Lecture 8
Internet Protocol

Topics Covered

- IP Protocol
- IP Datagram
- Structure of IP frame header
- Header length (HLEN)
- Flags
- Fragmentation offset
- Time to live
- Various n/w layer protocols

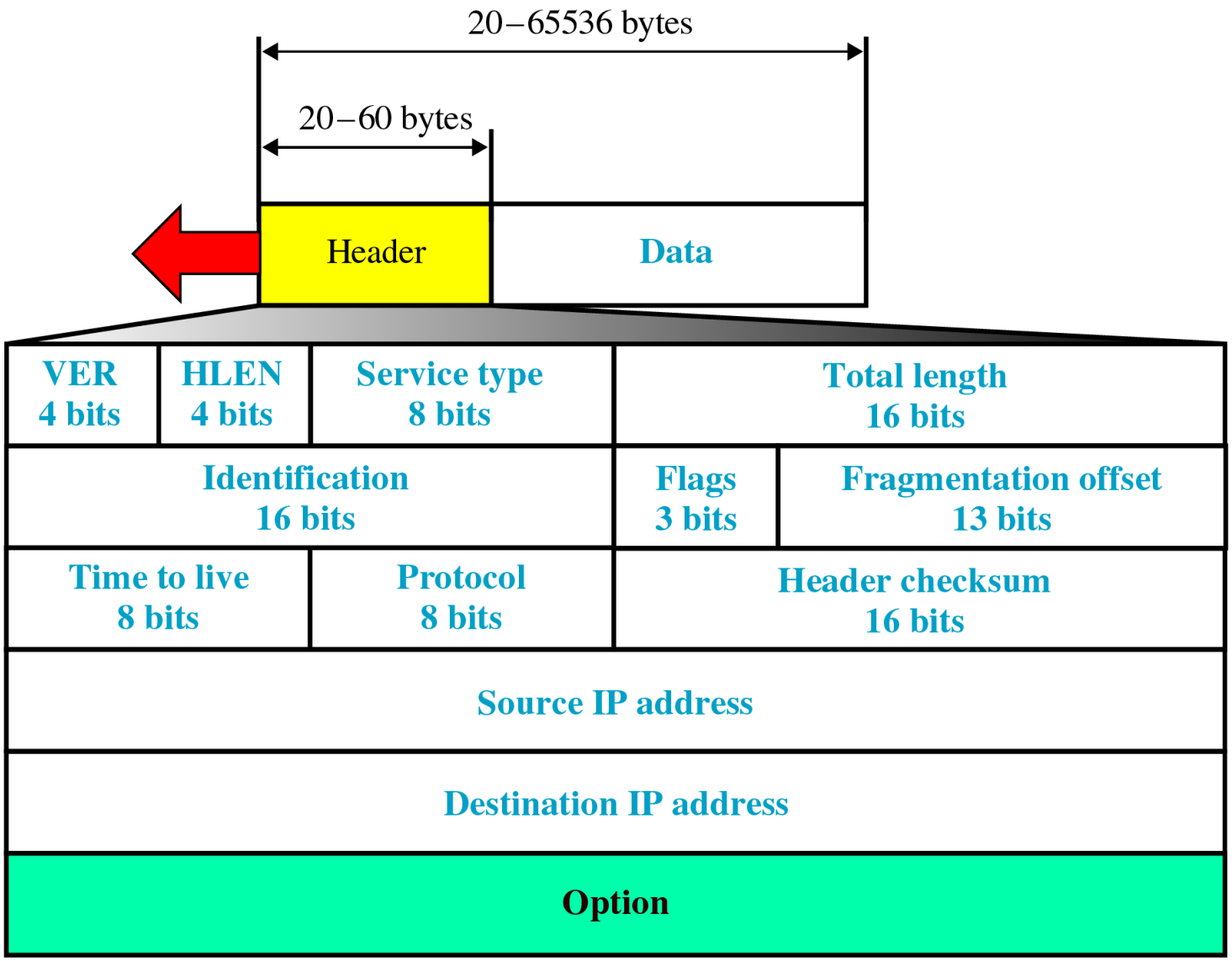
IP Protocol

- This is host to host network layer connection less datagram protocol with no guarantee of reliability.
- It is a unreliable protocol b’z it does not provide any error and flow control.
- It can only detect the error and discard the corrupted packet.

