Module 4

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- IP protocol, IP addresses, Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP). Open Shortest Path First(OSPF) Protocol, Border Gateway Protocol (BGP), Internet multicasting, IPv6, ICMPv6.

IP protocol

- IP stands for **internet protocol**.
- It is a protocol defined in the TCP/IP model used for sending the packets from source to destination.
- The main task of IP is to deliver the packets from source to the destination based on the IP addresses available in the packet headers.
- IP defines the packet structure as well as the addressing method .
- An IP protocol provides the connectionless service, which is accompanied by two transport protocols, i.e., TCP/IP and UDP/IP, so internet protocol is also known as TCP/IP or UDP/IP.

IP protocol

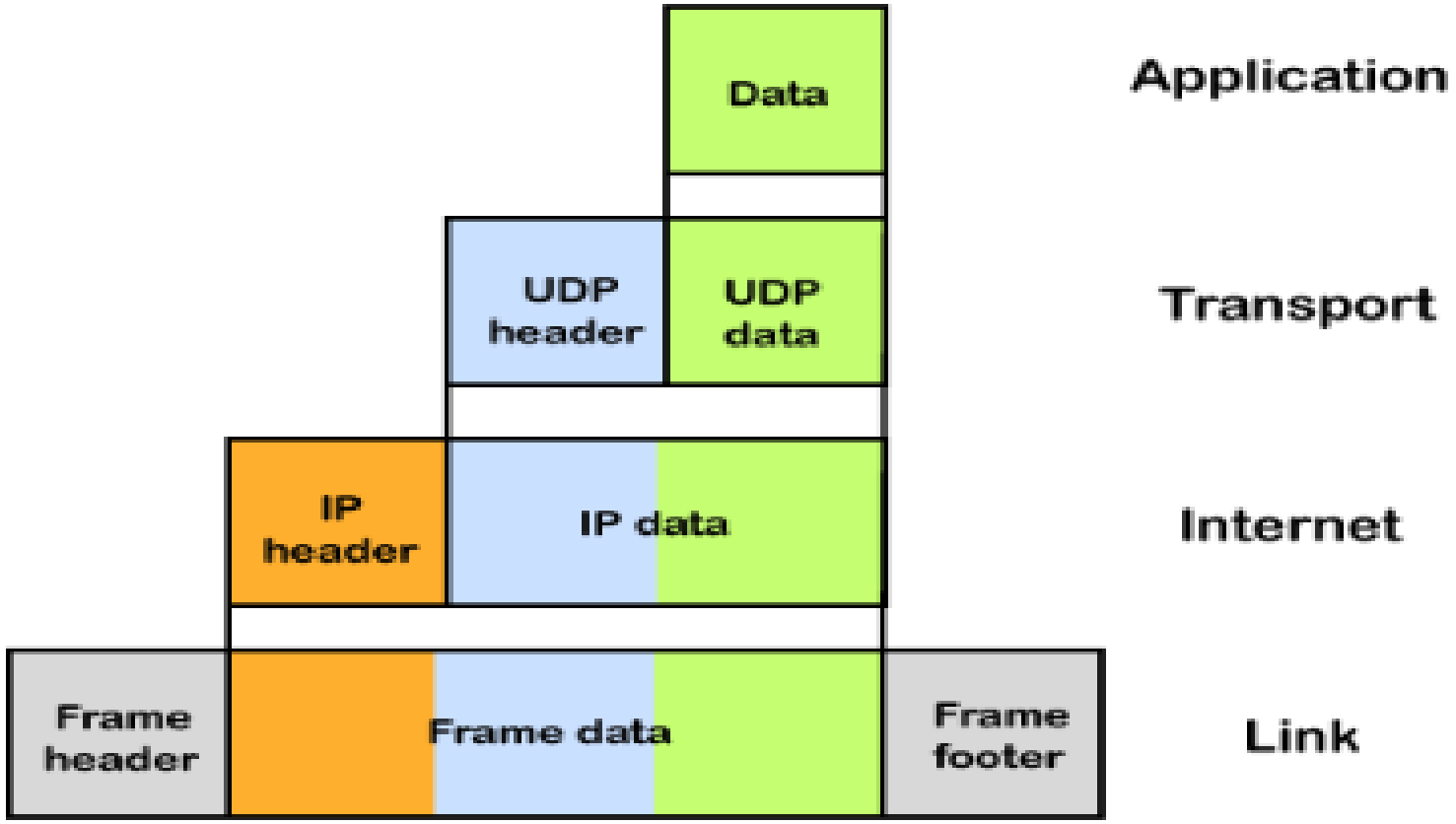
- Internet Protocol is **connectionless** and **unreliable** protocol.
- It ensures no guarantee of successfully transmission of data.
- In order to make it reliable, it must be paired with reliable protocol such as TCP at the transport layer.

