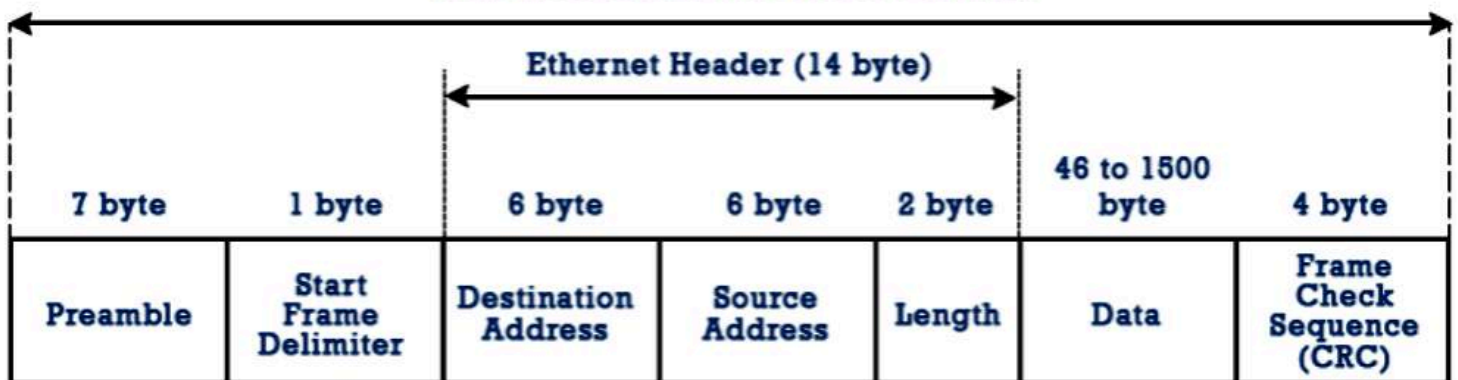


DAY 55 – 100 DAYS VERIFICATION CHALLENGE

Topic: Ethernet Protocol

1. What is an Ethernet protocol?
2. Why is Ethernet a standard protocol?
3. Which topology is used in Ethernet? Explain in detail.
4. What are features of Ethernet protocol?
5. What are Flexible address filtering modes?
6. What is Ethernet Protocol frame time stamping
7. Explain Ethernet Frame Format with importance of each field in the packet.
8. Explain Extended Ethernet Protocol Frame.
9. How to calculate the Throughput of Ethernet?
10. What are different types of Ethernet protocols. Explain in detail.
11. What is MAC Address?

IEEE 802.3 Ethernet Frame Format



ETHERNET [ETHERNET 802.3 (Ethernet LAN)

- One of the most widely used wired LAN Technologies.
∴ wired LAN Technologies is wifi, which is also for LAN but
wifi is an example of wireless LAN Technology

→ in which layer ethernet operates:-

ethernet operates in the data link layer and the physical layer.
It is working on both the layer data link layer and physical link layer.

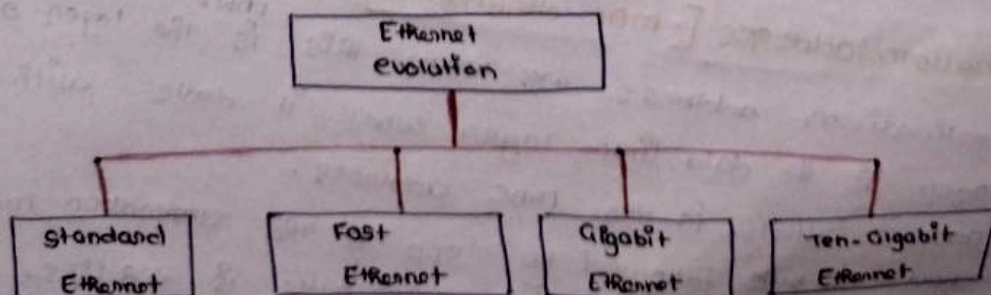
- Ethernet belongs to the family of networking technologies that are defined in the IEEE 802.2 and 802.3 standards.
- It supports data bandwidths of 10, 100, 1000, 10,000, 40,000, 100,000 mbps (100 Gbps)
- Ethernet was evolved it was in megabits per second now its ranges up to 100 gigabits per second and more.