IP Datagram

- Packet in IP layer are called datagram.
- Datagram is a variable length packet with two parts **Header** and **Data .**
- The header is 20-60 bytes in length and contains information required for routing and delivery.
- Data field is of variable length.

Structure of IP frame header



Version (VER).

- This 4-bit field defines the version of the IP protocol.
- Currently the version is 4. However, version 6 may totally replace version 4 in the future.
  - This field tells the IPv4 software running in the processing machine that the datagram has the format of version 4.
  - All fields must be interpreted as specified in the fourth version of the protocol.
  - If the machine is using some other version of IPv4, the datagram is discarded rather than interpreted incorrectly.

Header length (HLEN)

- This 4-bit field defines the total length of the datagram header in 4-byte words.
- This field is needed because the length of the header is variable (between 20 and 60 bytes).
- When there are no options, the header length is 20 bytes, and the value of this field is 5 (5 x 4 = 20).
- When the option field is at its maximum size, the value of this field is 15 (15 x 4 = 60).

Services

- This is 8-bit field. This field, previously called service type, is now called differentiated services. It defines the class of datagram for quality of service purpose.

Total length

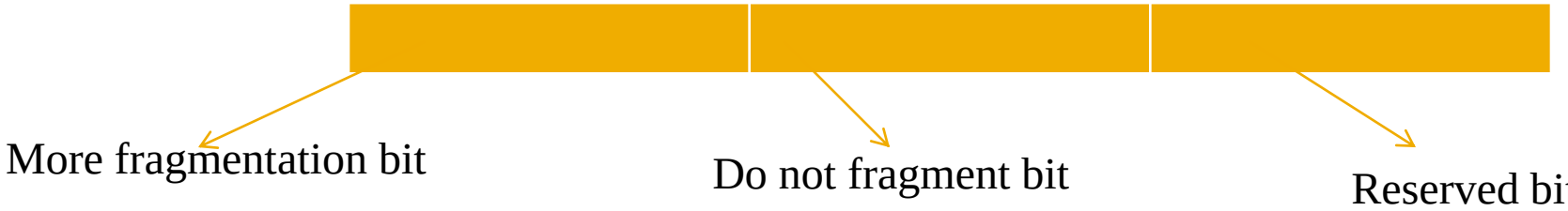
- field defines the total length of the datagram including the header.
- Length of data =total length - header length
- Since the field length is 16 bits, the total length of the IPv4 datagram is limited to **65,535 (216-1) bytes,** of which 20 to 60 bytes are the header and the rest is data.

Identification

- This 16-bit field identifies a datagram originating from the source host.
- When a datagram is fragmented, the value in the identification field is copied to all fragments .
- The identification number helps the destination in reassembling the datagram.
- It knows that all fragments having the same identification value must be assembled into one datagram.

Flags

- This is a 3-bit field.
- The first bit is reserved and it should be zero.
- The second bit is called the do not fragment bit.
  - If its value is 1, the machine must not fragment the datagram .
  - If its value is 0, the datagram can be fragmented if required.
- The third bit is called the more fragment bit.
  - If its value is 1, it means the datagram is not the last fragment; there are more fragments after this one.
  - If its value is 0, it means this is the last or only fragment.

