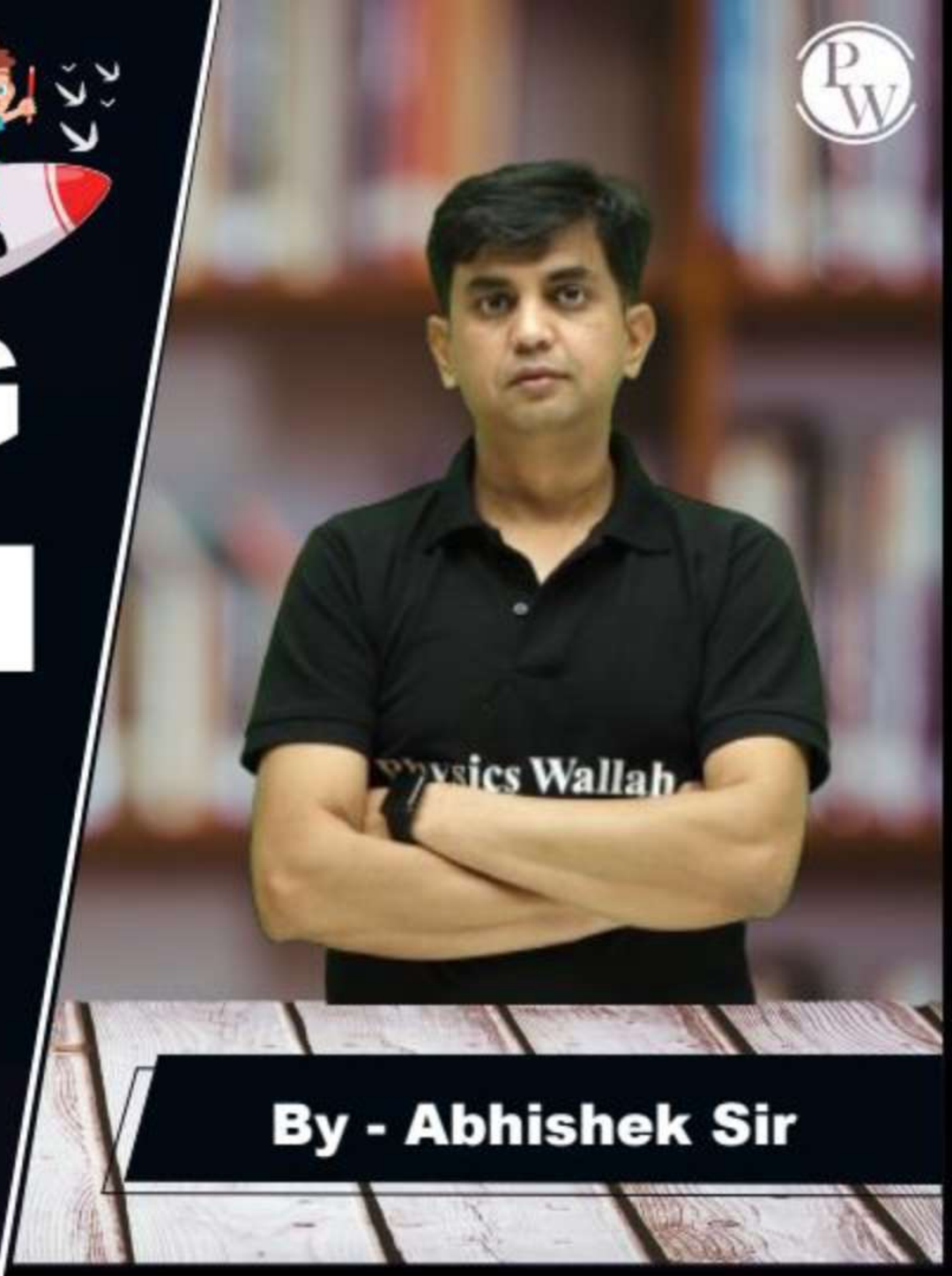
CS & IT ENGINEERING

Computer Network

MAC Layer

Lecture No. - 04



By - Abhishek Sir

Recap of Previous Lecture

Topic Slotted ALOHA

Topic CSMA

Topics to be Covered

Topic CSMA

Topic CSMA/CD

ABOUT ME

Hello, I'm Abhishek

- GATE CS AIR - 96
- M.Tech (CS) - IIT Kharagpur
- 12 years of GATE CS teaching experience

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#Q. Consider a simplified time slotted MAC protocol, where each host always has data to send and transmits with probability p = 0.2 in every slot. There is no backoff and one frame can be transmitted in one slot. If more than one host transmits in the same slot, then the transmissions are unsuccessful due to collision. What is the maximum number of hosts which this protocol can support, if each host has to be provided a minimum through put of 0.16 frames per time slot?

