CS & IT ENGINEERING

COMPUTER NETWORKS

Medium Access Control

Lecture No-04

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Multiple Access Protocols-4

CSMA/CD

Sending Port → For sending the data

Listening Port → For detecting the collision

CSMA/CD (Carrier Sense multiple access/Collision Detection)

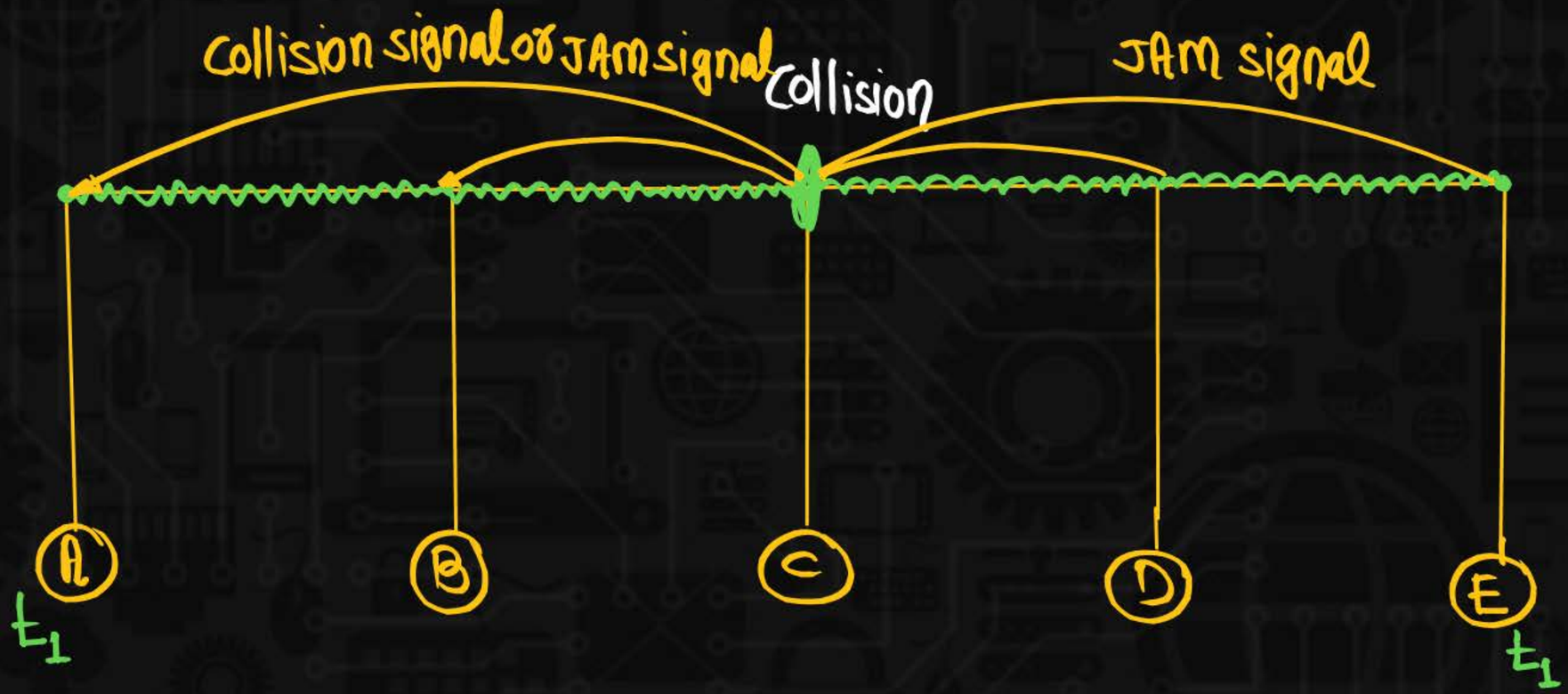
- CSMA does not specify what station will do after collision.
- In CSMA if two station sense the channel to be idle and begin transmitting simultaneously, then both station data will be collide and still stations will keep on sending the data.
- Better way to save the time and bandwidth is to detect the collision and immediately stop transmission this strategy is used in CSMA/CD.
- In CSMA/CD station do not send the entire frame and then look for collision.
- In CSMA/CD transmitting the frame and detecting the collision are continuous process.
- Sender needs two different port i.e one for sending the data and another for detecting the collision.
- If collision is detected then sender immediately stop transmitting the data.

