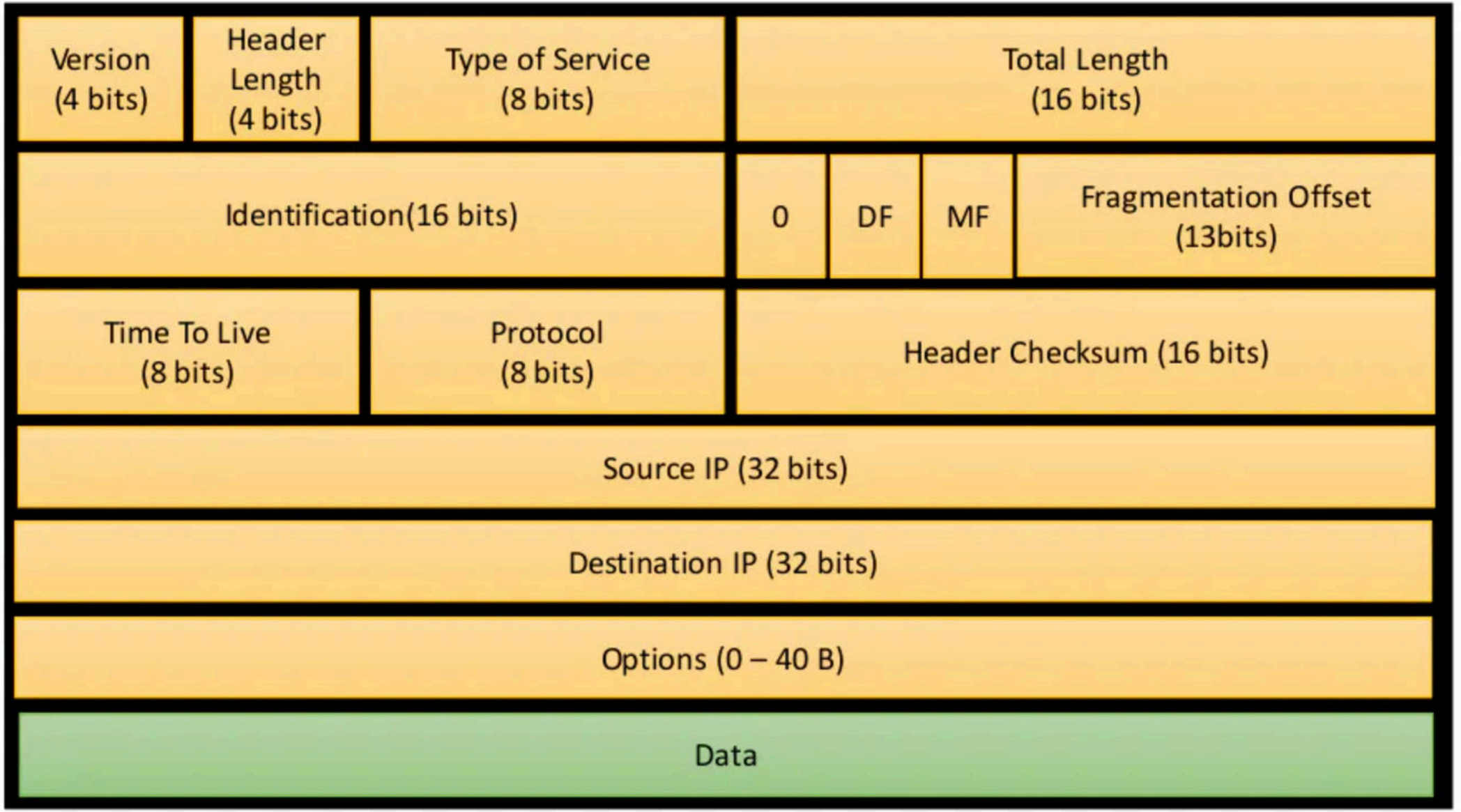
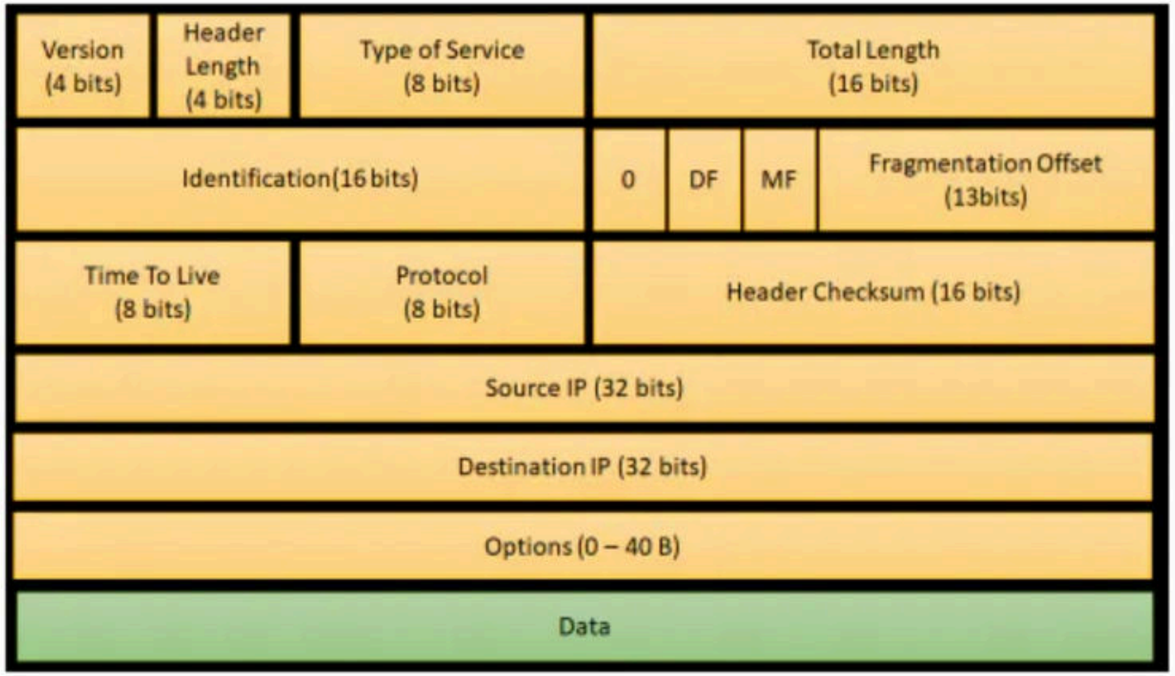
Computer Networks

