CS & IT ENGINEERING

COMPUTER NETWORKS

Medium Access Control

Lecture No-05

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Multiple Access Protocols-5

Introduction To Ethernet

IEEE 802 Project: IEEE started project 802, so that different LAN can be interconnected

IEEE 802.1 → Bridge LAN

IEEE 802.2 → LLC

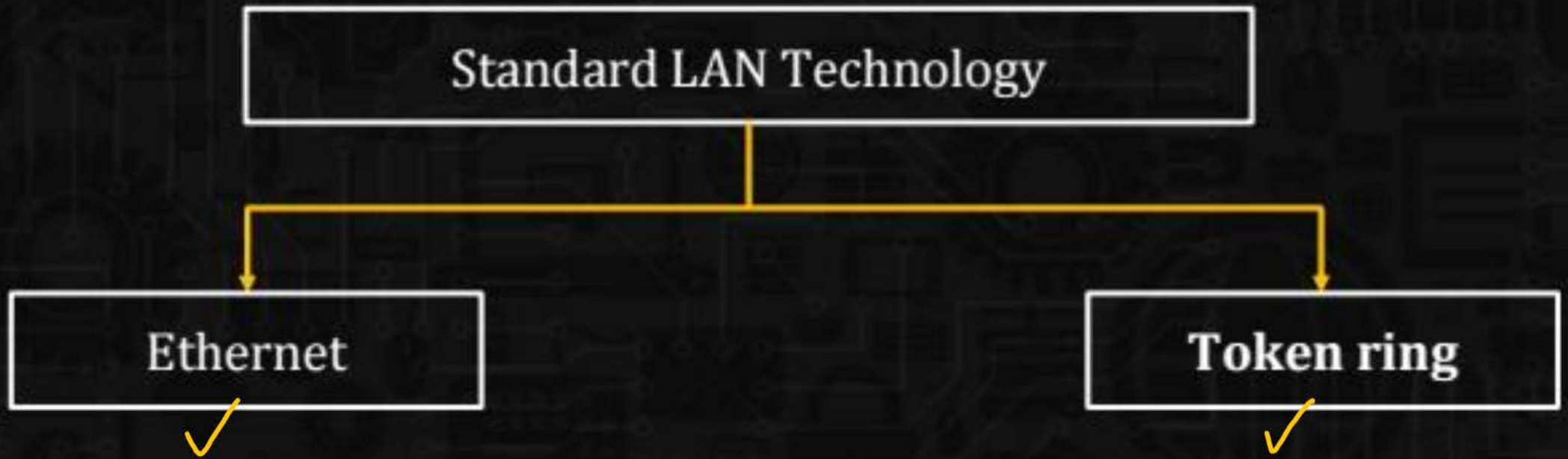
* IEEE 802.3 → Ethernet [CSMA/CD]

IEEE 802.4 → Token bus

IEEE 802.5 →Token ring

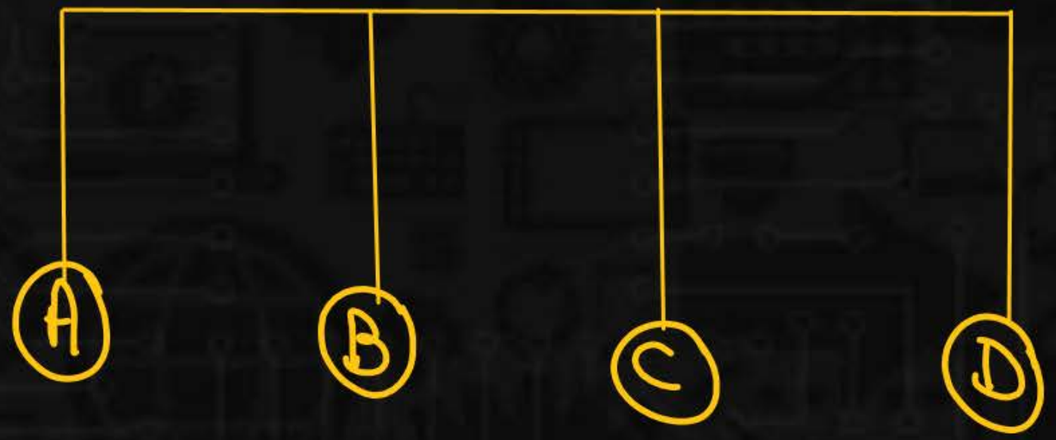
IEEE 802.11 → Wireless: LAN (CSMA/CA)