No Acknowledgement:

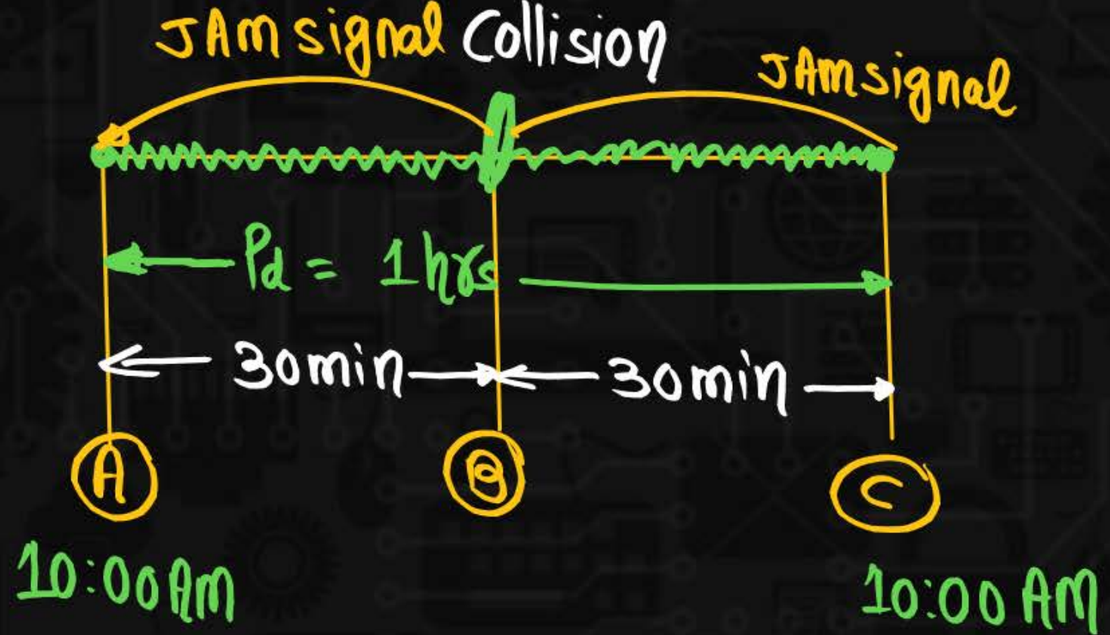
There is no need of acknowledgement, if collision is not detected then frame is definitely received by receiver.

No Copy:

Once frame is transmitted sender does dot maintain a copy of that frame because station is simultaneously sending the frame and detecting the collision, if collision is not detected that means receiver has successfully received the frame.

