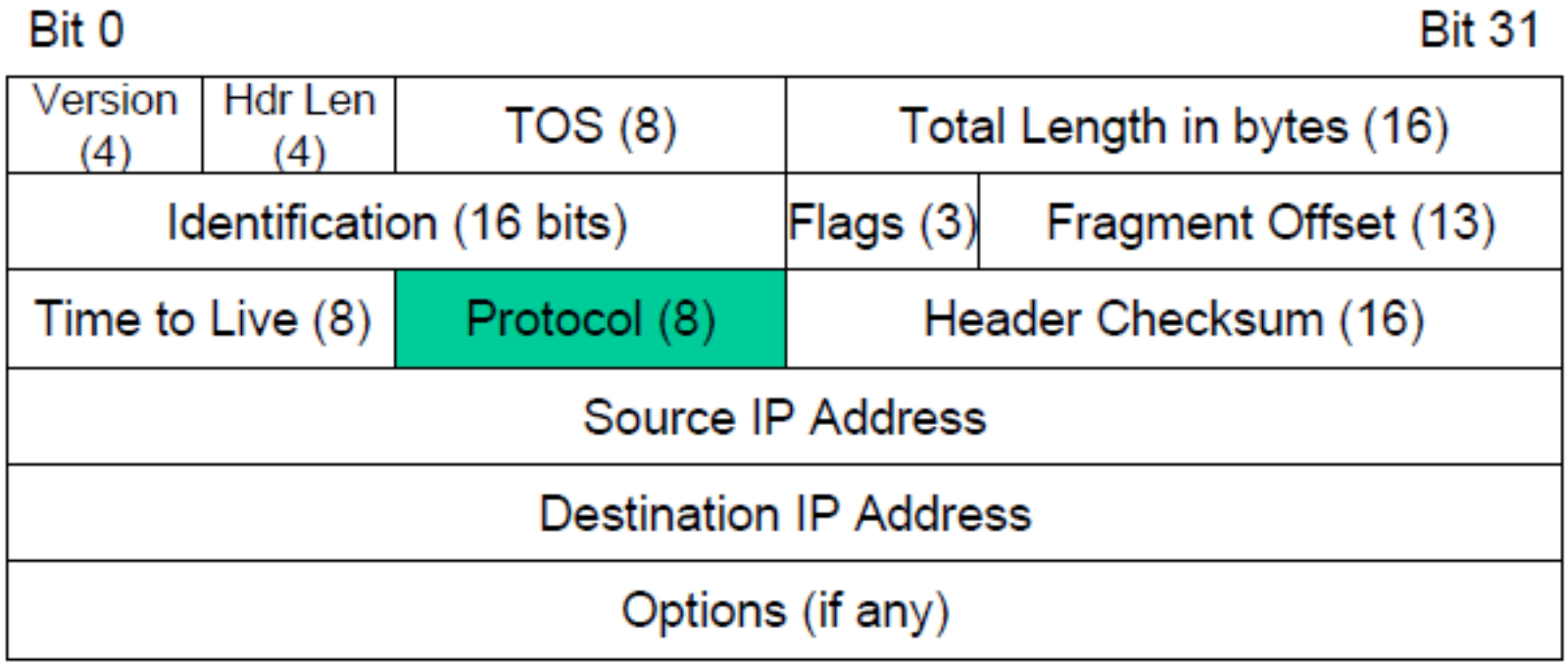
- ✓ This field limits a datagram's lifetime.
- ✓ Initially set by sender (up to 255)
- ✓ Decremented by each router
- ✓ Discard when TTL = 0 to avoid infinite routing loops



## • Protocol

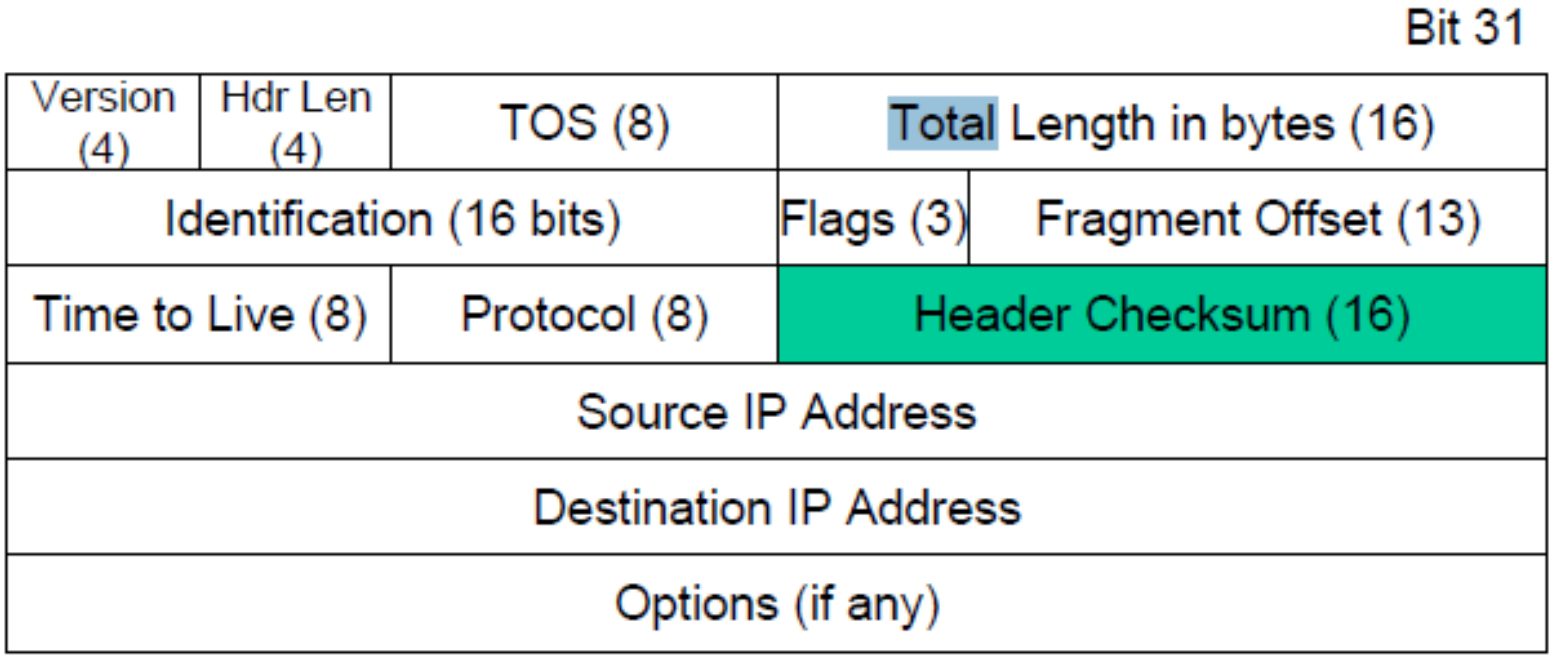
✓ Value indicates what is in the data field