IEEE 802.16 → Wireless WAN


Standard LAN Technology
Ethernet
Token ring

Ethernet Characteristics

1. It offers connection less communication
2. No Flow control and packet level error control
3. No Acknowledgement
4. It uses Bus topology

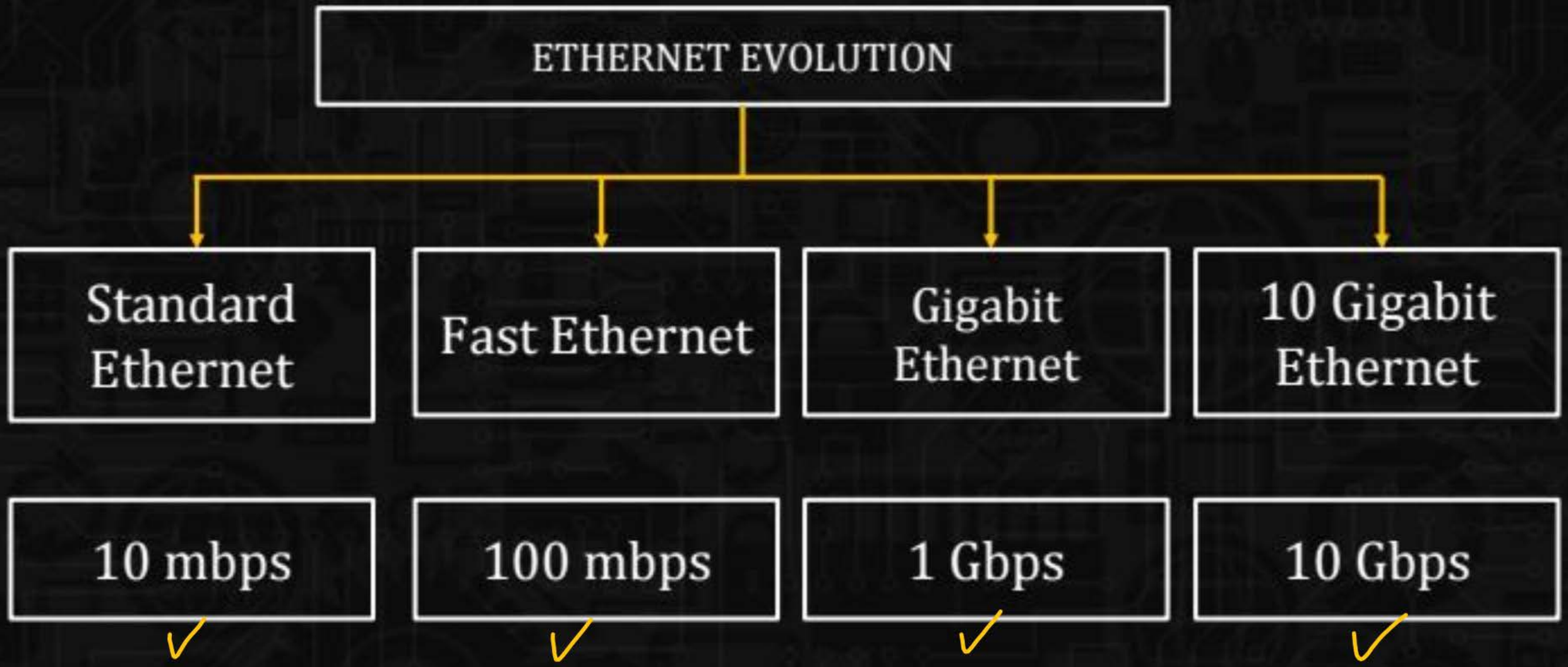


Ethernet Characteristics

5. Ethernet uses CSMA/CD as an Access control method to deal with the collision.
6. In Ethernet signal is Broadcasted by sender hence every station on LAN receive it
7. Ethernet uses Manchester encoding technique for converting data bits into signal

