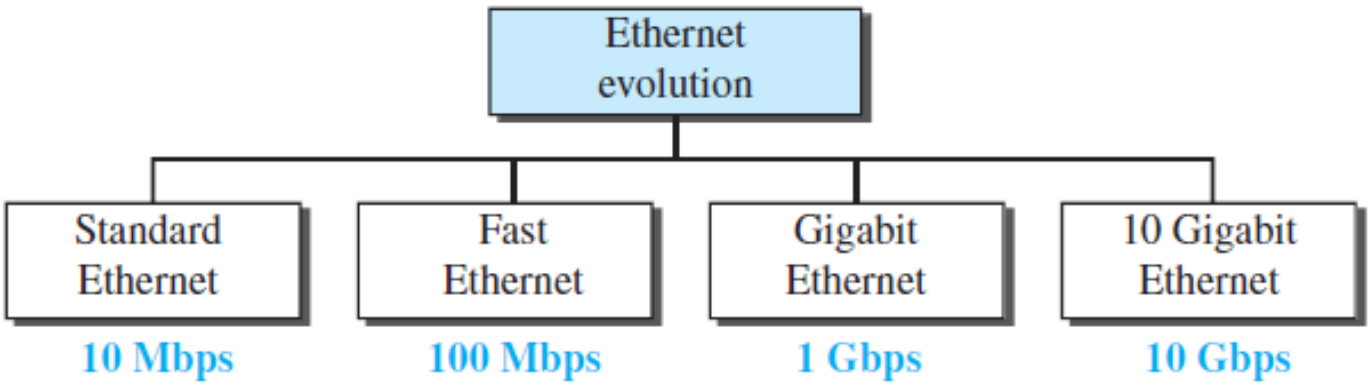
Ethernet

- Ethernet is a family of computer networking technologies commonly used in local area networks (LANs) and metropolitan area networks (MANs). It was commercially introduced in 1980 and first standardized in 1983 as IEEE 802.3, and has since been refined to support higher bit rates and longer link distances. Over time, Ethernet has largely replaced competing wired LAN technologies such as token ring, FDDI and ARCNET.
- The original 10BASE5 Ethernet uses coaxial cable as a shared medium, while the newer Ethernet variants use twisted pair and fibre optic links in conjunction with hubs or switches. Over the course of its history, Ethernet data transfer rates have been increased from the original 2.94 megabits per second (Mbit/s) to the latest 100 gigabits per second (Gbit/s). The Ethernet standards comprise several wirings and signalling variants of the OSI physical layer in use with Ethernet.
- Systems communicating over Ethernet divide a stream of data into shorter pieces called frames. Each frame contains source and destination addresses, and error-checking data so that damaged frames can be detected and discarded; most often, higher-layer protocols trigger retransmission of lost frames. As per the OSI model, Ethernet provides services up to and including the data link layer.
- Since its commercial release, Ethernet has retained a good degree of backward compatibility. Features such as the 48-bit MAC address and Ethernet frame format have influenced other networking protocols. The primary alternative for some uses of contemporary LANs is Wi-Fi, a wireless protocol standardized as IEEE 802.11.
- Ethernet uses Bus Topology.
- No idea of acknowledgement, if application require ack then it can send ack as a data packet.
- Encoding techniques is Manchester.
- At physical layer a packet is called Single Protocol Data Unit (SPDU)



STANDARD ETHERNET

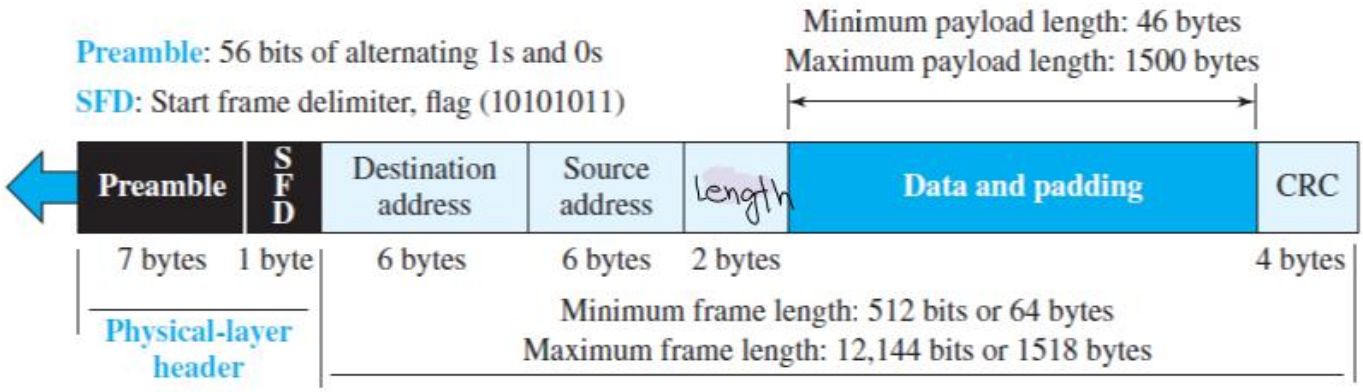
Connectionless and Unreliable Service:

- Each frame sent is independent of the previous or next frame. Ethernet has no connection establishment or connection termination phases.

- Ethernet is also unreliable, if a frame is corrupted during transmission and the receiver finds out about the corruption, the receiver drops the frame silently.

- In case of requirement ack can be sent separately at data packets.

Frame Format (IEEE 802.3)



- **Preamble**
  - It is a 7-byte field that contains a pattern of alternating 0's and 1's.
  - It alerts the stations that a frame is going to start.
  - It also enables the sender and receiver to establish bit synchronization.
  - The Preamble field is added at the physical layer.

- **Start Frame Delimiter (SFD)**
  - It is a 1-byte field which is always set to 10101011.
  - The last two bits "11" indicate the end of Start Frame Delimiter and marks the beginning of the frame.
  - The SFD field is also added at the physical layer.
  - Initial only SFD was there Preamble was added later

- **Destination Address**
  - It is a 6-byte field that contains the MAC address of the destination for which the data is destined. e.g. 2D : 8A : 7B : C5
  - MAC address is present on NIC card.
  - MAC address can be of three types
    - Unicast-LSB of the first byte is 0 (Source address will always be unicast)
    - Multicast- LSB of the first byte is 1, if we want to send, repeated messages to a group of station on the network then we can group these stations together and can assign a Multicast address to the group.
    - Broadcast-all bit are assigned 1's

- **Source Address**
  - It is a 6-byte field that contains the MAC address of the source which is sending the data.

- Using some protocol, we can broadcast a request message asking MAC address of every other station in the network.

- **Length**
  - As ethernet use variable size frames therefore we need Length field
  - It is a 16-bit field.

- **Data**
  - It is a variable length field which contains the actual data, also called as a payload field.
  - The length of this field lies in the range [46 bytes, 1500 bytes], i.e. in an Ethernet frame, minimum data has to be 46 bytes and maximum data can be 1500 bytes.
  - If it is less than 46 bytes, it needs to be padded with extra 0s.
  - If more than 1500 bytes, it should be fragmented and encapsulated in more than one frame.
  - The minimum length restriction is required for the correct operation of CSMA/CD, value in general come to be 64B, 64-6-6-2-4 = 46B.
  - The maximum length restriction has two historical reasons:
    - Memory was very expensive when Ethernet was designed; a maximum length restriction helped to reduce the size of the buffer.
    - The maximum length restriction prevents one station from monopolizing the shared medium, blocking other stations that have data to send.

- **CRC**
  - The last field contains error detection information.
  - At the time of transmission CRC is calculated so it is in the last.
  - It is a 4-Byte field

Point to Note

- Ethernet is very simple easy to install and reconfigure.
- Should not be used with real time applications, because of collision possibility.
- if amount of data is very less then also should not be used.
- No idea of priority (Server suffer).

Efficiency of Standard Ethernet

- The practical efficiency of standard Ethernet has been measured to be:

- **Efficiency** = **1** / **(1** + **6.4** * ***a*****)**
- ***a*** = (propagation delay)/(transmission delay)

Example: In the Standard Ethernet with the transmission rate of 10 Mbps, we assume that the length of the medium is 2500 m and the size of the frame is 512 bits. The propagation speed of a signal in a cable is normally 2×10^8 m/s.