✓ Example: TCP or UDP



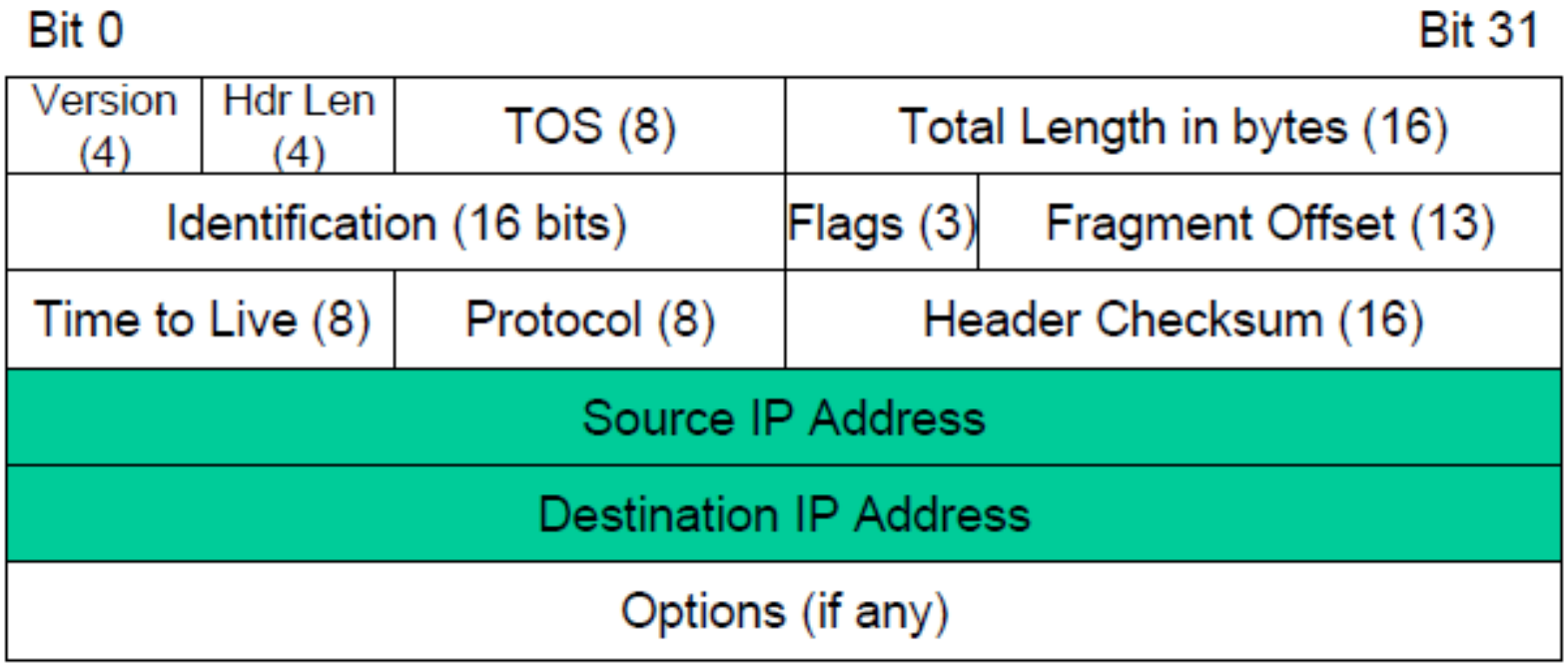
# Header Checksum

- ✓ Checks for error in the header only
- ✓ Bad headers can harm the network
- ✓ If error found, packet is simply discarded Total



