CS & IT ENGINEERING

COMPUTER NETWORKS

Medium Access Control

Lecture No-06

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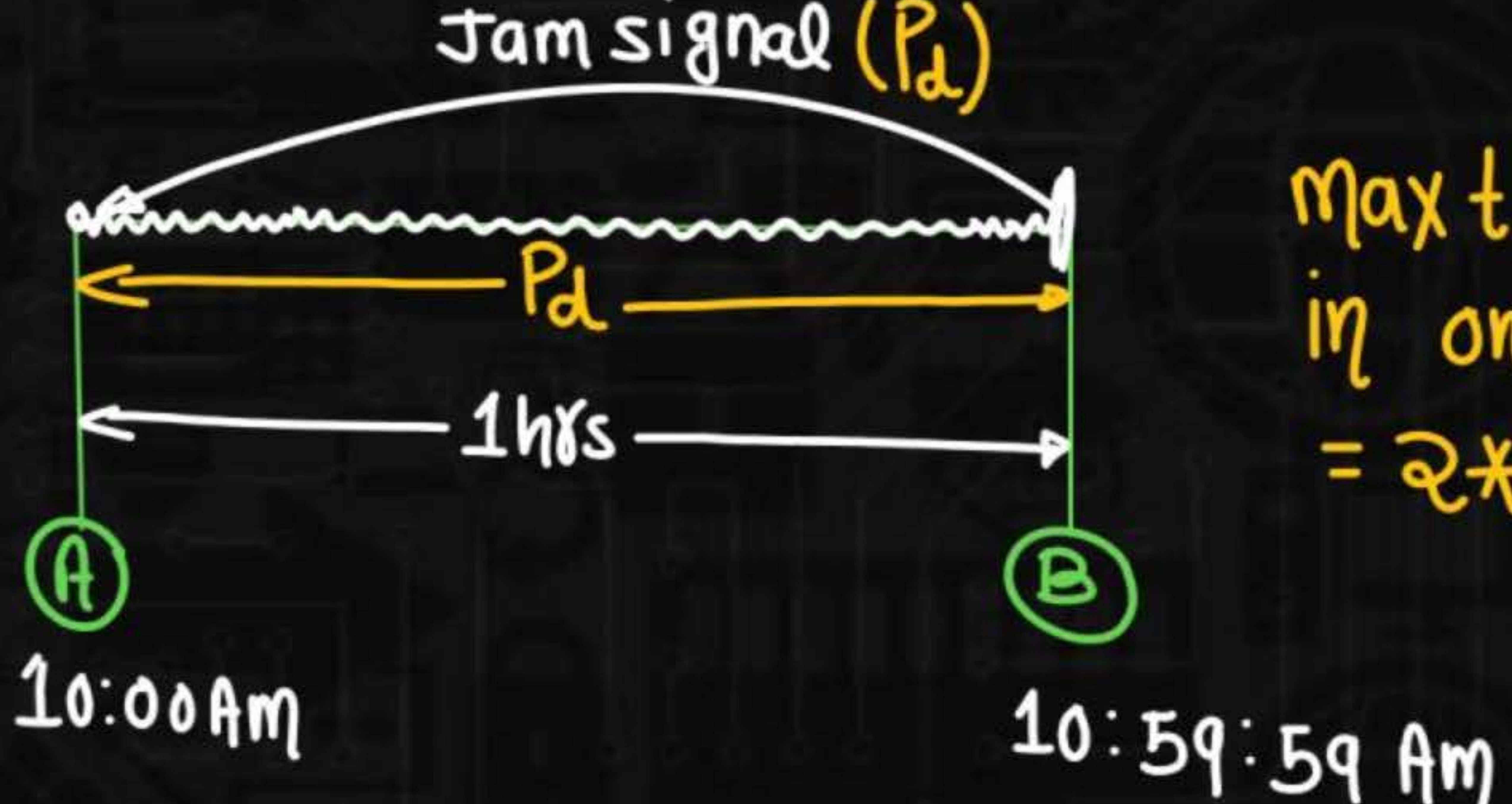
TOPICS TO BE COVERED