② Ethernet Standards:

- define layer 2 protocols and layer 1 technologies.
∴ in layer 2 protocols as an Ethernet protocol. and layer 1 it is called as an Ethernet technology

- Two separate sublayers of the data link layer to operate
- logical link control (LLC) and the MAC sublayers.

EVOLUTION OF ETHERNET



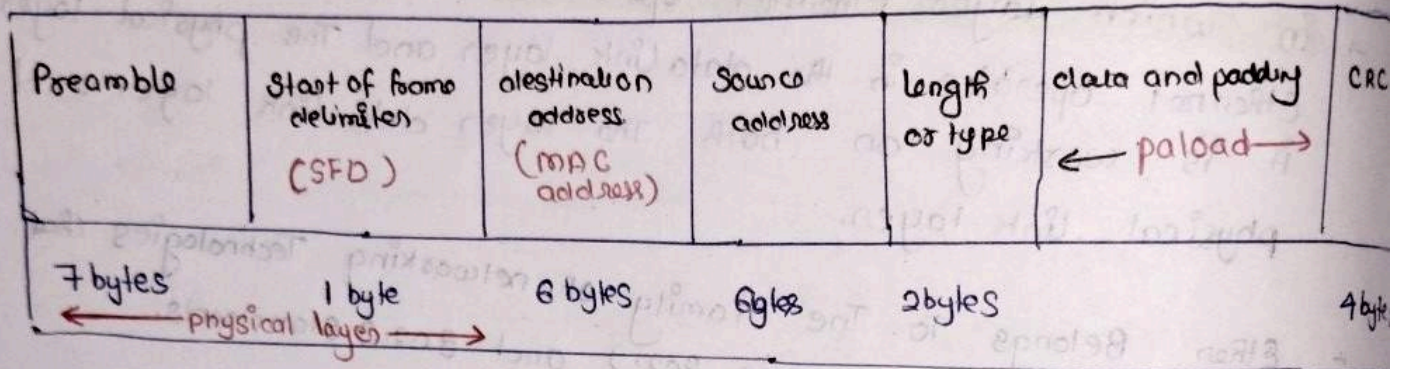
• Standard Ethernet Speed = 10 mbps

• Fast Speed = 100 mbps

• Gigabit Speed = 1 Gbps

• Ten-gigabit Speed = 10 Gbps

- ① Explain Ethernet frame format with importance of each field in the packet.
- Frame Format of Ethernet is somewhat similar to the previous data link layer protocols we address. we will see here frame format of Ethernet :



- ② **Preamble** : 56 bits of alternating 1s and 0s. This preamble is of 7 bytes. when we say 7 bytes it is of 56 bits of alternating ones and zeros.
 ∴ So 101010... up to 56 bits.
- what do we need this preamble
 ∴ This preamble is just for passing synchronization purpose

- * 7 byte field (56 bits)
- * 10101010 --- (up to 56 bits)
- * indicates starting of the frame
- * for bit synchronization.

③ **SFD : [Start frame delimiter]** →

- * 1 byte field
- * set to 10101011

∴ This acts as a flag so this is also for synchronization purpose the flag is fixed here. The SFD is 1 byte. we have this 1 byte information that is 8 bits 10101011 and the main feature about this is act as a flag at the same time last two bits that is these two ones indicates the receiver that the ~~next~~ upcoming field is the destination MAC address

- ④ **Destination address [MAC destination]** → sender and receiver with the same LAN.
- ∴ destination address we know this is the layer 2 protocol. layer is the data link layer where it deals with the physical address that is the MAC address.
- next 6 bytes followed by SFD is the destination MAC address which is 6 bytes. we know 6 bytes is 48 bits or MAC address

① Length or Ethertype fields :-

which is two bytes. so length three decides the length of the data and the type of the data. means that is upper layer protocol is using so that information is placed in this path and then comes the data and the padding.