# Source and Destination IP Addresses

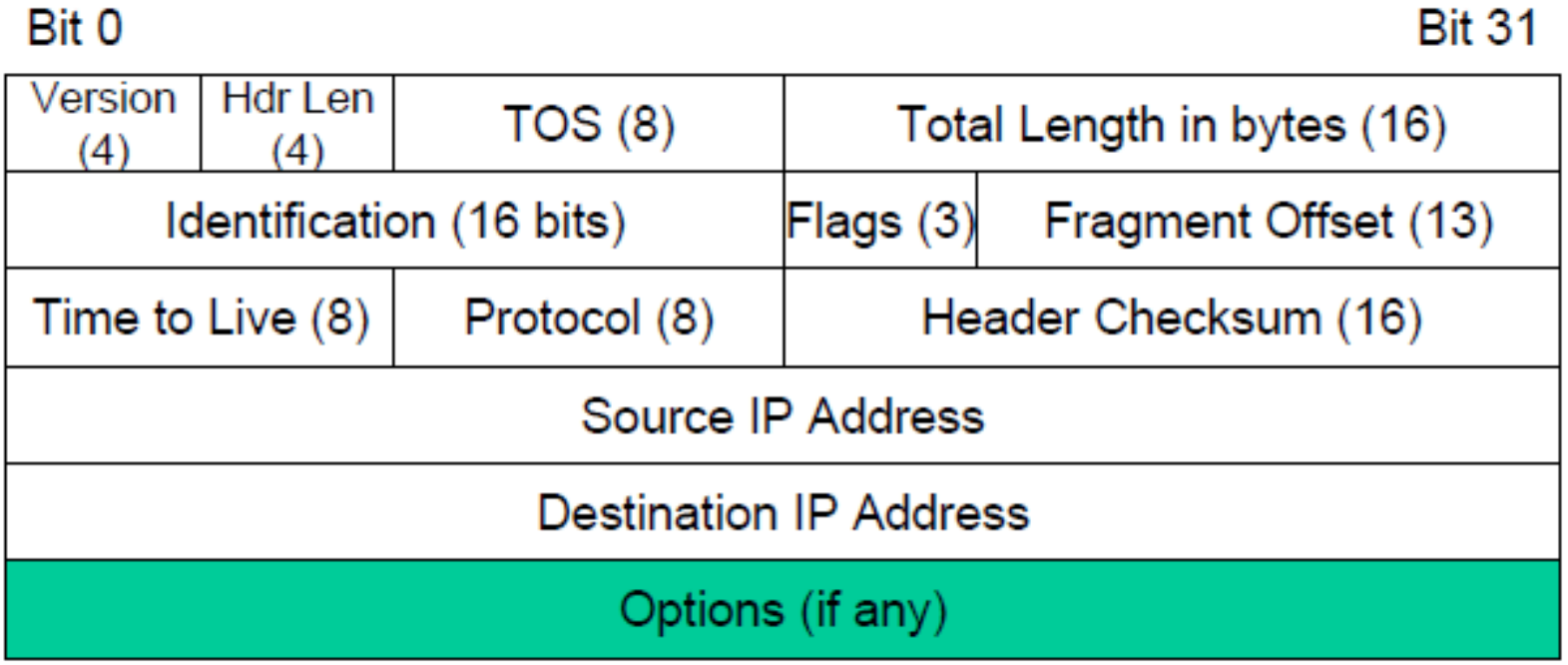
– Strings of 32 ones and zeros



- Options

✓ Contains other information about security, routing

✓ These are used for network testing and debugging

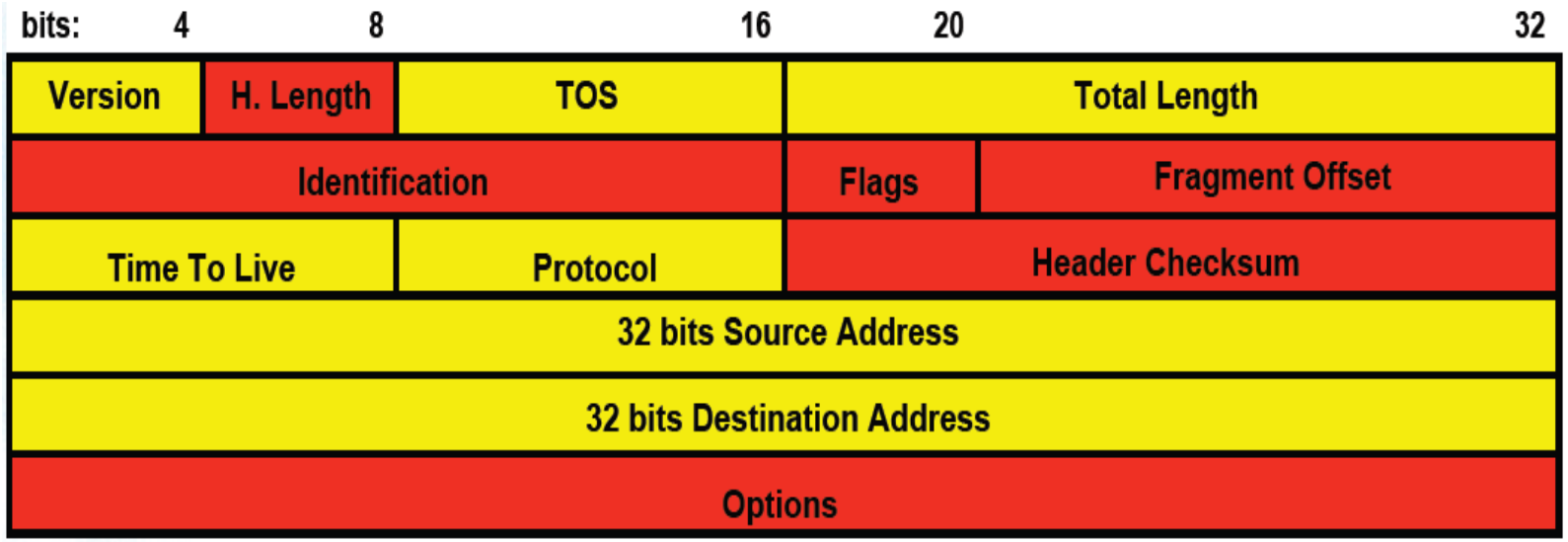


# IPv6 Packet Header

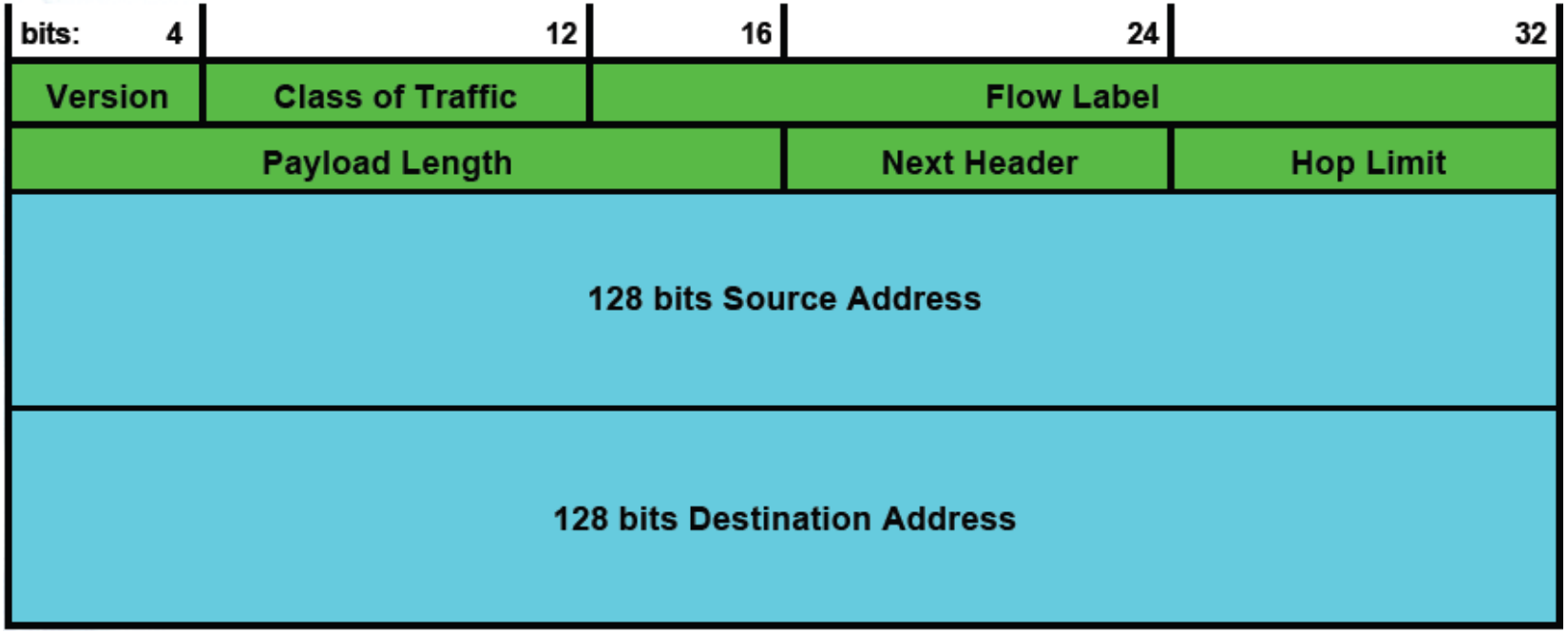
Internet Protocol, Version 6 specification
Change from IPv4 to IPv6:

- ✓ Expanded addressing capabilities
- ✓ Header format Simplification
- ✓ Improved support for extensions and options
- ✓ Flow labeling capability
- ✓ Authentications and privacy capabilities

# How IPv4 differs with IPv6

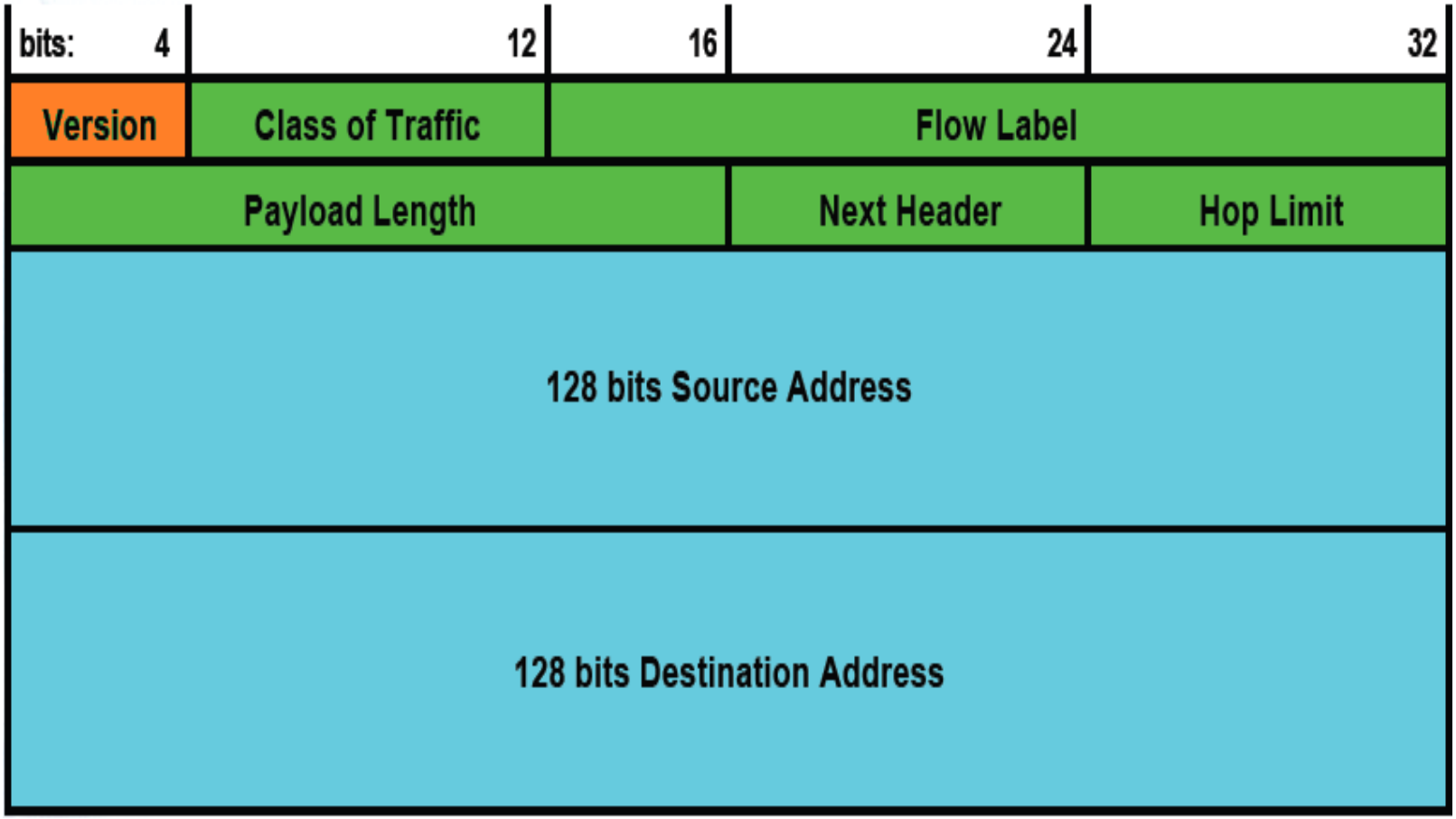



# IPv6 Packet Header



# Version

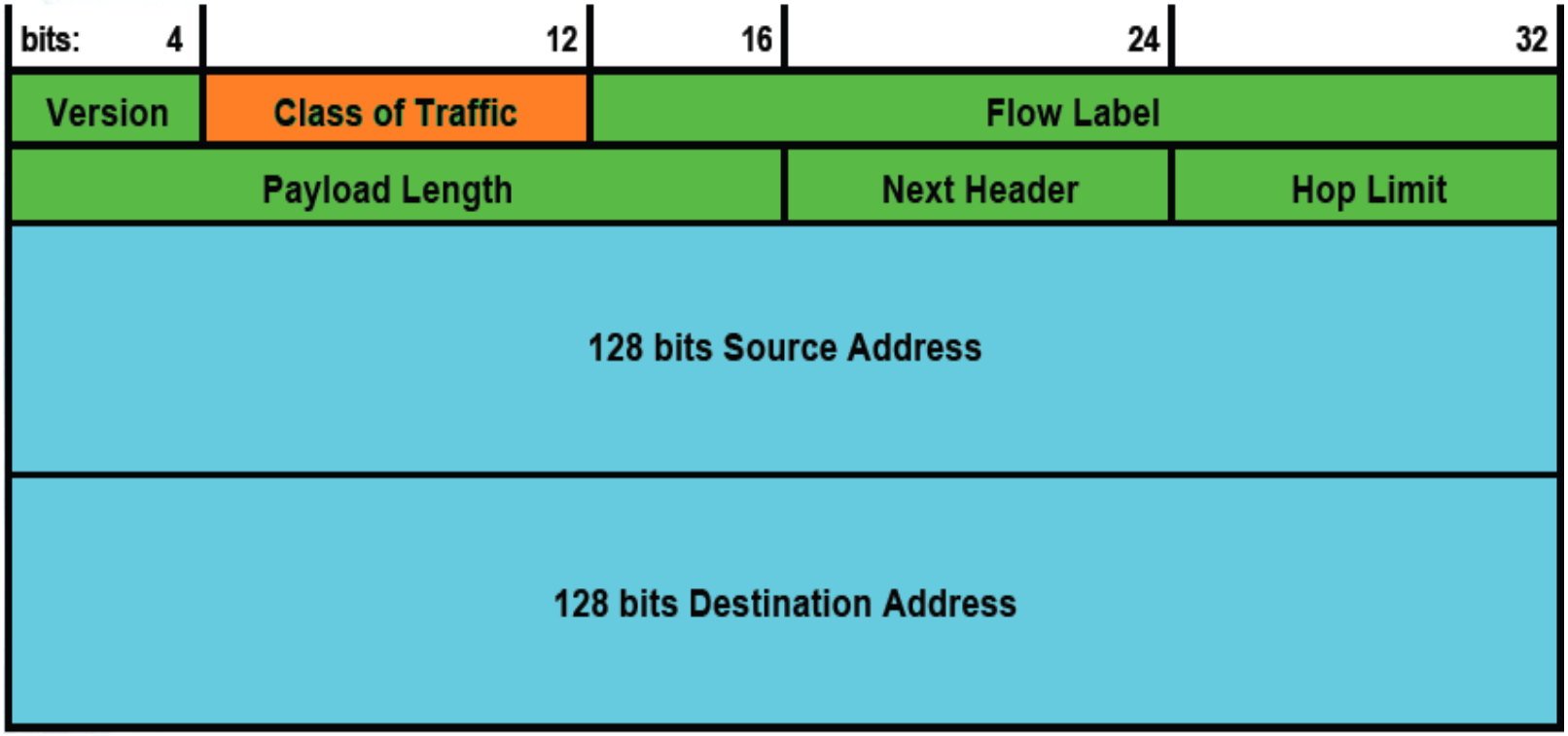
– 4 bits are used to indicate the version of IP and is set to 6.