IPV4


Version (4 bits)
Header Length (4 bits)
Type of Service (8 bits)
Total Length (16 bits)
Identification(16 bits)
0
DF
MF
Fragmentation Offset (13bits)
Time To Live (8 bits)
Protocol (8 bits)
Header Checksum (16 bits)
Source IP (32 bits)
Destination IP (32 bits)
Options (0 – 40 B)
Data

Version

•Version is a 4 bit field that indicates the IP version used.
•The most popularly used IP versions are version-4 (IPv4) and version-6 (IPv6).
•Only IPv4 uses the above header.
•So, this field always contains the decimal value 4.



Header Length

•Header length is a 4 bit field that contains the length of the IP header.
•It helps in knowing from where the actual data begins.

Header length = Header length field value x 4 bytes

Ex. If header length field contains decimal value 5 (represented as 0101), then-

Header length = 5 x 4 = 20 bytes

Minimum And Maximum Header Length-

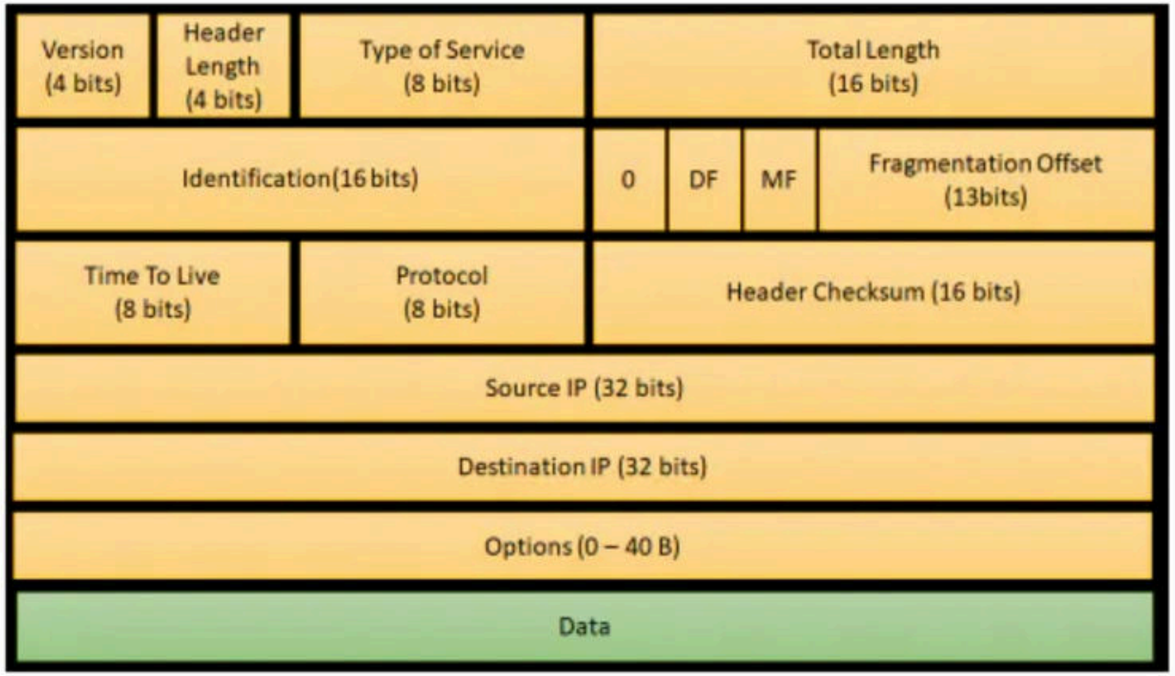
The length of IP header always lies in the range-

[20 bytes , 60 bytes]

•The initial 5 rows of the IP header are always used.
•So, minimum length of IP header = 5 x 4 bytes = 20 bytes.
•The size of the 6th row representing the Options field vary.
•The size of Options field can go up to 40 bytes.
•So, maximum length of IP header = 20 bytes + 40 bytes = 60 bytes.

Type Of Service

•Type of service is a 8 bit field that is used for Quality of Service (QoS).
•The datagram is marked for giving a certain treatment using this field.



Total Length

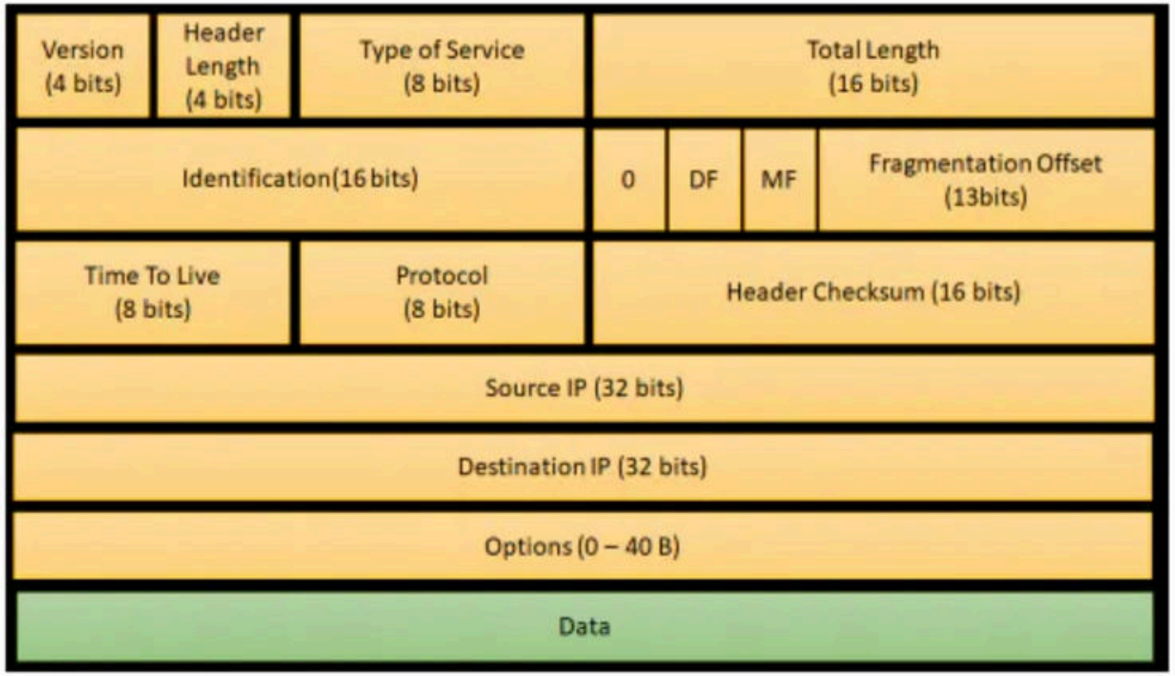
•Total length is a 16 bit field that contains the total length of the datagram (in bytes).