[GATE 2004]

(A) 1
(B) 2
(C) 3
(D) 4

Probability $P = 0.2$

Throughput of Host $= 0.16$

$P * (1-P)^{(n-1)} = 0.16$

$0.2 * (0.8)^{(n-1)} = 0.16$

No. of Hosts $= n$

$n = 2$

Ans: B

#Q. Consider a LAN with four nodes S1, S2, S3 and S4. Time is divided into fixed-size slots, and a node can begin its transmission only at the beginning of a slot. A collision is said to have occurred if more than one node transmit in the same slot. The probabilities of generation of a frame in a time slot by S1, S2, S3 and S4 are 0.1, 0.2, 0.3 and 0.4, respectively. The probability of sending a frame in the first slot without any collision by any of these four stations is _____ .

[GATE 2015]

S_1 S_2 S_3 S_4

$P_1 = 0.1$ $P_2 = 0.2$ $P_3 = 0.3$ $P_4 = 0.4$

IIT K

Ans = 0.4404

$$Throughput_{S_1} = P_1 * (1-P_2) * (1-P_3) * (1-P_4)$$

$$Throughput_{S_2} = (1-P_1) * P_2 * (1-P_3) * (1-P_4)$$

$$Throughput_{S_3} = (1-P_1) * (1-P_2) * P_3 * (1-P_4)$$

$$Throughput_{S_4} = (1-P_1) * (1-P_2) * (1-P_3) * P_4$$

Throughput of channel

$$= Throughput_{S_1} + Throughput_{S_2} + Throughput_{S_3} + Throughput_{S_4}$$

$$= (0.1 * 0.8 * 0.7 * 0.6) + (0.9 * 0.2 * 0.7 * 0.6) + (0.9 * 0.8 * 0.3 * 0.6) + (0.9 * 0.8 * 0.7 * 0.4)$$

$$= 0.4404$$

Topic : CSMA

→ Carrier Sense Multiple Access

→ Sense before transmit
[Sense the channel, before transmission]

→ if channel sensed idle : "transmit entire frame"

→ if channel sensed busy : "defer transmission"

* Receiver send ACK
* Sender Retransmit the frame (in case timeout)

Topic : CSMA

Different variations of CSMA protocols :

i. 1 – Persistent CSMA

ii. Non – Persistent CSMA

iii. p – Persistent CSMA

Topic : 1-persistent CSMA

→ Sense before transmit

→ if channel sensed idle
transmit entire frame immediately (with probability 1)

→ if channel sensed busy
sense the channel continuously (till it become idle)

Topic : Non-persistent CSMA

→ Sense before transmit

→ if channel sensed idle
transmit entire frame immediately

→ if channel sensed busy
Wait a random amount of time and then sense the channel

It do not sense the channel continuously when channel is busy.
[Unlike 1 – Persistent CSMA]