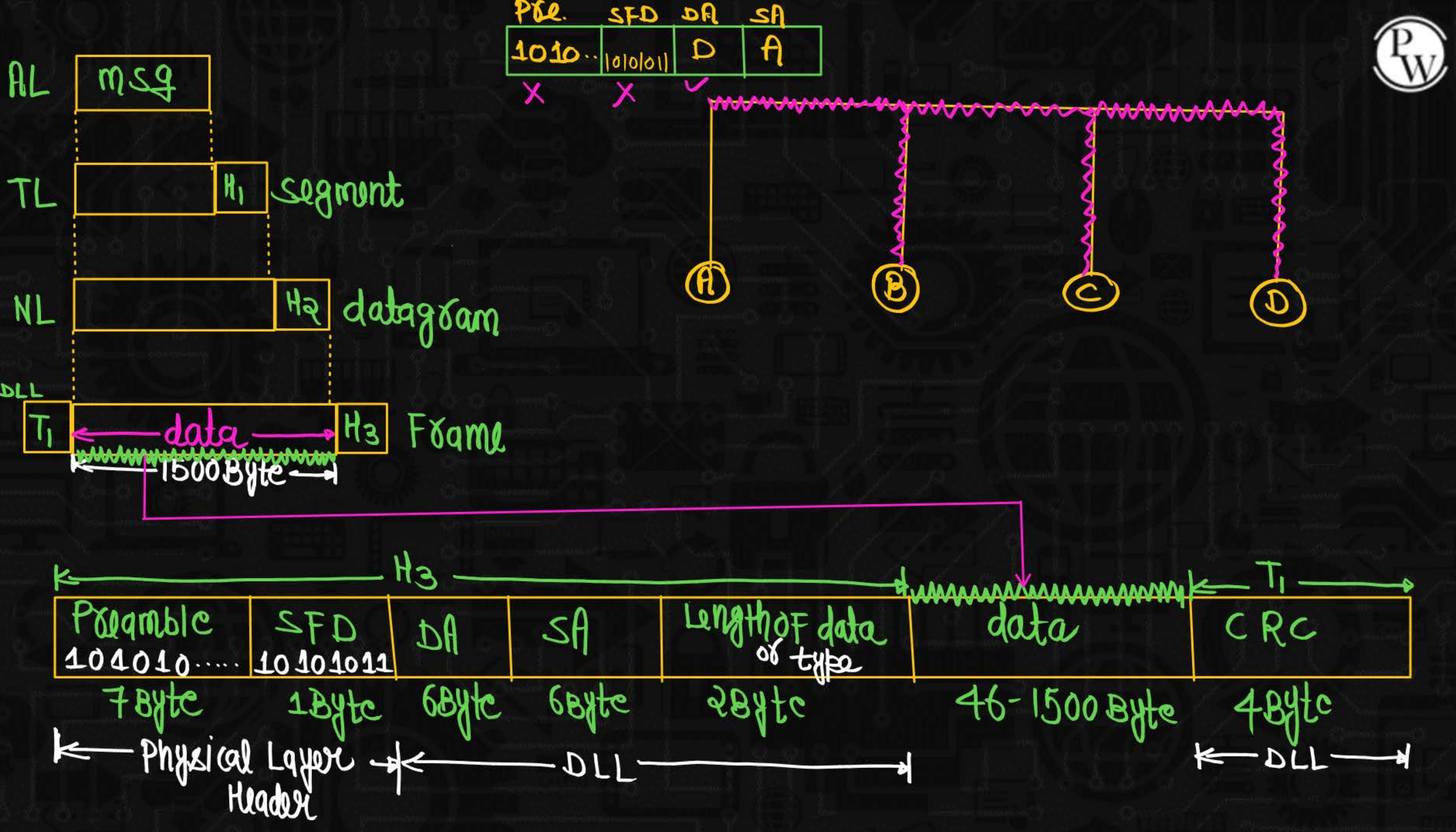
(Baud rate = 2 x bit rate)