Total length = Header length + Payload length

•Minimum total length of datagram = 20 bytes (20 bytes header + 0 bytes data)
•Maximum total length of datagram = Maximum value of 16 bit word = 65535 bytes

Identification

•Identification is a 16 bit field.
•It is used for the identification of the fragments of an original IP datagram.



DF Bit

•DF bit stands for Do Not Fragment bit.
•Its value may be 0 or 1.

When DF bit is set to 0,

•It grants the permission to the intermediate devices to fragment the datagram if required.

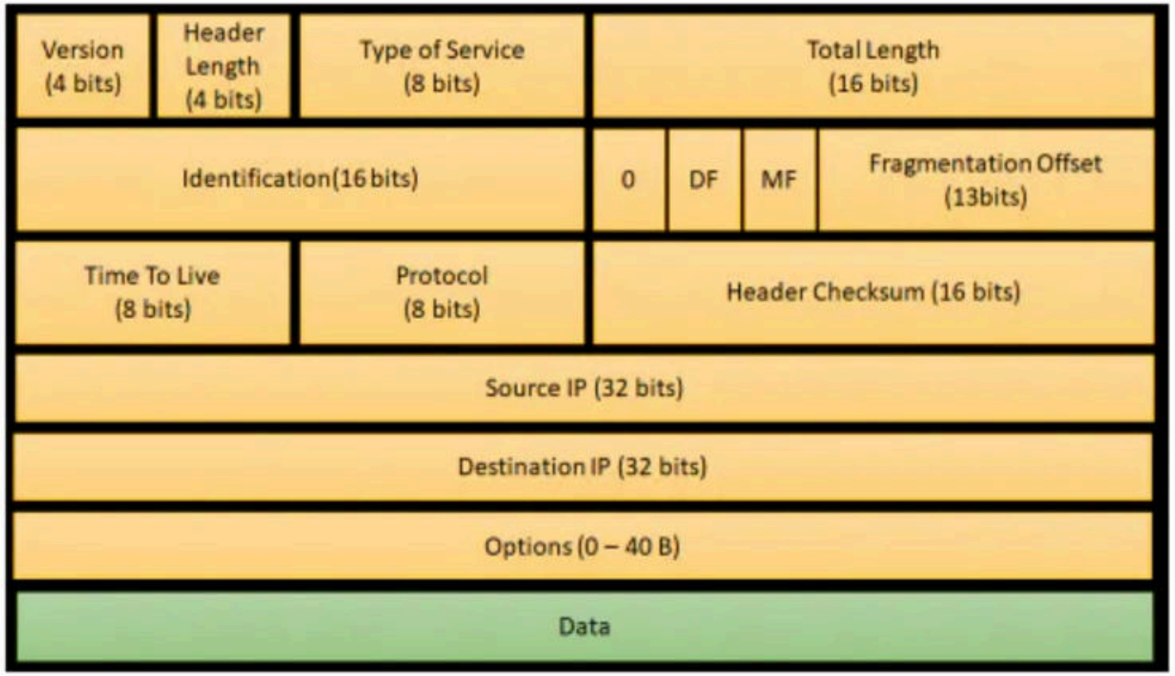
When DF bit is set to 1,
•It indicates the intermediate devices not to fragment the IP datagram at any cost.
•If network requires the datagram to be fragmented to travel further but settings does not allow its fragmentation, then it is discarded.
•An error message is sent to the sender saying that the datagram has been discarded due to its settings.