# Traffic Class

– Indicates the class or priority of the IPv6 packet

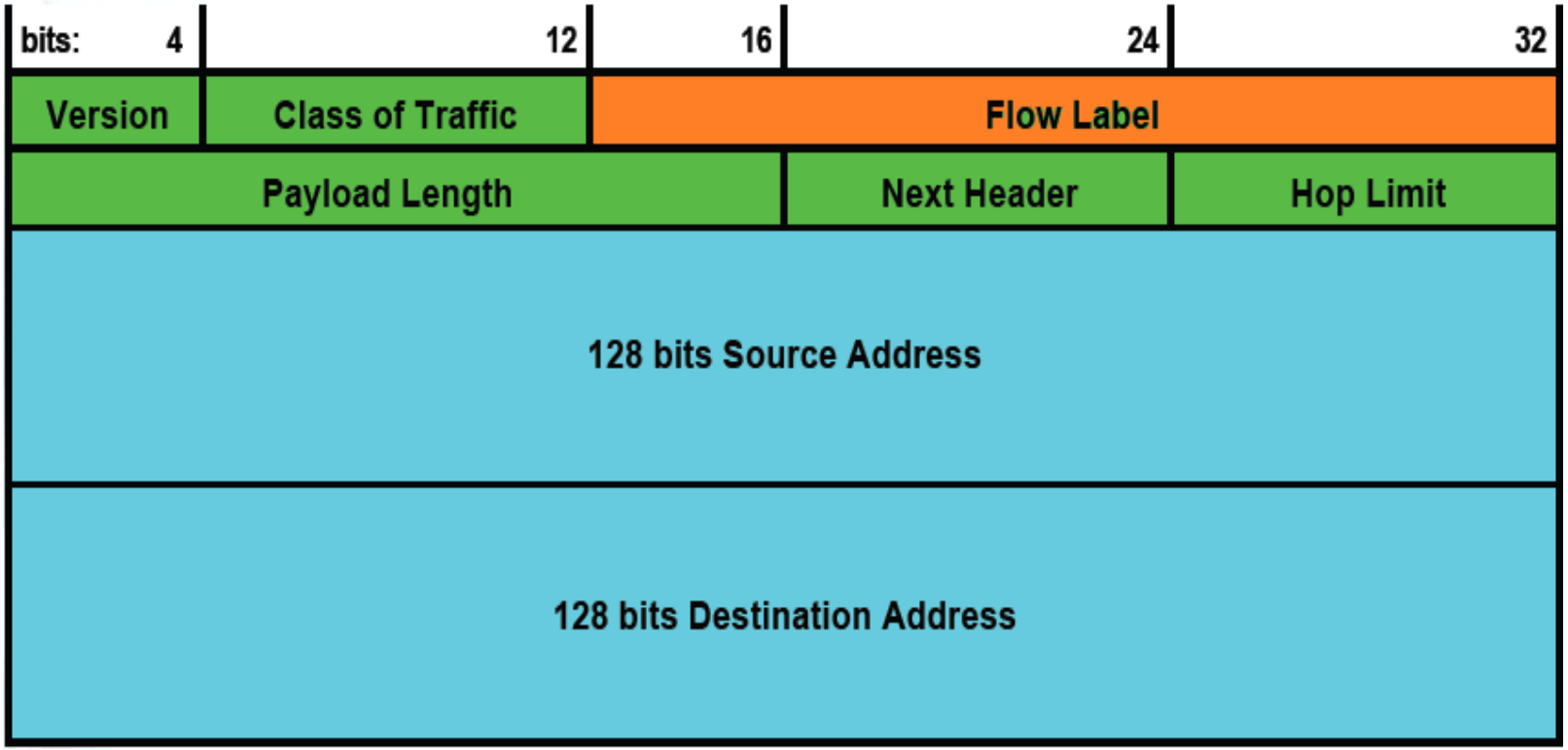
The bits of this field hold two values. The 6 most-significant bits are used for differentiated services, which is used to classify packets. The remaining two bits are used for priority values subdivide into ranges: traffic where the source provides *congestion control and non-congestion control traffic*.