Bit rate = 1/2 baud rate


ETHERNET EVOLUTION
Standard Ethernet
Fast Ethernet
Gigabit Ethernet
10 Gigabit Ethernet
10 mbps
100 mbps
1 Gbps
10 Gbps

IEEE 802.3 Ethernet Frame Format

Ethernet Frame format


Pre.
SFD
DA
SA
1010..
10101011
D
A
X
X
✓
AL
msg
TL
H1
segment
NL
H2
datagram
DLL
T1
data
H3
Frame
1500 Byte
A
B
C
D
H3
T1
Preamble
10101010.....
SFD
10101011
DA
SA
Length of data
or type
data
CRC
7 Byte
1 Byte
6 Byte
6 Byte
2 Byte
46-1500 Byte
4 Byte
Physical Layer
Header
DLL
DLL

1. Preamble: (7 Byte)

- It is a 7 byte field. preamble is an alternating pattern of 1's and 0's
- It alerts the station that frame is going to start
- It is also enables the sender and receiver to establish bit synchronization

2. Start Frame Delimiter [SFD]

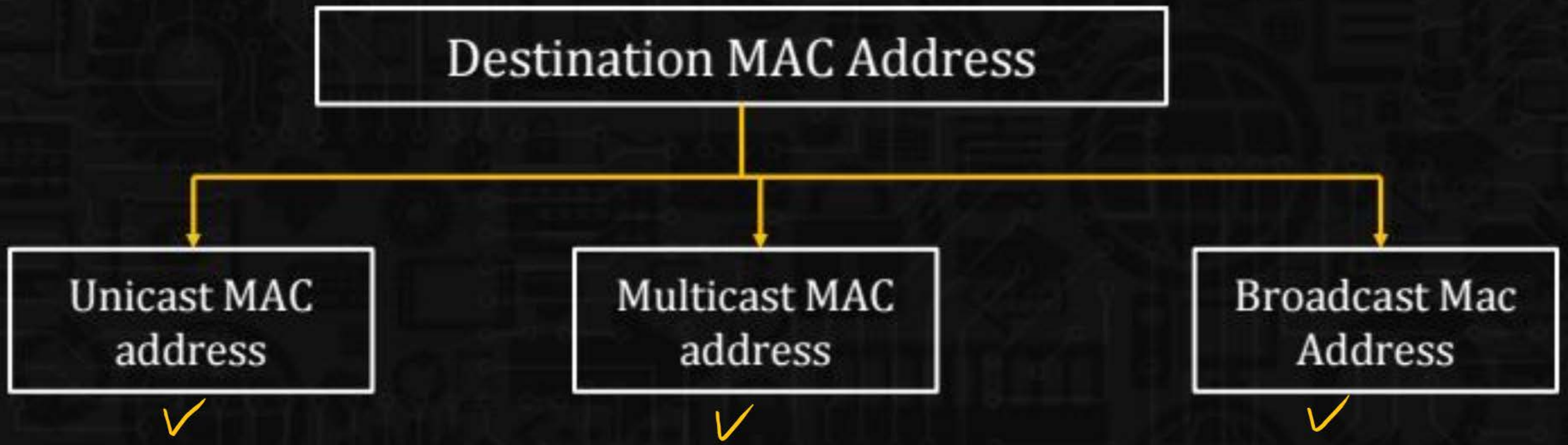
- It is a one byte field which is always set to 10101011
- SFD alerts the station that this is the last for synchronization
- The last two bits are '11' and alerts the receiver that the next field is destination address.