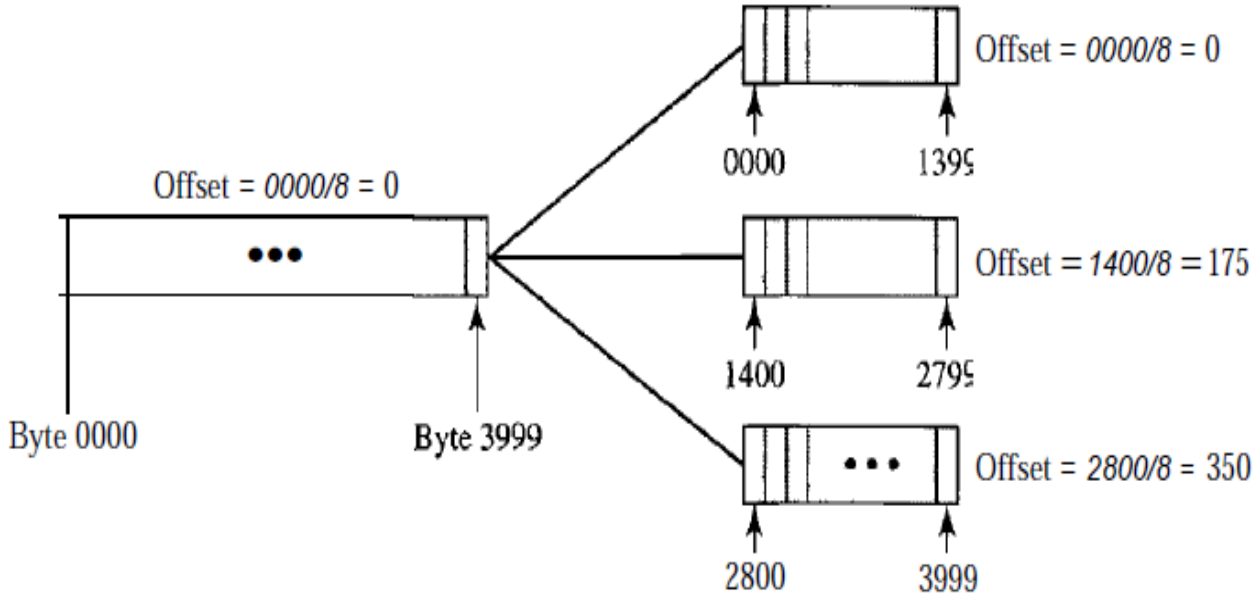


Fragmentation offset

- This 13-bit field shows the relative position of this fragment with respect to the whole datagram.
- It is the offset of the data in the original datagram measured in units of 8 bytes.
- The bytes in the original datagram are numbered 0 to 3999.
- The first fragment carries bytes 0 to 1399.
  - The offset for this datagram is 0/8 =0.
- The second fragment carries bytes 1400 to 2799.
  - The offset value for this fragment is 1400/8 = 175.
- Finally, the third fragment carries bytes 2800 to 3999.
  - The offset value for this fragment is 2800/8 =350.

Fragmentation offset

- Remember that the value of the offset is measured in units of 8 bytes. This forces hosts that fragment datagrams to choose a fragment size so that the first byte number is divisible by 8.



Time to live

- A datagram has a limited lifetime in its travel through an internet.
- This field was designed to hold a timestamp, which was decremented by each visited router.
- The datagram was discarded when the value became zero.
- All the machines must have synchronized clocks and must know how long it takes for a datagram to go from one machine to another.

Time to live

- This field is used mostly to control the maximum number of routers visited by the datagram.
- When a source host sends the datagram, it stores a number in this field.
- This value is 2 times the maximum number of routes between any two hosts. Each router that processes the datagram decrements this number by 1.If this value is zero, the router discards the datagram .

Time to live

- This field is needed because routing tables in the Internet can become corrupted . A datagram may travel between two or more routers for a long time without ever getting delivered to the destination host. This field limits the lifetime of a datagram .
- This field is also used to intentionally limit the journey of the packet. if the source wants to **confine the packet to the local network, it can store 1** in this field. When the packet arrives at the first router, this value is decremented to 0, and the datagram is discarded

Services provided by IP

- **Addressing** –32 bit address used by intermediate router to select a path through the network for the packet.
- **Fragmentation–** IP packet may be split in to smaller packets. This permit a large packet to travel through a n/w that can handle the smaller packets.
- **Packet time out –** time to live

Address Space

- An address space is the total number of addresses used by the protocol.
- IP uses 32-bit addresses, which means that the address space is 2^{32} or 4,294,967,296 (more than 4 billion).

Various n/w layer protocols

- IP needs services of
  - ARP to find the MAC(physical) address ,
  - RARP to find IP address ,
  - ICMP for query and error reporting messages and
  - IGMP for the simultaneous transmission of a message to a group of receivers.

Applications/Assignment

- From the discussion , students should find out all the applications of IP protocol.

Scope of Research

- IP in mobile networks
- IP in Mobile adhoc networks
- IP in wireless domain