MF Bit

•MF bit stands for More Fragments bit.
•Its value may be 0 or 1.

When MF bit is set to 0,
•It indicates to the receiver that the current datagram is either the last fragment in the set or that it is the only fragment.

When MF bit is set to 1,
•It indicates to the receiver that the current datagram is a fragment of some larger datagram.
•More fragments are following.
•MF bit is set to 1 on all the fragments except the last one.



Fragment Offset

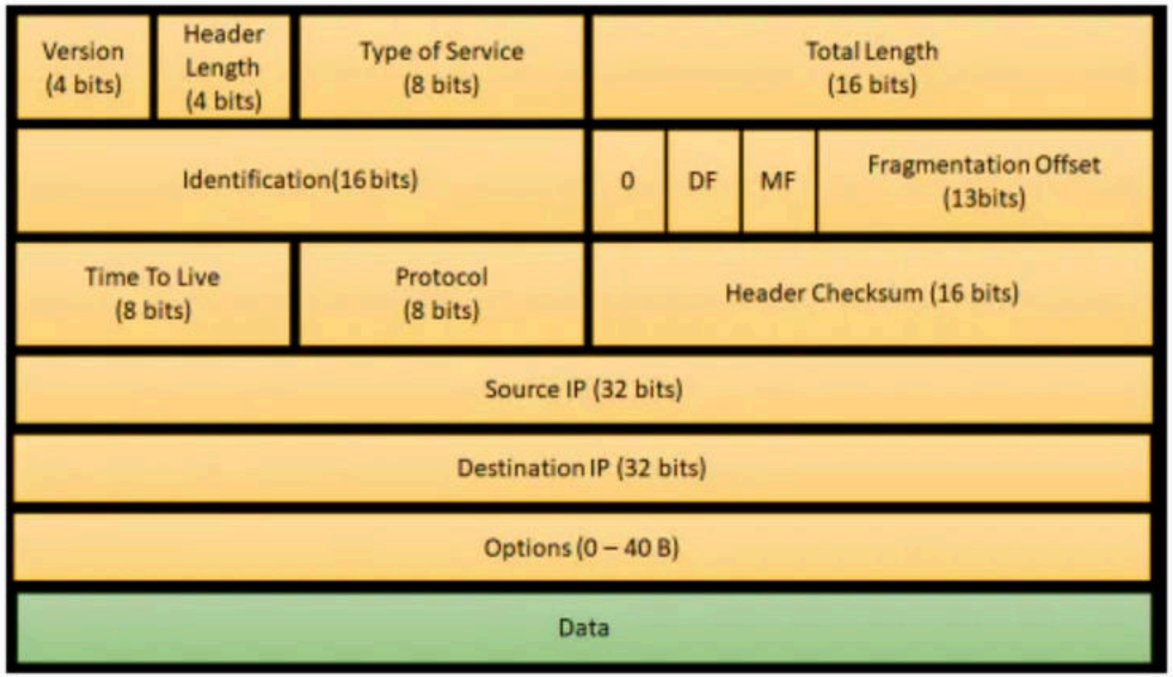
•Fragment Offset is a 13 bit field.
•It indicates the position of a fragmented datagram in the original unfragmented IP datagram.
•The first fragmented datagram has a fragment offset of zero.

Fragment offset for a given fragmented datagram
= Number of data bytes ahead of it in the original unfragmented datagram