Note: The above two fields are added by the physical layer and represent the physical layer header

- Some times, SFD is considered to be part of preamble
- That is why, at many places, preamble field length is described as 8 byte

3. Destination Address (DA)

- It is a 6 byte field that contains the MAC address of the destination



Unicast MAC Address:

If last bit of the first byte is 0. It indicate unicast MAC address

3A : 2B : 3C : F2 : D4 : C2

00111010 → It indicate unicast MAC Address

Multi cast MAC Address:

If the last bit of the first byte is 1 it indicate multicast mac address

A3 : 2B : 3C : F2 : D4 : C2

10100011 → It indicate multicast MAC Address

Broadcast MAC Address:

If all the 48 bits are 1. it indicate broad cast MAC Address

FF : FF : FF : FF : FF : FF

4. Source Address (6 Byte):

- It is a 6 byte field that contains the MAC address of the source which is sending the data
- Source address is always unicast address

5. Length of data: (2 Byte):

- Length is a 2 Byte Field, which specifies the number of byte present in the data filed.
- In Ethernet data is varying from 46 to 1500 byte, so to keep track of correct size of data in the packet we need length of data field
- The 16 bit filed can hold the length value 0 to $2^{16}-1$ = 65535 byte but the maximum amount of data that can be sent in ethernet frame is 1500 Byte.

10 bit → Max No → $2^{10} - 1 = 1023$

11 bit → Max No → $2^{11} - 1 = 2047$

OR

Type: This filed defines the upper layer protocol whose packet is encapsulated in the frame this protocol can be IP, ARP, OSPF, and soon

Note: Type field was used in original ethernet. But in IEEE 802.3 this field was replaced by length of data

6. Data:

- It is the variable length field which contains the actual data
- It is also known as payload length
- The length of this field lies in between 46 byte – 1500 byte
- In the Ethernet the minimum data has to be 46 byte and maximum data can be 1500 byte
- If data coming from the upper layer is more than 1500 byte, it should be fragmented and encapsulated in more than one frame. If it is less than 46 byte it needs to be padded with extra 0's.

Note:

- Minimum size is needed to sense the collision
- Ethernet uses CSMA/CD as an access control method to deal with collision
- Maximum size is needed to avoid monopoly of any single station
- If Ethernet allows the frames of big size, then other station may not get fair chances to send their data

7. CRC (4 Byte):

- CRC is used for error detection

Disadvantage of Ethernet

46
18
64

1. In the Ethernet there is restriction on minimum size of data hence it is not suitable for interactive application where data size very less
2. It is not suitable for real time application . Real time applications requires the delivery of data with in some time limit. Ethernet is not reliable because of high probability of collision
3. It is not suitable for client server application. client server applications requires that server must be given higher priority than clients. In Ethernet there is no facility to set priorities.

18Byte

46B + 6B + 6B + 2B + 4B = 64Byte
data DA SA CRC

Length of data

min Frame size

min	max	
46	1500	→ Data size
64	1518	→ Frame size

Problem solving on Ethernet

Q.1 Ethernet when Manchester encoding is used, the bit rate is:

[GATE – 2007]

A. Half the baud rate.

B. Twice the baud rate.

C. Same as the baud rate.

D. None of the above.

$$\text{Baud rate} = 2 * \text{bit rate}$$

$$\text{Bit rate} = \frac{1}{2} \text{Baud rate}$$

Q.2 What is the baud rate of the standard 10-Mbps 802.3 LAN?

A. 20 mega baud

B. 10 mega baud

C. 25 mega baud

D. 40 mega baud

Q.3 Which of the following statements is TRUE?