# Flow Label

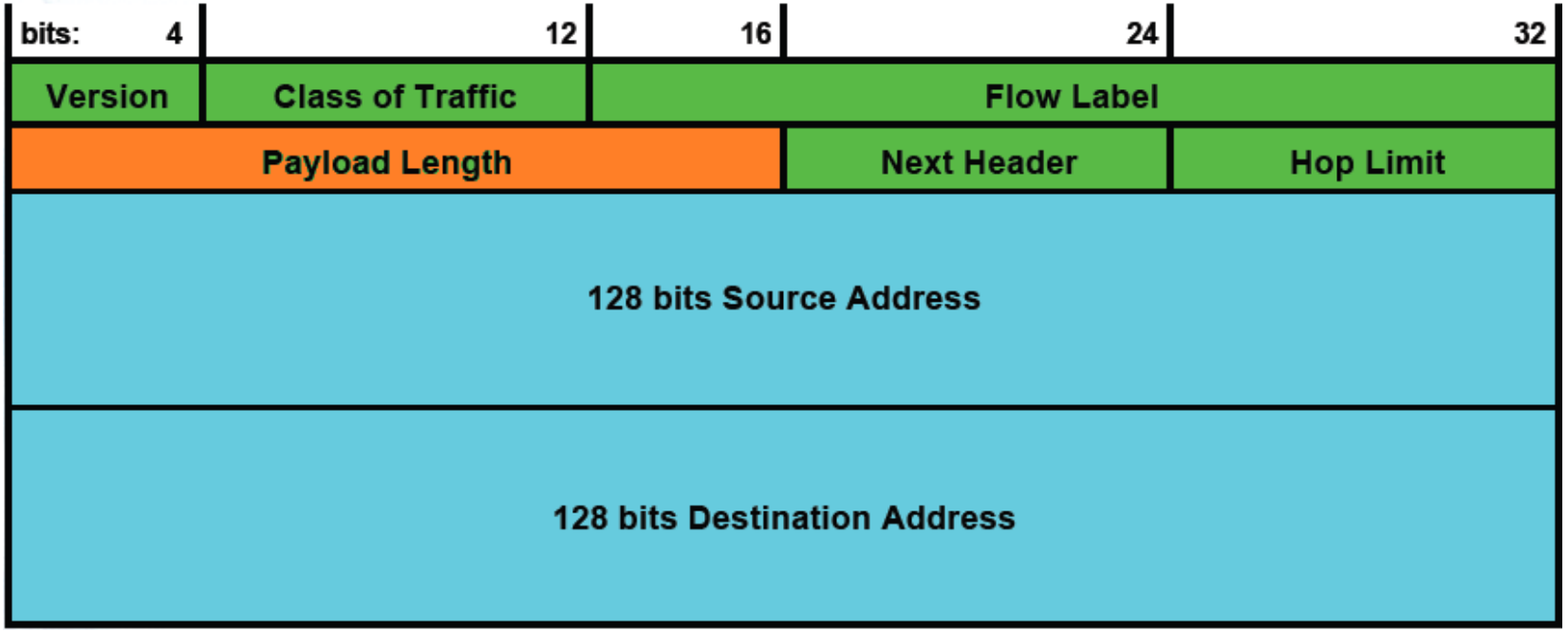
– Originally created for giving real-time applications special service.

Indicates that this packet belongs to a specific sequence of packets between a source and destination, requiring special handling by intermediate IPv6 routers.



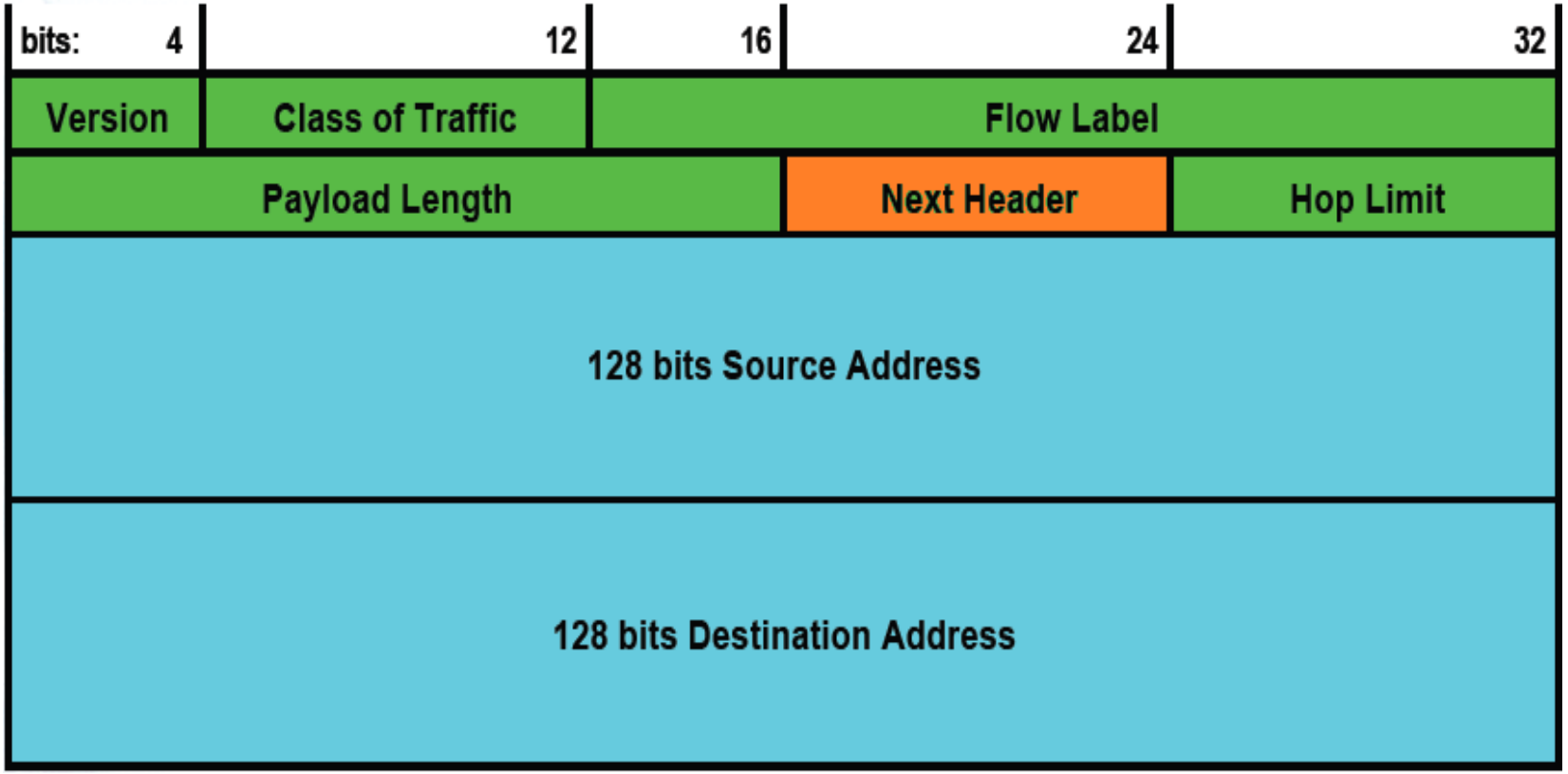
# Payload Length

– Indicates the length of the IPv6 payload. The size of this field is 16 bits.
It tell how many bytes follow the 40 bytes headers.