T_p = distance / velocity = 2500 / 2×10^8 = 0.0000125 * 10^6 us = 12.5 us

T_t = L / B = 512 / 10 * 10^6 = 0.0000512 * 10^6 = 51.2 us

a = 12.5 / 51.2 = 0.24

Efficiency = 1 / (1 + 6.4 * 0.24) = 39%

Q In an Ethernet local area network, which one of the following statements is TRUE? **(Gate-2016) (2 Marks)**
(A) A station stops to sense the channel once it starts transmitting a frame
(B) The purpose of the jamming signal is to pad the frames that are smaller than the minimum frame size
(c) A station continues to transmit the packet even after the collision is detected
(D) The exponential back off mechanism reduces the probability of collision on retransmission
ANSWER D

Q Determine the maximum length of the cable (in km) for transmitting data at a rate of 500 Mbps in an Ethernet LAN with frames of size 10,000 bits. Assume the signal speed in the cable to be 2,00,000 km/s. **(Gate-2013) (2 Marks)**
(A) 1 **(B)** 2 **(C)** 2.5 **(D)** 5
Answer: (B)

Q Suppose the round-trip propagation delay for a 10 Mbps Ethernet having 48-bit jamming signal is 46.4 ms. The minimum frame size is **(Gate-2005) (2 Marks)**
(A) 94 **(B)** 416 **(C)** 464 **(D)** 512
Answer: (C)

Q A host is connected to a Department network which is part of a University network. The University network, in turn, is part of the Internet. The largest network in which the Ethernet address of the host is unique is: **(Gate-2004) (1 Marks)**
(A) the subnet to which the host belongs **(B)** the Department network

(C) the University network **(D)** the Internet

Answer: (D)

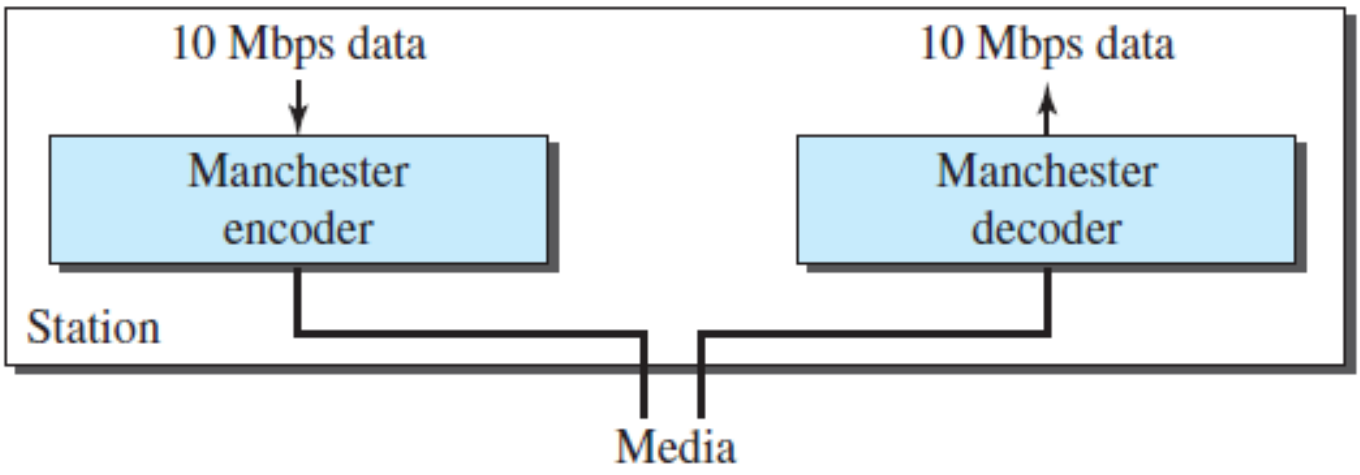
Q How many 8-bit characters can be transmitted per second over a 9600 baud serial communication link using asynchronous mode of transmission with one start bit, eight data bits, two stop bits, and one parity bit ? **(Gate-2004) (1 Marks)**

(A) 600 **(B)** 800 **(C)** 876 **(D)** 1200

Answer: (B)