Time To Live

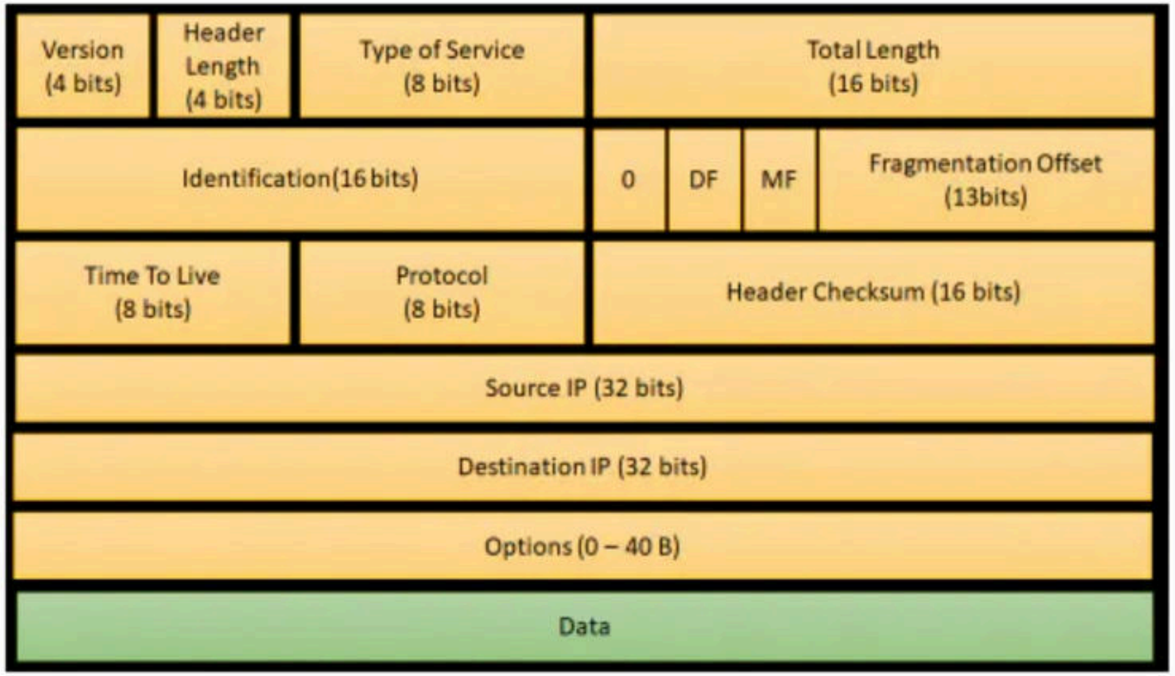
•Time to live (TTL) is a 8 bit field.
•It indicates the maximum number of hops a datagram can take to reach the destination.
•The main purpose of TTL is to prevent the IP datagrams from looping around forever in a routing loop.

The value of TTL is decremented by 1 when-
•Datagram takes a hop to any intermediate device having network layer.
•Datagram takes a hop to the destination.



Protocol

•Protocol is a 8 bit field.
•It tells the network layer at the destination host to which protocol the IP datagram belongs to.
•In other words, it tells the next level protocol to the network layer at the destination side.
•Protocol number of ICMP is 1, IGMP is 2, TCP is 6 and UDP is 17.



Why Protocol Number Is A Part Of IP Header?

Consider-
•An IP datagram is sent by the sender to the receiver.
•When datagram reaches at the router, it's buffer is already full.

In such a case,
•Router does not discard the datagram directly.
•Before discarding, router checks the next level protocol number mentioned in its IP header.
•If the datagram belongs to TCP, then it tries to make room for the datagram in its buffer.
•It creates a room by eliminating one of the datagrams having lower priority.
•This is because it knows that TCP is a reliable protocol and if it discards the datagram, then it will be sent again by the sender.
•The order in which router eliminate the datagrams from its buffer is-

ICMP > IGMP > UDP > TCP

If protocol number would have been inside the datagram, then-
•Router could not look into it.
•This is because router has only three layers- physical layer, data link layer and network layer.

That is why, protocol number is made a part of IP header.