- The first version of IP (Internet Protocol) was IPv4 **defines an IP address as a 32- bit number.**.
- After IPv4, IPv6 came into the market, using 128 bits for the IP address which has been increasingly used on the public internet since 2006

An internet protocol defines two things:

- Format of IP packet
- IP Addressing system

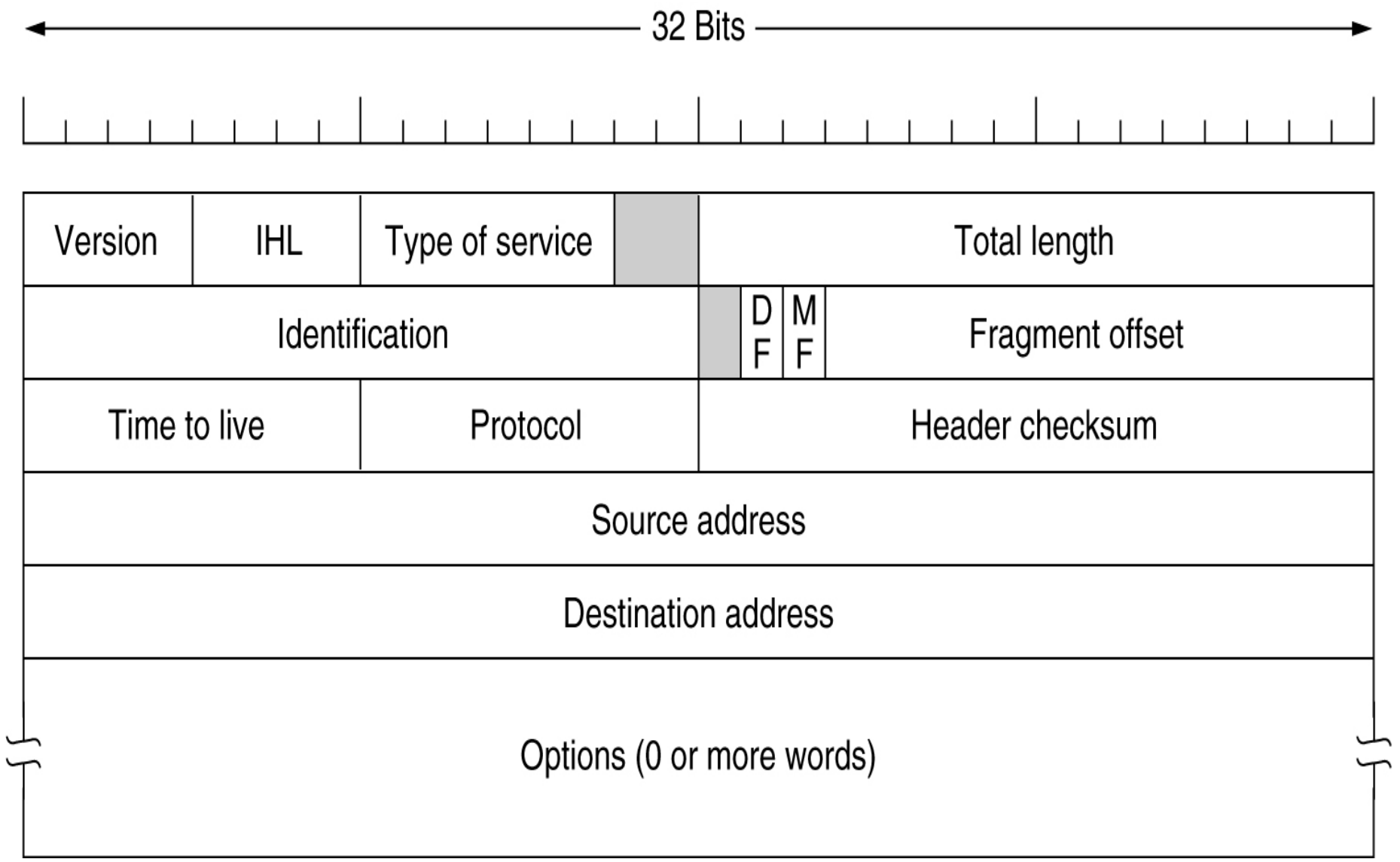
Flow of data


Data
UDP header
UDP data
IP header
IP data
Frame header
Frame data
Frame footer
Application
Transport
Internet
Link

The IP packet format

- IP datagram (packet)consists of a header part and a data part
- header has a 20-byte fixed part and a variable length optional part

IPV4 Header format



The IP Protocol

- Version field
- keeps track of which version of the protocol the datagram belongs to.

- IHL field
  - Since the header length is not constant, IHL is provided to tell how long the header is, in 32-bit words.
  - The minimum value is 5, which applies when no options are present.
  - The maximum value of this 4-bit field is 15, which limits the header to 60 bytes, and thus the Options field to 40 bytes.

The IP Protocol

- Type of service field.
  - to distinguish between different classes of service
  - 6-bit field contained a three-bit Precedence field and three flags, D, T, and R.
  - The Precedence field was a priority from 0 (normal) to 7 (network control packet)
  - The three flag bits allowed the host to specify from the set {Delay, Throughput, Reliability}

The IP Protocol

Total length field

includes everything in the datagram—both header and data.

The maximum length is 65,535 bytes.

Identification field

needed to allow the destination host to determine which datagram a newly arrived fragment belongs to.

If the IP packet is fragmented then each fragmented packet will use the same 16 bit identification number to identify to which IP packet they belong to.

All the fragments of a datagram contain the same Identification value.

Note:

Fragmentation is done by the network layer when the maximum size of datagram is greater than maximum size of data that can be held in a frame

The IP Protocol

- two 1-bit fields: DF & MF
- DF stands for Don't Fragment.
  - It is an order to the routers not to fragment the datagram because the destination is incapable of putting the pieces back together again.

- MF stands for More Fragments.
  - – tells if more fragments are ahead of this fragment if MF = 1, and if MF = 0, it is the last fragment.

The IP Protocol

- Fragment offset field:
  - this 13 bit field specifies the position of the fragment in the original fragmented IP packet.
- Time to live field
  - Everytime an IP packet passes through a router, the time to live field is decremented by 1.
  - Once it hits 0 the router will drop the packet and sends time exceeded message to the sender.
  - The time to live field has 8 bits and is used to prevent packets from looping around forever. Thus prevents datagrams from wandering around forever

The IP Protocol

- Protocol field
  - this 8 bit field tells us which protocol is encapsulated in the IP packet, for example TCP has value 6 and UDP has value 17.
- Header checksum field
  - verifies the header only.
  - field is used to store a checksum of the header. The receiver can use the checksum to check if there are any errors in the header.

The IP Protocol

- Source IP address*:* 32 bits IP address of the sender

- Destination IP address*:* 32 bits IP address of the receiver
- Options field
  - Optional information such as source route, record route.
  - Used by the Network administrator to check whether a path is working or not.
  - The options are variable length and is not used often.

Some of the IP options.

Option	Description
Security	Specifies how secret the datagram is
Strict source routing	Gives the complete path to be followed
Loose source routing	Gives a list of routers not to be missed
Record route	Makes each router append its IP address
Timestamp	Makes each router append its address and timestamp