Length :- **

* 2 bytes (16 bits) field

* 916-1 value

② data and padding :-

data means whatever it has receives from the upper layer that is the network layer that information is placed here generally padding is used to make the frames a fixed size. finally we trailer part.

Payload
Field.
variable
length field

③ CRC [Frame check Sequence] :-

CRC stands for cyclic redundancy check which is used for error detection purpose. The size of the CRC in Ethernet is 4 bytes. The Ethernet frame has the fields preamble, start frame delimiter, The destination mac address and source address.

→ The preamble and SFD is placed in the physical layer that is mention as physical layer header, actually the physical layer only has to deal with the Synchronization part.

* 4 byte field
* used to detect the errors

④ ETHERNET FRAME Field :- MIN AND MAX LENGTH :-

MAC destination address 6 bytes	MAC Source address 6 bytes	Ethertype length POV 2 bytes	minimum Payload length: 46 bytes max Payload length: 1500 bytes Data and Padding	CRC
minimum frame length: 512 bits or 64 bytes				
maximum frame length: 12,144 bit or 1518 bytes				

- Ethernet is a data link layer protocol. It deals with the mac address and obviously IP address will be in this part because network layer it will be adding the IP address and it will be placed here and then we have length field which is of 2 bytes

∴ minimum payload length is 46 bytes and
 ∴ maximum payload length will be 1500 bytes, this is actual

on IP packet

So minimum frame length is $46 + 6 + 6 + 2 + 4$ is 64 bytes or 512 bytes,

maximum frame length is $1500 + 6 + 6 + 2 + 4$
 $= 1518$ bytes or 12,144 bits.

NOTES :-

Frame Length :-

minimum :- 64 bytes (512 bits)

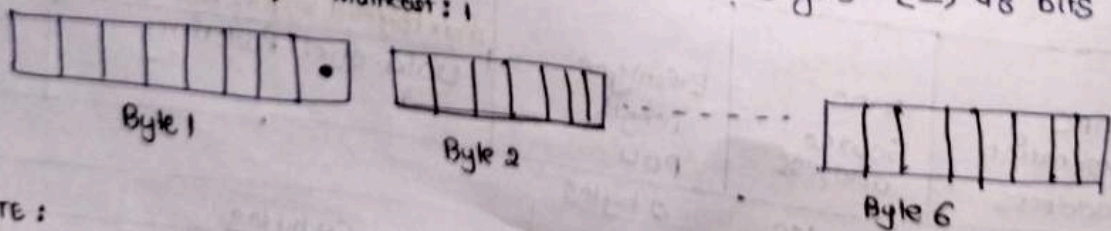
maximum :- 1518 bytes (12,144 bits).

① ETHERNET ADDRESS :-

- we know MAC address is the Ethernet address.

Example :

06:01:02:01:2C:4B
 Byte1 Byte2 Byte3 Byte4 Byte5 Byte6
 06:01:02:01:2C:4B \Leftrightarrow 6 bytes \Leftrightarrow 12 hex digits \Leftrightarrow 48 bits
 Unicast : 0; Multicast : 1



→ NOTE :

what is MAC address ?

- MAC address, when a device is manufactured.
- It is assigned to NIC of the device.
- Unique identifier assigned to every device.

Q: Topic: Ethernet Protocol

Soln ① what is ethernet protocol?

- The most popular and oldest LAN Technology is ethernet protocol. So it more frequently used in LAN environment which is used in almost ^{network} all offices, homes, public place university.
- Ethernet has gain huge popularity because of its max rates over longer distances using optical media.
- Ethernet protocol use a star topology or linear bus which is the foundation of the IEEE 802.3 standard.

Soln ② why is ethernet a standard protocol?