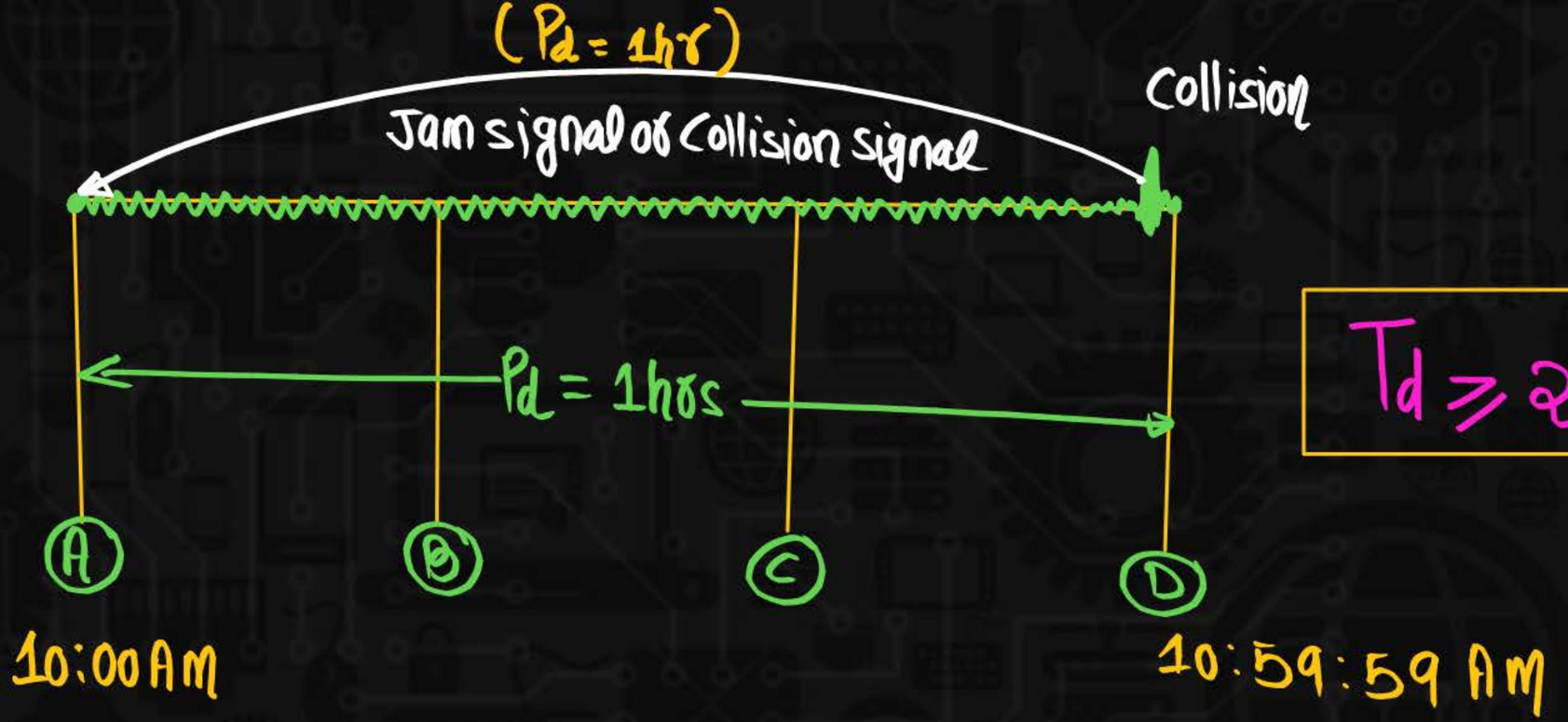

Collision signal or JAM signal
Collision
JAM signal
A
B
C
D
E
t_1
t_1

Minimum Frame to detect the collision



$$T_d \geq P_d$$

At 10:00 AM → Both 'A' and 'C' start transmitting the data
At 10:30 AM → Collision
At 11:00 AM → Both A & C receive Collision signal