Header Checksum

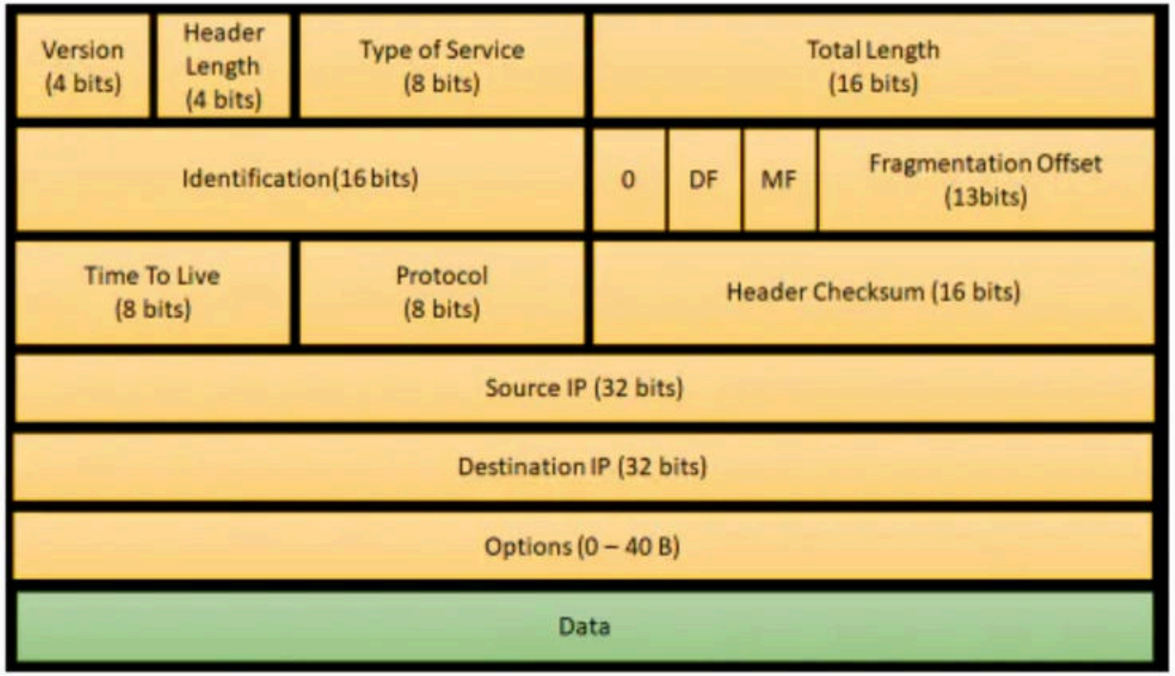
- Header checksum is a 16 bit field.
- It contains the checksum value of the entire header.
- The checksum value is used for error checking of the header.

At each hop,

- The header checksum is compared with the value contained in this field.
- If header checksum is found to be mismatched, then the datagram is discarded.
- Router updates the checksum field whenever it modifies the datagram header.

The fields that may be modified are-

1. TTL
2. Options
3. Datagram Length
4. Header Length
5. Fragment Offset



Source IP Address

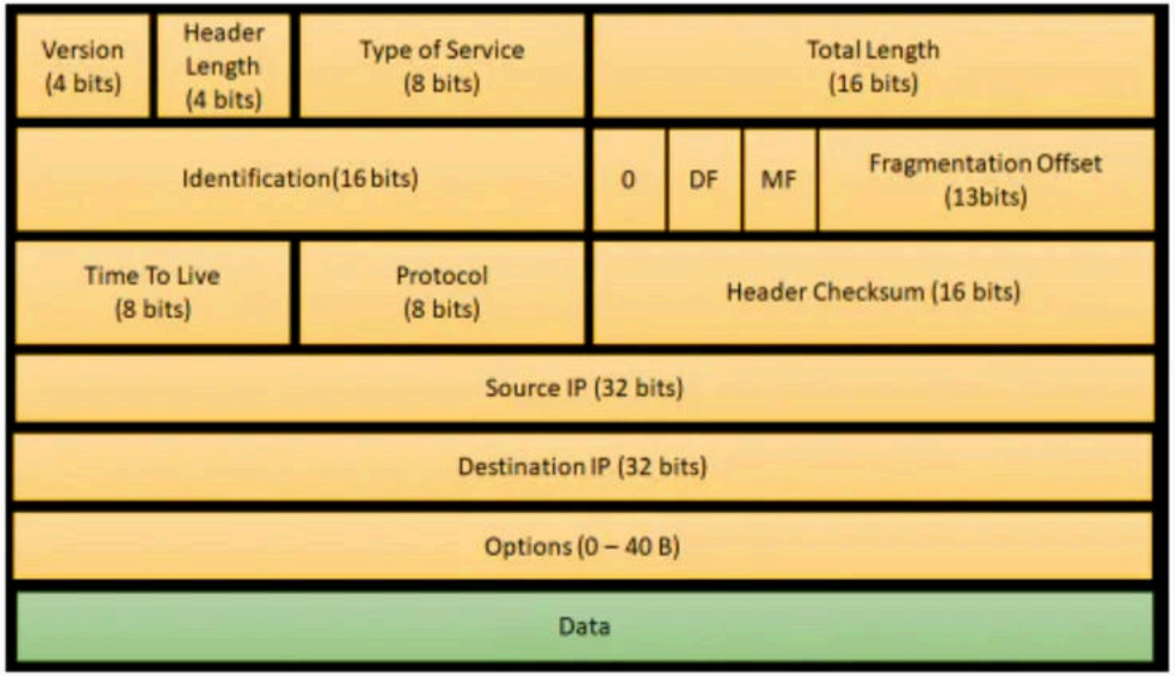
•Source IP Address is a 32 bit field.
•It contains the logical address of the sender of the datagram.