Topic : p-persistent CSMA

→ Channel has divided into time slots

→ Sense before transmit

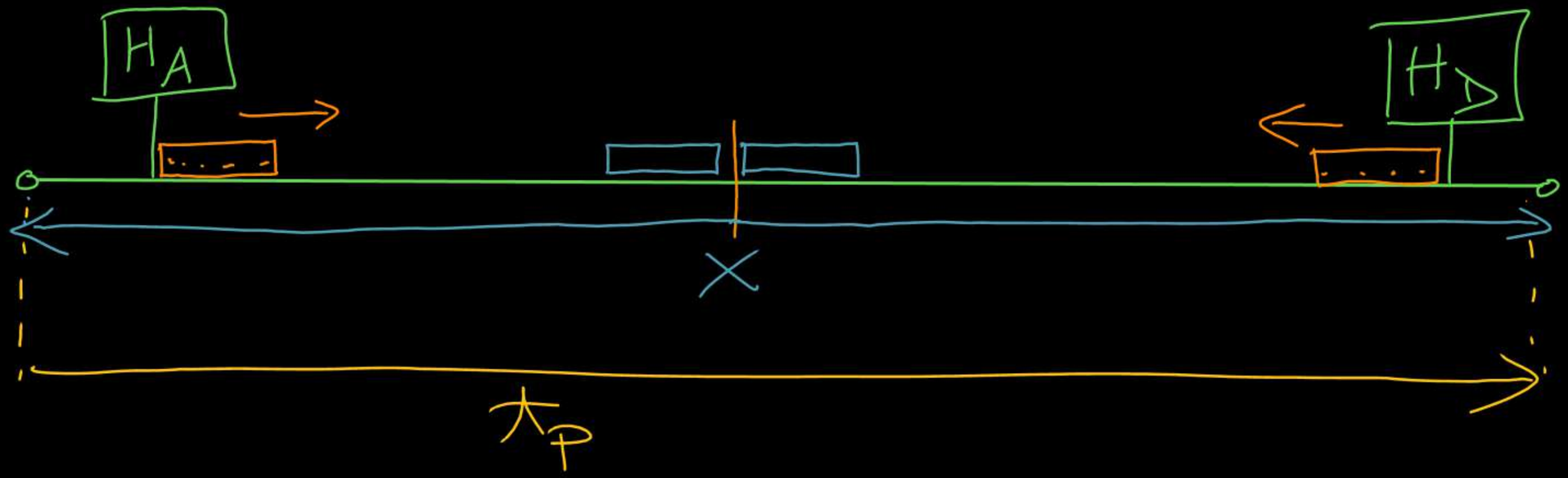
→ if channel sensed idle
transmit the frame with probability **p**

→ if channel sensed busy
sense the channel continuously (till it become idle)

In case low traffic
$P \rightarrow 1$

In case high traffic
$P \rightarrow 0$

$0 < P \leq 1$


H_A
H_B
X
λ_P

Topic : CSMA/CD

→ CSMA with Collision Detection

→ Applicable only for wired LAN (Bus topology)

→ Sense before transmit

→ Sense while (during) transmission

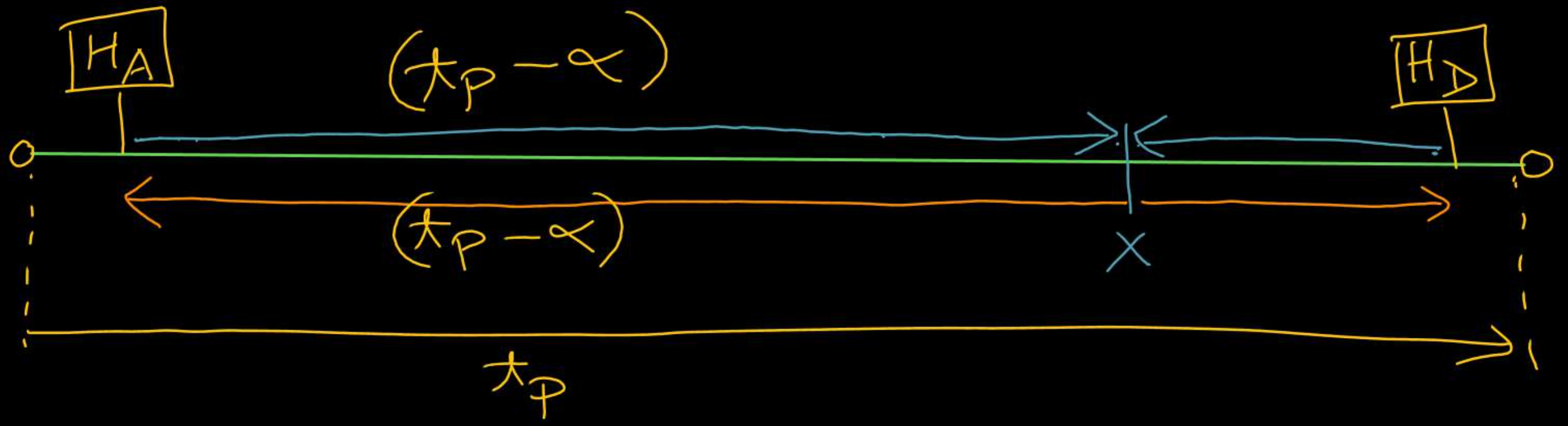
→ No any feedback (acknowledgment) from receiver