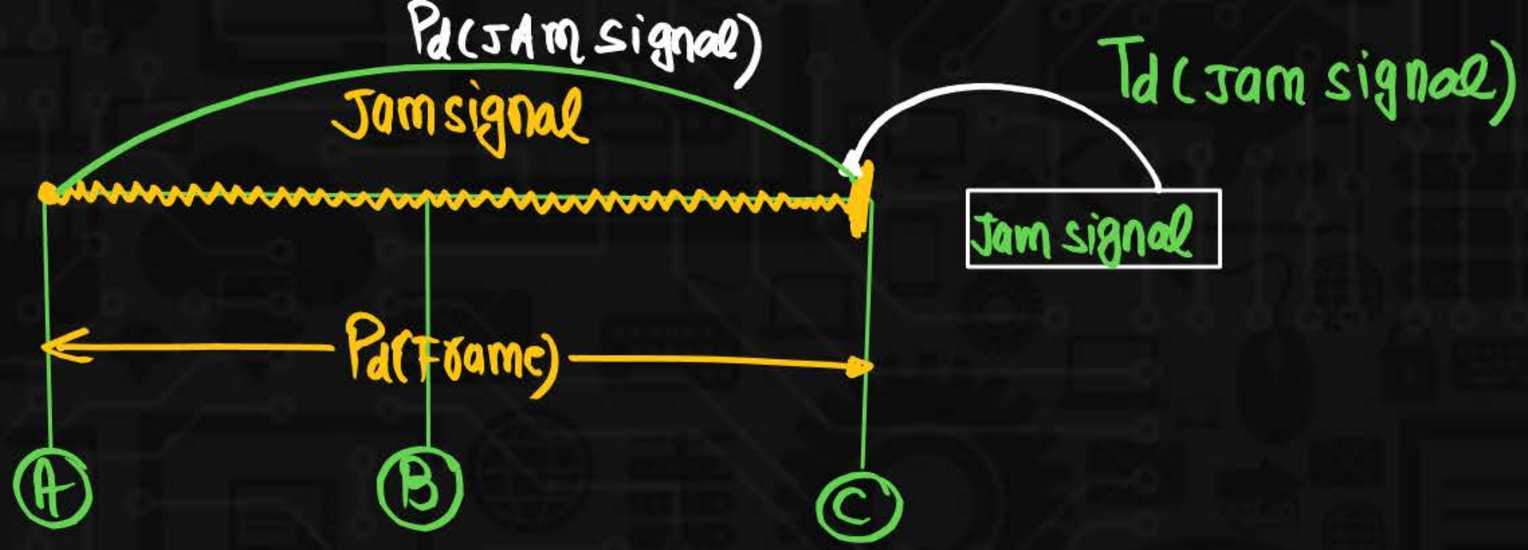
$$Td \geq 2 * Pd$$

10:00 AM → 'A' start transmitting the data

10:59:59 AM → 'D' start transmitting the data

11:00 AM → collision

12:00 PM → 'A' receive collision signal



$$Td(Frame) \geq Pd(Frame) + Td(JAM\ signal) + Pd(JAM\ signal)$$

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

$$Td(Frame) \geq 2 * Pd + Td(JAM\ signal)$$

⇓

minimum Frame size to Detect the collision

$$\frac{\text{Frame size}(L)}{\text{Bandwidth}(B)} \geq 2 * P_d + T_d(\text{JAM signal})$$

$$\text{Frame size} \geq \left(2 * P_d + T_d(\text{JAM signal})\right) * \text{Bandwidth}$$

$$L \geq \left(2 * P_d + T_d(\text{JAM signal})\right) * B \quad \text{(exact Formula)}$$

→ minimum Frame size to Detect the collision in CSMA/CD

Problem Solving on CSMA/CD

Q.1 Building a CSMA/CD network running at 1 Gbps over a I-km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. The minimum frame size is ____ bits.

[GATE – 2005]

$B = 1\text{Gbps} = 10^9$ bits/sec , $d = 1$ km

$v = 200000$ km/sec , minimum Frame size = ?

$T_d \geq 2 * P_d + T_d(\text{JAM signal})$

$\frac{L}{B} \geq 2 * P_d$

$L \geq 2 * P_d * B$

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

$$L \geq 2 * \frac{1\,km}{200000\,km/sec} * 10^9\,bits/sec$$

$$L \geq 10^4\,bits$$

$$\boxed{L \geq 10000\,bits}$$

Q2. Consider a CSMA/CD network that transmits data at a rate of 100 Mbps (10^8 bits per second) over a 1 km (kilometer) cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

[GATE – 2015]

A. 8000

B. 10000

C. 16000

D. 20000

$B = 10^8$ bits/sec , $d = 1$ km , $L = 1250$ Byte $= 8 * 1250 = 10{,}000$ bits

$v = ?$

$$T_d \geq 2 * P_d + T_d(\text{JAM signal})$$

$T_d(\text{JAM signal}) \to 0$

$$T_d \geq 2 * P_d$$

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

$$\frac{10{,}000 \text{ bits}}{10^8 \text{ bits/sec}} \geq \frac{2 * 1 \text{ km}}{v}$$

$$\frac{1}{10^4} \geq \frac{2}{v}$$

$$v = 2 * 10^4 \text{ km/sec}$$

$$v = 20{,}000 \text{ km/sec}$$

Q.3 A network has a data transmission bandwidth of 20×10^6 bits per second. It uses CSMA/CD in the MAC layer. The maximum signal propagation time from one node to another node is 40 microseconds. The minimum size of a frame in the network is _____ bytes.