[GATE – 2006]

A. Both Ethernet frame and IP packet include checksum fields.

B. Ethernet frame includes a checksum field and IP packet includes a CRC field

C. Ethernet frame includes a CRC field and IP packet includes a checksum field

D. Both Ethernet frame and IP packet include CRC fields

Q.4 Suppose the round trip propagation delay for a 10Mbps Ethernet having 48-bit jamming signal is 46.4μs. The minimum frame size is:

[GATE – 2005]

A. 94

B. 416

C. 464

D. 512

B = 10mbps = $10 * 10^6$ bits/sec , RTT = 46.4 μsec

JAM signal size = 48 bits

Frame size = ?

$$T_d(\text{Frame}) \geq \underbrace{2 * P_d}_{RTT} + T_d(\text{JAM signal})$$

$$\frac{\text{Frame size}}{\text{Bandwidth}} \geq RTT + T_d(\text{JAM signal})$$

$$\frac{L}{B} \geq 46.4\,\mu sec + 4.8\,\mu sec$$

$$\frac{L}{B} \geq 51.2\,\mu sec$$

$$L \geq 512 * 10^{-6}\,sec * B$$

$$L \geq 512 * 10^{-6}\,sec * 10 * 10^{6}\,bits/sec$$

$$L \geq 512\ bits$$

$$T_d(\text{JAM signal}) = \frac{\text{JAM signal size}}{\text{Bandwidth}}$$

$$= \frac{48\ bits}{10 * 10^{6}\ bits/sec}$$

$$= 4.8 * 10^{-6}\,sec$$

$$= 4.8\,\mu sec$$

OR

$$L \geq \left(\underbrace{2 * P_d}_{RTT} + T_d(\text{JAM signal})\right) * B$$

$$L \geq (46.4\,\mu sec + 4.8\,\mu sec) * 10 * 10^6 \text{ bits/sec}$$

$$L \geq 51.2\,\mu sec * 10 * 10^6 \text{ bits/sec}$$

$$L \geq 51.2 * 10^{-6} \text{ sec} * 10 * 10^6 \text{ bits/sec}$$

$$L \geq 512 \text{ bits}$$

Q.5 Define the type of the following destination address. 4A:30:10:21:10:1A in the Ethernet Frame Format.

01001010 → If indicate unicast MAC Address

A. Unicast

B. Multicast

C. Broadcast

D. None

Q.6 *A* and *B* are the only two stations on an Ethernet. Each has a steady queue of frames to send. Both A and B attempt to transmit a frame, collide, and *A* wins the first backoff race. At the end at this successful transmission by A, both A and B attempt to transmit and collide. The probability that *A* wins the second backoff race is

[GATE – 2004]

A. 0.5

B. 0.625

C. 0.75

D. 1.0

Q.7 Suppose the Round trip propagation delay for 100 Mbps Ethernet has 24.2 μsec. The network has 48 bit jamming signal then what is minimum frame size

A. 2420 bits

B. 4640 bits

C. 2468 bits

D. 464 bits

Q.8 Determine the maximum length of the cable(in km) for transmitting data at a rate of 500 Mbps in 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]

A. 1

B. 2

C. 2.5

D. 5

$d = ?$, $B = 500 Mbps$

$B = 500 * 10^6$ bits/sec

$L = 10,000$ bits

$v = 200000$ km/sec

$$T_d(CF) \geq 2 * P_d + \cancel{T_d(JS)}\ 0$$

$$\frac{L}{B} \geq 2 * \frac{d}{v}$$

$$\frac{10{,}000\ \cancel{bits}}{500 * 10^6\ \cancel{bits/sec}} \geq \frac{2 * d}{200000\ km/\cancel{sec}}$$

$$d = 2\ km$$

Q.9 In an Ethernet local area network , which one of the following statements is TRUE ?

A. A station stops to sense the channel once it starts transmitting a frame.

B. The purpose of 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

$P(C) = 100 \cdot 1$
$P(C) = 50 \cdot 1$
$P(C) = 25 \cdot 1$
P

$P(\epsilon) = 19.5$


THANK YOU
GW
SOLDIERS !