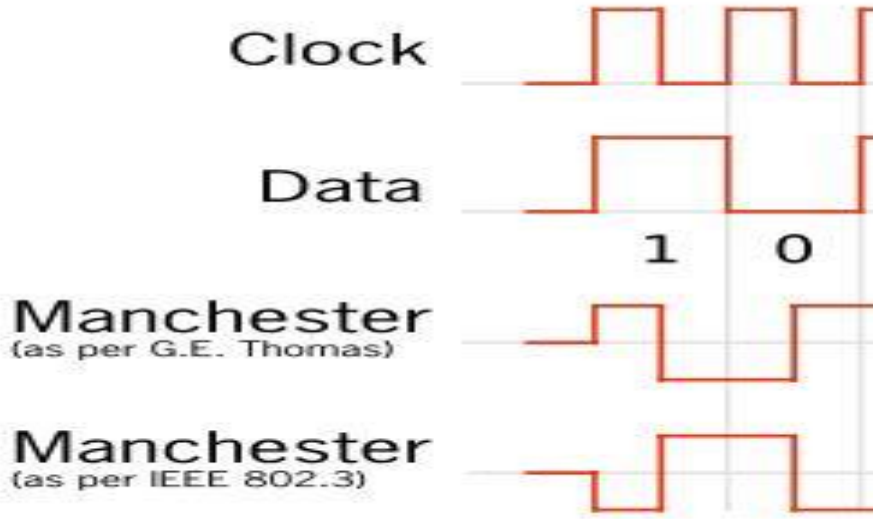
Implementation

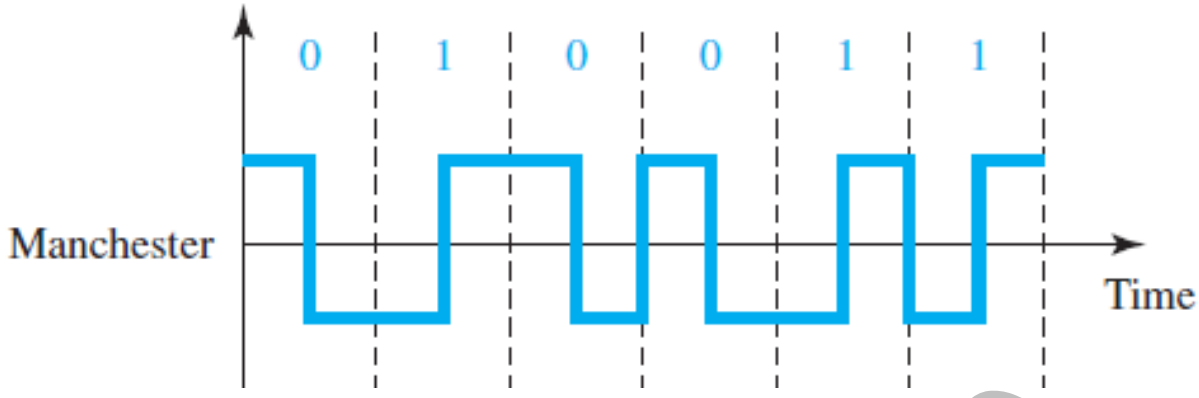
- At the sender, data are converted to a digital signal using the Manchester scheme; at the receiver, the received signal is interpreted as Manchester and decoded into data.



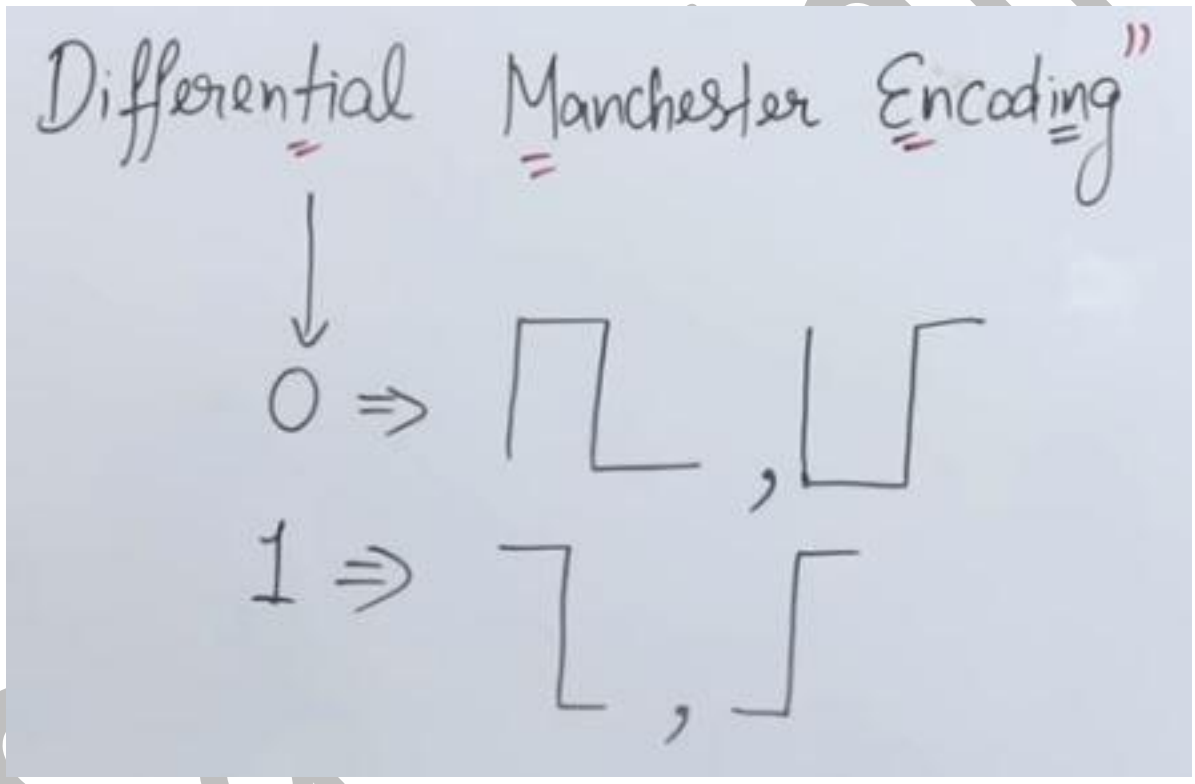
- A digital-to-digital polar encoding method in which a transition occurs at the middle of each bit interval to provide synchronization.