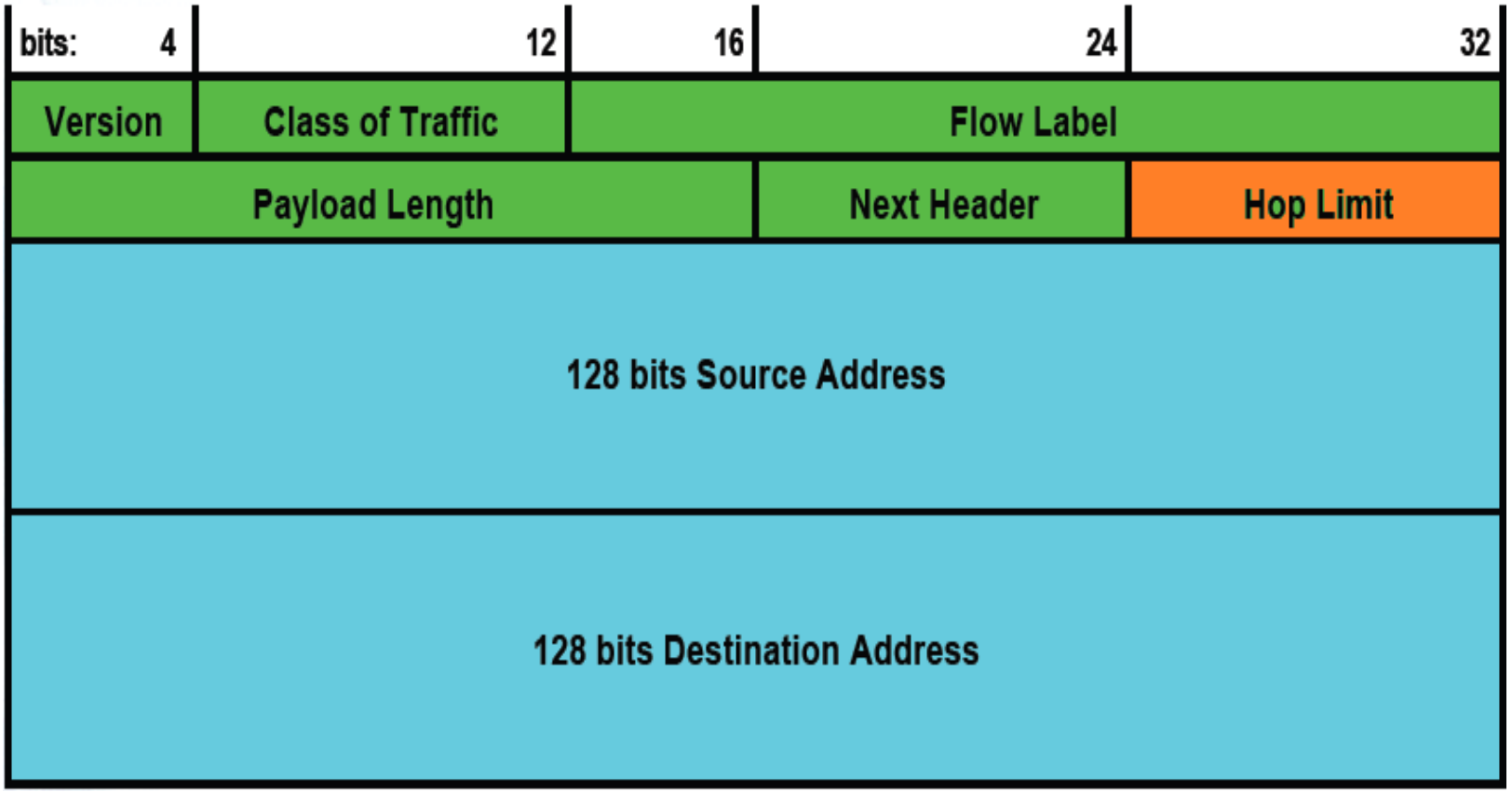
# Next Header

- ✓ –IPv6 support the extension header
- ✓ It use to simplify the headers
- ✓ Next header fields tell which extension header is used