- ethernet is considered a standard protocol primarily coz it has gained wide spread adoption & has undergone extensive standardization process.
- Some of the factors are ubiquity, standardization, scalability, cost effectiveness etc.

Soln ③ which topology is used in Ethernet? Explain in detail.

- The Ethernet protocol uses a star topology or linear bus which is the foundation of the IEEE 802.3 standard.
- where each device on the network is connected to a central hub or switch using a point to point connection.

Soln ④ what are features of Ethernet protocol?

- Cost effectiveness
- Speed
- flexibility
- Reliability
- Simplicity
- interoperability

Solⁿ ⑤ what are flexible address filtering modes?

- 128 MAC address for the 48-bit perfect filtering.
- A 64 bit hash filter for multicast and unicast (DA) addresses.
- Option to pass all multicast addressed packets.
- promiscuous mode to pass all packet without any filtering for network monitoring
- Additional packet filtering eg: VLAN (virtual LAN).

Solⁿ ⑥ what is Ethernet protocol frame time stamping.

- Ethernet header includes both Source & Destination MAC address after which the frame's payload is present. The end field is Cyclical Redundancy checking, used to notice the error.
- preamble specifies the receiver that frame is coming & lets the receiver lock on the data stream before the genuine frame starts.
- The time-stamping feature can be used in precision time protocol to synchronize clk throughout a network of rotary encoders & control stepping motor at required timing.

Solⁿ ⑦ Explain Extended Ethernet protocol frame.
∴ frame using which can obtain Payload even higher than 1500 Bytes.

DA (destination) address)	SA (Source address)	Type	DSAP (destination Service access point)	SSAP (Source Service Accesspoint)	Ctrl (Control field)	Data (data) protocol	FCS (Frame checksum)
6 Bytes	6 Bytes	2 Bytes	1 Byte	1 Byte	1 Byte	>46 Byte	4 Byte

- destination mac address is 6 Bytes similar Source mac address is 6 Bytes.
- Type [0x8870 (Ethen Type)] is 2 bytes.
- Destination Service Accesspoint, 802.2 source service and control field is 1 Byte. Data or protocol data is above 46 bytes.

Solⁿ ⑨ How To calculate The Throughput protocol Frame Ethernet ?

$$\text{Throughput} = \left(\frac{\text{Data Size}}{\text{Data Size} + \text{Overhead}} \right) \times \text{Nominal Bandwidth Utilization}$$

$$\text{Protocol Overhead} = \frac{(\text{Packet Size} - \text{Payload Size})}{\text{Packet Size}}$$

$$\text{Efficiency} : \frac{\text{Payload Size}}{\text{Packet Size}}$$

$$\text{Throughput} = \text{efficiency} \times \text{total Bit Rate}$$

Solⁿ ⑩ what are different types of Ethernet protocols . Explain in details.

- Ethernet protocol \Rightarrow data rate is 10mbps.
- Fast Ethernet / 100 Base-T \Rightarrow data rate is 100mbps.
- Gigabit ethernet \rightarrow data rate is 1000mbps.
- 10 gigabit ethernet \Rightarrow data rate is 10 gbps.

Solⁿ ⑪ what is mac address ?

- MAC address is unique identifier assign to every device
- A MAC address is given to the NIC adapter when it is manufactured . its hardwired or hard-coded onto your computer's NIC interface card (NIC) & is unique to it.
- a media access control address uniquely identifies digital devices, in fact, a device can have several MAC addresses, coz devices need a different address for each network interface.

◎ ADVANTAGES OF USING Ethernet:-

- It is simple to understand and implement
- Its maintenance is easy.
- It is cheap.
- It does not need any hub or switches.
- The gigabit Ethernet provides very fast speed like 1 Gbps.
It speeds mainly ranges from above 10 times as compared to Fast ethernet.
- Simple maintenance
 - The quality of data transfer is good.

◎ Application:-

- It is simply used for connecting several devices within a network through each other.
- It is also used for connecting wifi router to the entry port of an internet otherwise telephone line.
- These are used in different organization like hospitals, companies, school etc.