- In Manchester encoding, the duration of the bit is divided into two halves. The voltage remains at one level during the first half and moves to the other level in the second half. The transition at the middle of the bit provides synchronization.

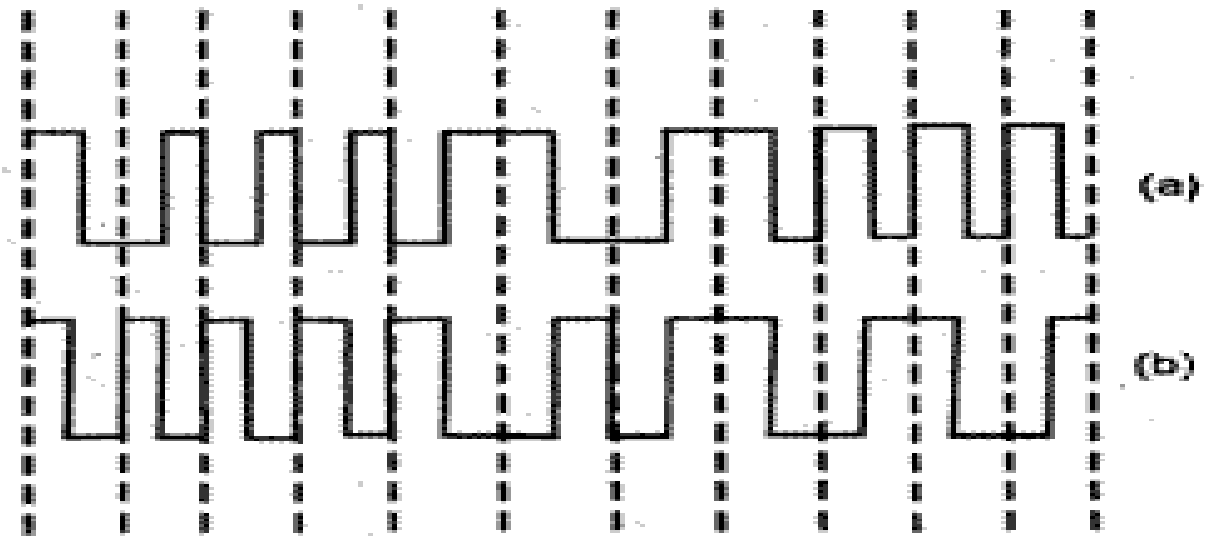




- ***In Manchester encoding, the bitrate is half of the baud rate.***



Q In the waveform (a) given below, a bit stream is encoded by Manchester encoding scheme. The same bit stream is encoded in a different coding scheme in wave form (b). The bit stream and the coding scheme are **(Gate-2007) (2 Marks)**



(A) 1000010111 and Differential Manchester respectively
(B) 0111101000 and Differential Manchester respectively
(C) 1000010111 and Integral Manchester respectively
(D) 0111101000 and Integral Manchester respectively
Answer: (A)

Q In Ethernet when Manchester encoding is used, the bit rate is: **(Gate-2007) (1 Marks)**

a) Half the baud rate.
b) Twice the baud rate.
c) Same as the baud rate
d) None of the above.

ANSWER A

Q Consider that 15 machines need to be connected in a LAN using 8-port Ethernet switches. Assume that these switches do not have any separate uplink ports. The minimum number of switches needed is _____. **(Gate-2019) (1 Marks)**

Ans: 3