[GATE – 2016]

$B = 20 * 10^6$ bits/sec

$P_d = 40\mu sec = 40 * 10^{-6}$ sec

$L = ?$

$T_d \geq 2 * P_d + T_d(\text{JAM signal})$

$\frac{L}{B} \geq 2 * P_d$

$L \geq 2 * P_d * B$

$L \geq 2 * 40 * 10^{-6}\ sec * 20 * 10^6$ bits/sec

$L \geq 1600$ bits

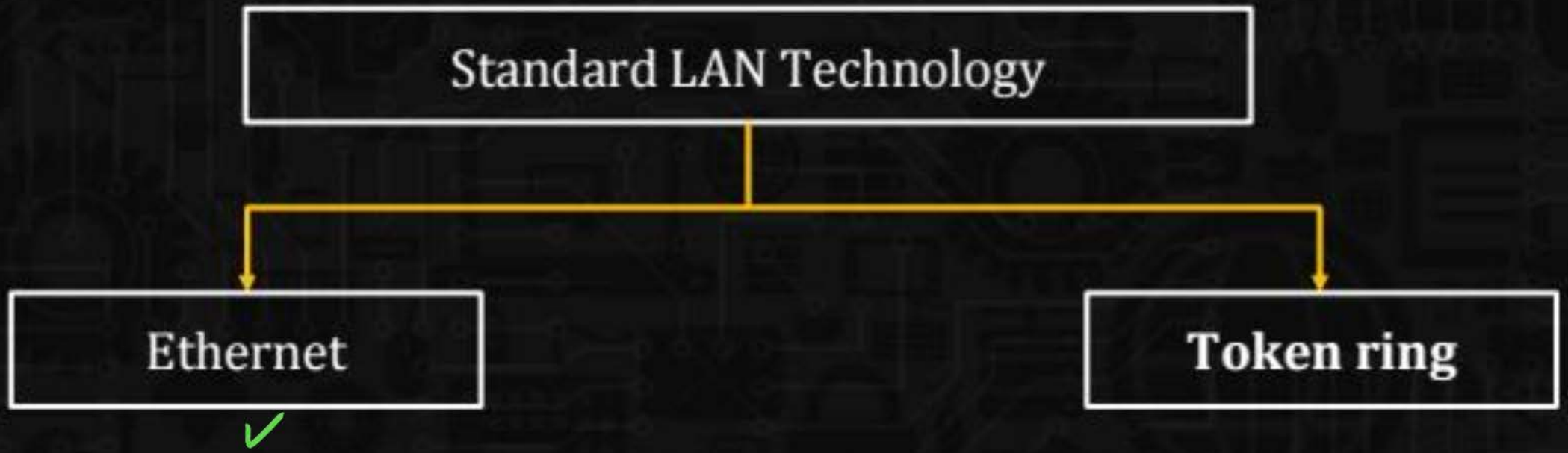
$L \geq \frac{1600}{8}$ Byte

$L \geq 200$ Byte

Introduction To Ethernet

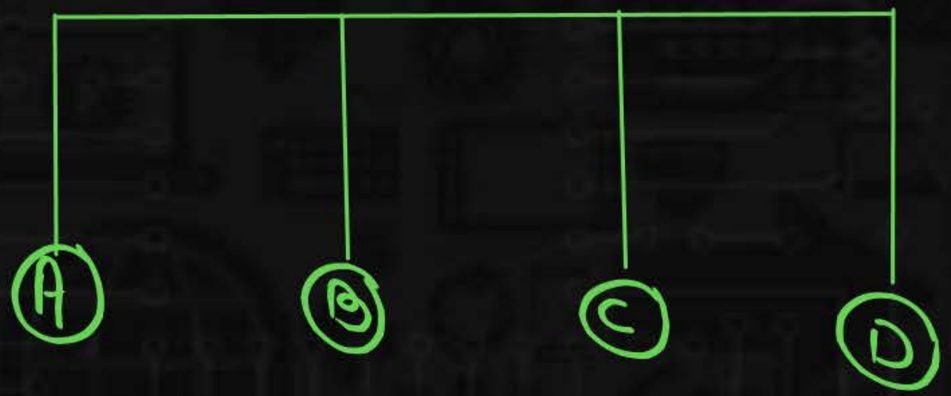
IEEE 802 Project: IEEE started project 802, so that different LAN can be interconnected