Topic : CSMA/CD

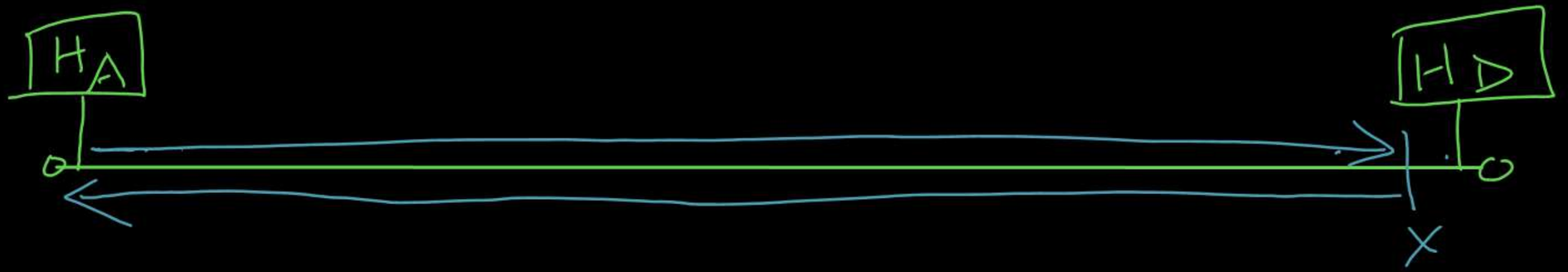
→ To detect collision,
minimum frame transmission delay should be
greater than equal to (maximum) round trip propagation delay.

frame transmission delay >= round trip propagation delay

$$t_x >= 2*t_p$$



$$t_{sc} \geq 2(t_p - \alpha)$$



In worst case $\alpha = 0$

$$t_x \geq 2t_p$$

$$t_{tx} \geq 2t_p$$

$$\left(\frac{\text{Frame Size}}{\text{Bandwidth}}\right) \geq 2t_p$$

$$\text{min}^m \text{ Frame Size} = (2t_p) * (\text{Bandwidth})$$

#Q. A 2 km long broadcast LAN has 10^7 bps bandwidth and uses CSMA/CD. The signal travels along the wire at 2×10^8 m/s. What is the minimum packet size that can be used on this network?

[GATE 2003]

(A) 50 bytes

(B) 100 bytes

(C) 200 bytes

(D) None of the above

Ans: D

Solution :

Minimum frame size = 2 * (Distance / Signal Speed) * Bandwidth

= 2 * (2 km / $2 * 10^8$ m/sec) * 10^7 bits/sec

= 2 * ($2 * 10^3$ m / $2 * 10^8$ m/sec) * 10^7 bits/sec

= 200 bits

= 25 bytes

#Q. A network with CSMA/CD protocol in the MAC layer is running at 1 Gbps over a 1 km cable with no repeaters. The signal speed in the cable is 2 x 10^8 m/sec. The minimum frame size for this network should be

[GATE 2004]

H W.

(A) 10000 bits

(B) 10000 bytes

(C) 5000 bits

(D) 5000 bytes

#Q. The minimum frame size required for a CSMA/CD based computer network running at 1 Gbps on a 200 m cable with a link speed of 2×10^8 m/s is :

[GATE 2008]

H.W

(A) 125 bytes

(B) 250 bytes

(C) 500 bytes

(D) None of these

#Q. 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]

H.W

#Q. Consider a CSMA/CD network that transmits data at a rate of 100 Mbps (10^8 bits per second) over a 1 km (kilometre) 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]

H.W.

(A) 8000

(B) 10000

(C) 16000

(D) 20000

2 mins Summary

Topic CSMA

Topic CSMA/CD

THANK - YOU