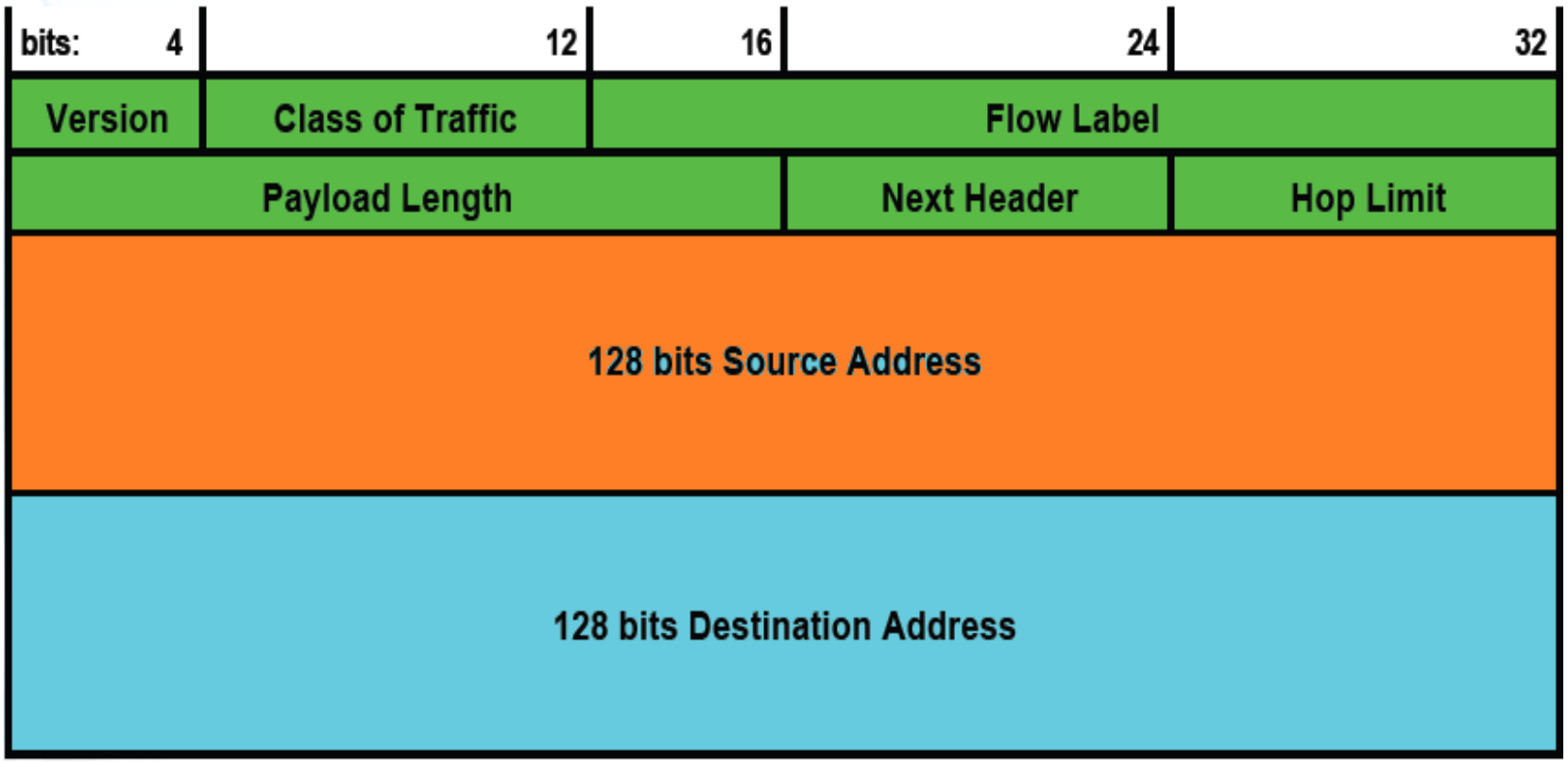
# Hop Limit

- ✓ The size of this field is 8 bits.
- ✓ Used to kill a packet
- ✓ It is numerical value which is decrement at each HOP
- ✓ If value of this field becomes zero it is discarded
- ✓ Replaces the time to live field of IPv4. This value is decremented by one at each intermediate node visited by the packet. When the counter reaches 0 the packet is discarded.



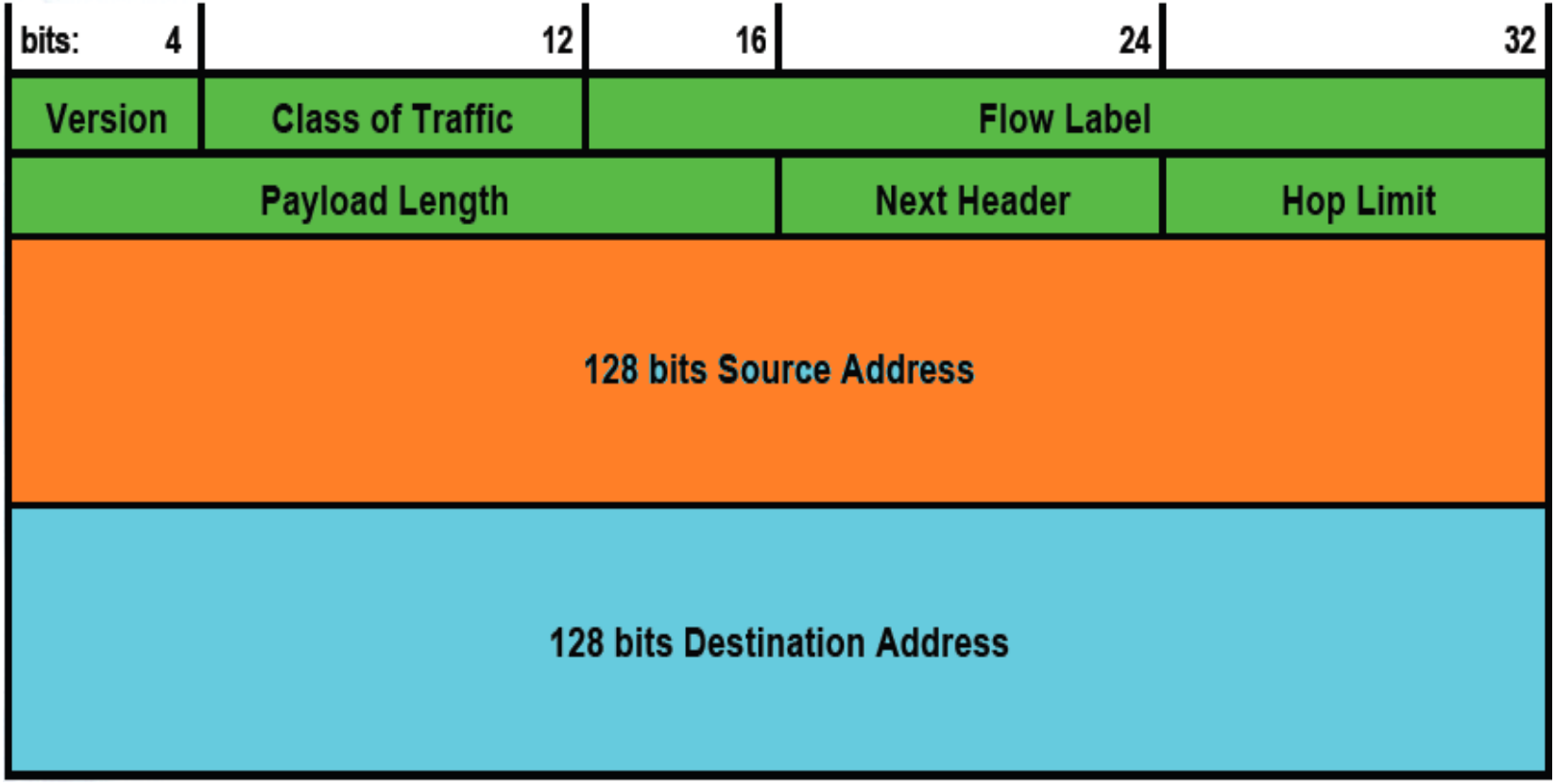
# Source Address

–Stores the IPv6 address of the originating host. The size of this field is 128 bits.



# Destination Address

– Stores the IPv6 address of the current destination host. The size of this field is 128 bits.



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