- 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

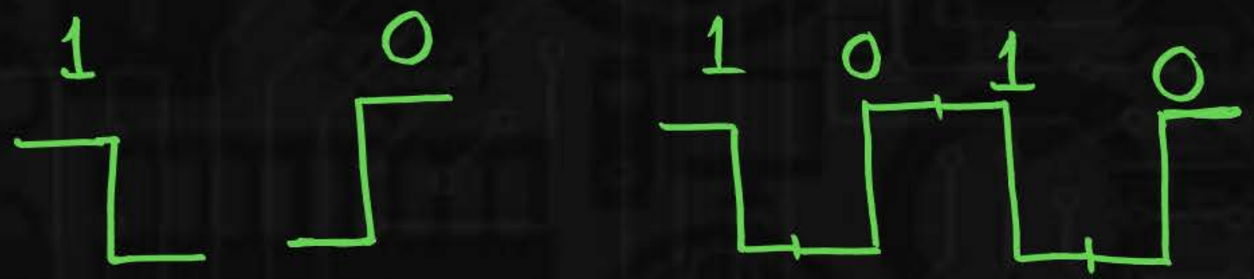


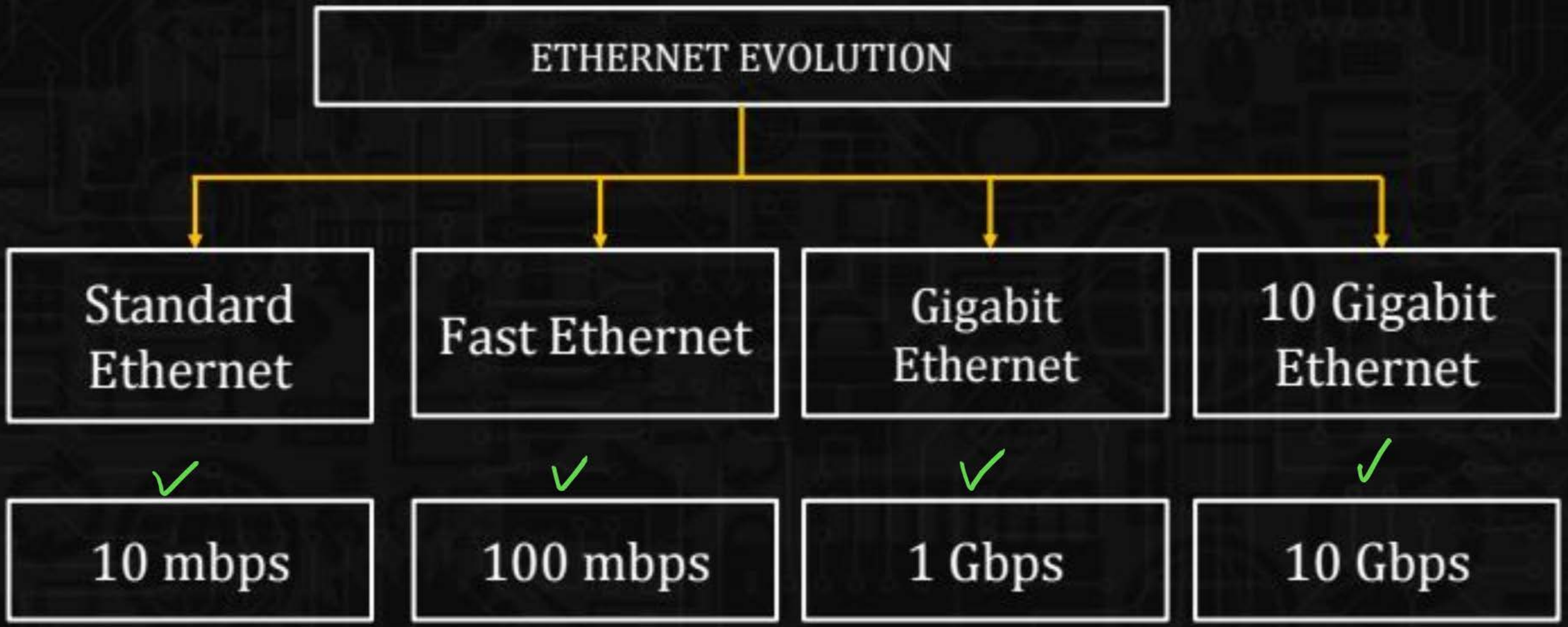
Ethernet Characteristics

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


THANK YOU
GW
SOLDIERS !