Multiple Access Protocols-6

Disadvantage of Ethernet

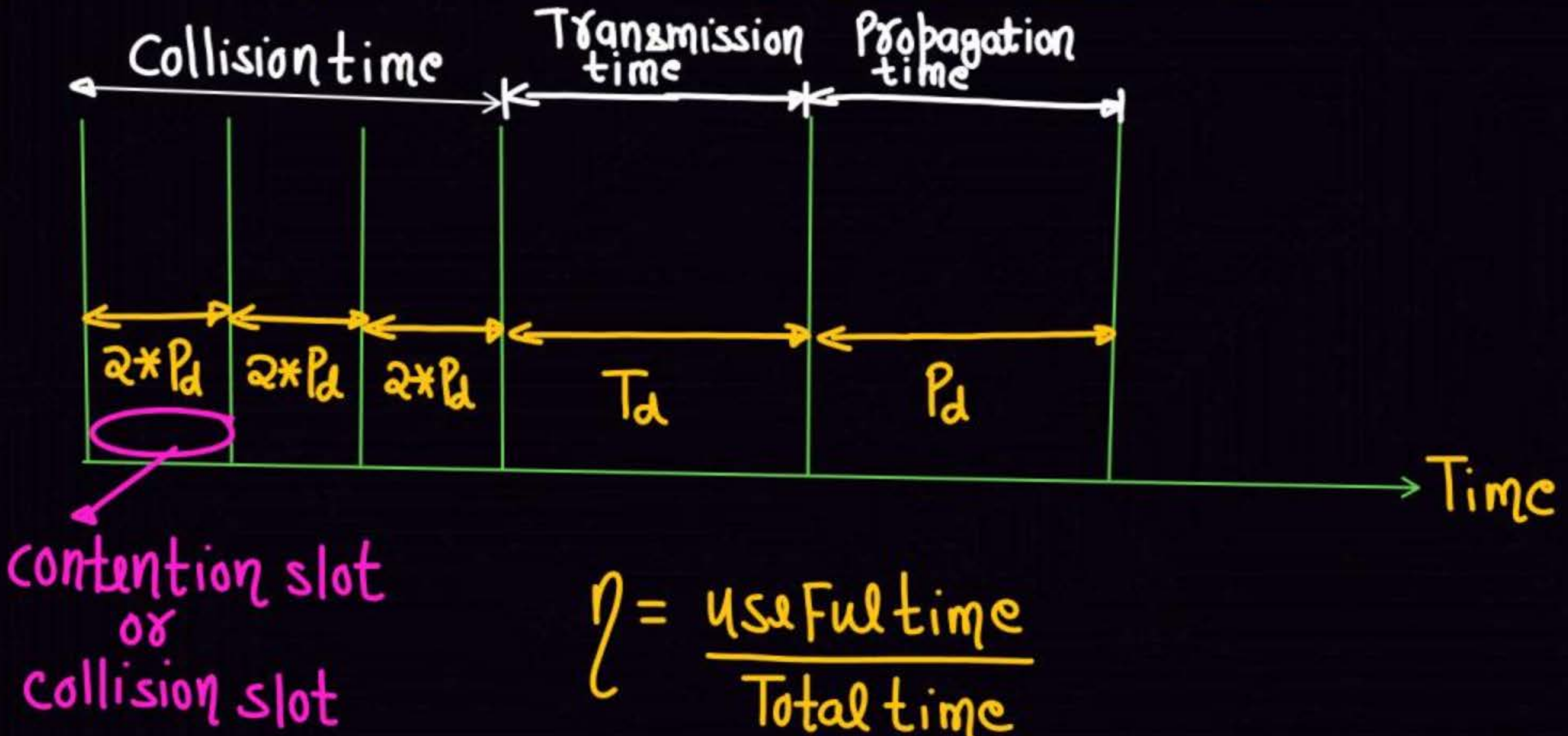
1. In the Ethernet there is restriction on minimum size of data hence it is not suitable for interactive application where data size very less
2. It is not suitable for real time application . Real time applications requires the delivery of data with in some time limit. Ethernet is not reliable because 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.