Destination IP Address

•Destination IP Address is a 32 bit field.
•It contains the logical address of the receiver of the datagram.

Options

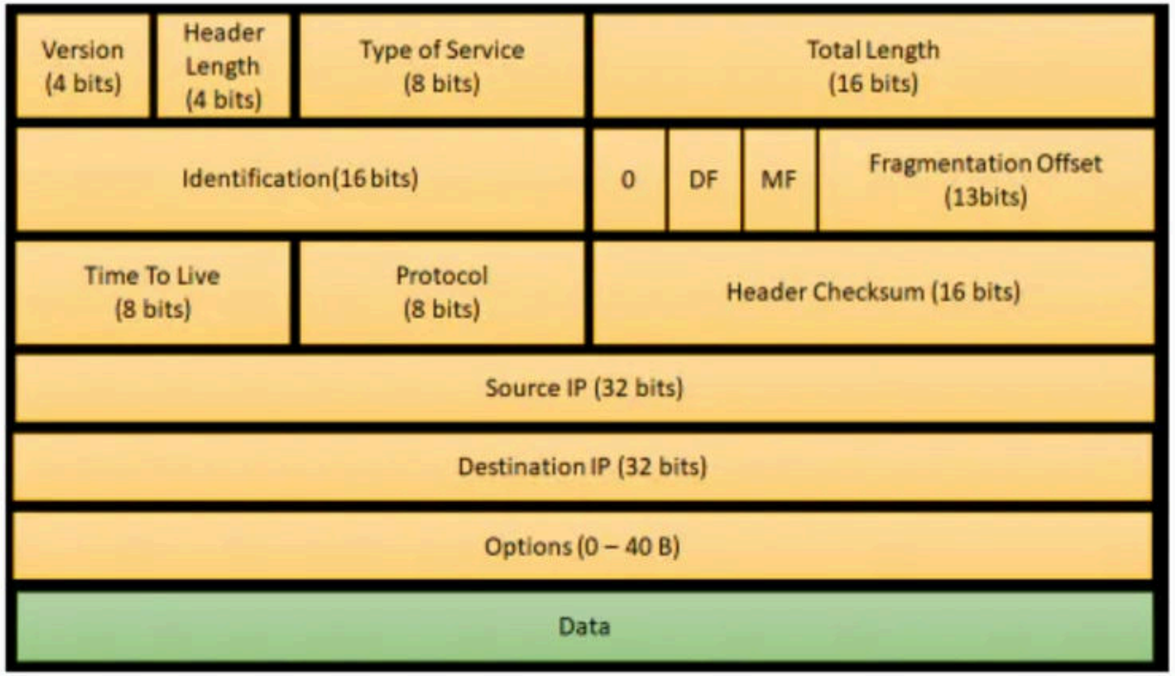
•Options is a field whose size vary from 0 bytes to 40 bytes.
•This field is used for several purposes such as-
1.Record route
2.Source routing
3.Padding



1. Record Route-

•A record route option is used to record the IP Address of the routers through which the datagram passes on its way.
•When record route option is set in the options field, IP Address of the router gets recorded in the Options field.

The maximum number of IPv4 router addresses that can be recorded in the Record Route option field of an IPv4 header is 9.



2. Source Routing-

•A source routing option is used to specify the route that the datagram must take to reach the destination.
•This option is generally used to check whether a certain path is working fine or not.
•Source routing may be loose or strict.

3. Padding-

•Addition of dummy data to fill up unused space in the transmission unit and make it conform to the standard size is called as padding.
•Options field is used for padding.