Efficiency of Ethernet (CSMA/CD)



Max time wasted in one collision $= 2 * P_d$

Efficiency Calcution oF Ethernet (CSMA/CD)



$$\eta = \frac{\text{useFul time}}{\text{Total time}}$$

$$\eta = \frac{\text{Transmission time}}{\text{Collision time} + \text{Transmission time} + \text{Propagation time}}$$

$$\eta = \frac{T_d}{c * 2 * P_d + T_d + P_d}$$

$$\eta = \frac{T_d}{e * 2 * P_d + T_d + P_d}$$

$$\eta = \frac{\cancel{T_d}}{\cancel{T_d}\left[e * 2 * \frac{P_d}{T_d} + 1 + \frac{P_d}{T_d}\right]}$$

$$\eta = \frac{1}{e * 2 * a + 1 + a}$$

c = No. of contention slot
or
No. of collision slot

$e = 2.72$

$$\frac{P_d}{T_d} = a$$

$$\eta = \frac{1}{2.72 * 2 * a + 1 + a}$$

$$\eta = \frac{1}{5.44a + 1 + a}$$

$$\eta = \frac{1}{6.44a + 1}$$

$$\boxed{\eta = \frac{1}{1 + 6.44a}}$$

$$\eta = \frac{1}{1 + 6.44 * \frac{d}{v} * \frac{B}{L}}$$

$V \rightarrow$ Fixed

$B \rightarrow$ fixed

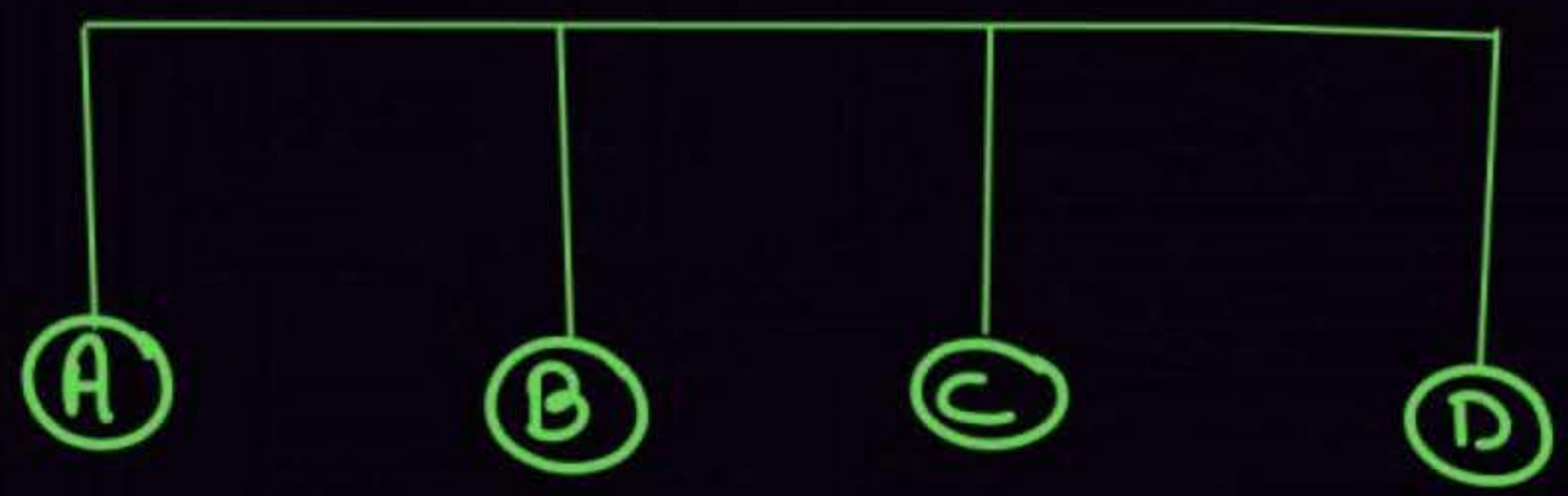
$d \uparrow \quad \eta \downarrow \rightarrow$ Good For LAN not For WAN

$L \uparrow \quad \eta \uparrow \rightarrow$ Good For Large Pkt size

Note

1. In Ethernet efficiency is High when propagation delay is Low and Transmission delay is High

2. In Ethernet efficiency is Low when Propagation delay is High and transmission delay is Low.



N = Total Number of station in Ethernet

p = Probability of station to transfer the data Packet

$(1-p)$ = Probability of station Not to transfer the data Packet

" For the successful transmission of one station then Remaining (N-1) station should Not transfer the data Pkt"

$(1-p)^{N-1}$ = Probability of (N-1) station Not to transfer the data Packet

$p(1-p)^{N-1}$ = Probability of success for a single station

$N \cdot p(1-p)^{N-1}$ = Probability of success For any station among 'N' stations

$$\boxed{P_{succ} = N \cdot p(1-p)^{N-1}}$$

For Max (P_{succ})

$$\frac{d}{dp}(P_{succ}) = 0$$

$$\frac{d}{dp}\left[N\cdot p(1-p)^{N-1}\right]$$

$$N\left[p\cdot\frac{d}{dp}(1-p)^{N-1}+(1-p)\frac{d}{dp}p\right]$$

$$\boxed{p=\frac{1}{N}}$$

$$P_{suc} = N\cdot p(1-p)^{N-1}$$

$$= \cancel{N} * \frac{1}{\cancel{N}}\left(1-\frac{1}{N}\right)^{N-1}$$

$$= \left(1-\frac{1}{N}\right)^{N-1}$$

If there are sufficienty Large Number of Stations i.e $n \to \infty$ then we Have -

$$\lim_{N\to\infty}(P_{suc})_{max} = \lim_{N\to\infty}\left(1-\frac{1}{N}\right)^{N-1}$$

$$= \frac{1}{e}$$

Number of times we need to try Before getting the 1st success = 'e'

From Here, we conclude -

Average Number of collision that might occur Before a successful transmission = e

Q.1 The efficiency of Ethernet

A. Increases when propagation delay and transmission delay are low

B. Increase When propagation delay and transmission delay are high

C. Increase when Propagation delay is low and transmission delay is high

D. Increases when propagation delay is high and transmission delay is low

Q.2 Which of the following statements is TRUE about CSMA/CD

[GATE – 2005]

→ CSMA/CA

A. IEEE 802.11 wireless LAN runs CSMA/CD protocol

$\eta = \frac{1}{1+6.44a}$

B. Ethernet is not based on CSMA/CD protocol

$\eta = \frac{1}{1+6.44 * \frac{P_d}{T_d}}$

C. CSMA/CD is not suitable for a high propagation delay network like satellite network

D. There is no contention in a CSMA/CD network

$P_d \uparrow \quad \eta \downarrow$

$T_d \uparrow \quad \eta \uparrow$

Q.3 The network consists of 4 hosts distributed as shown below.

Assume this network uses CSMA/CD and signal travel at 3×10^5 kM/sec.

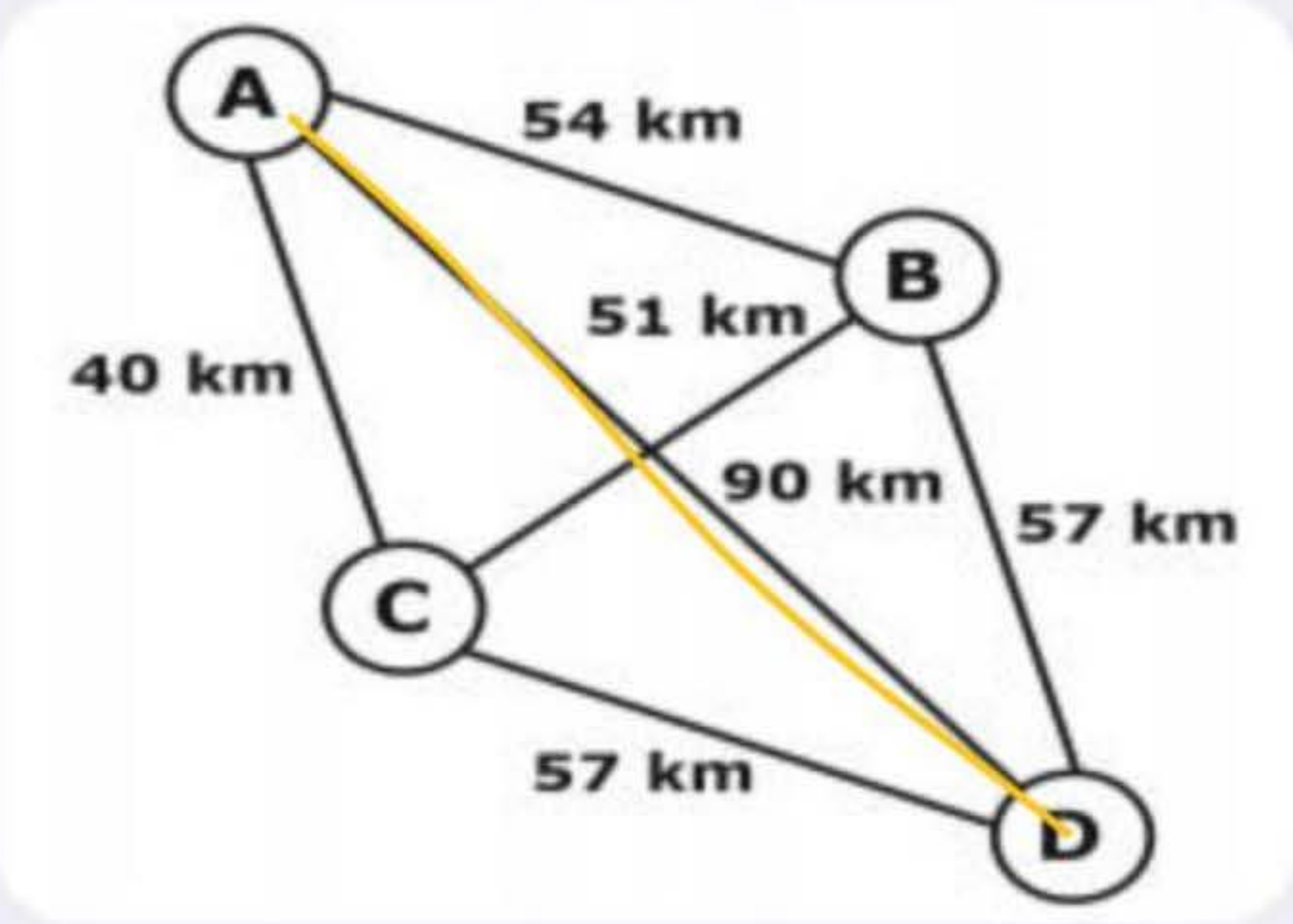
If sender send at 1 Mbps, what could be minimum size of the packet?

A. 600 bits

B. 400 bits

C. 6000 bits

D. 1500 bits



$v = 3 * 10^5$ km/sec

$B = 1$ mbps $= 10^6$ bits/sec

$L = ?$

$$\boxed{T_d(\text{Frame}) \geq 2 * P_d + \cancel{T_d(\text{Jam signal})}^{\,0}}$$

$$P_d = \frac{d}{v}$$

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

$$P_d = \frac{90\,\text{Km}}{3 * 10^5\,\text{Km/sec}}$$

$$L \geq 2 * P_d * B$$

$$P_d = 30 * 10^{-5}\,\text{sec}$$

$$L \geq 2 * 30 * \cancel{10^{-5}}\,\cancel{\text{sec}} * \cancel{10^{6}}\,\text{bits}/\cancel{\text{sec}}$$

$$L \geq 2 * 30 * 10\ \text{bits}$$

$$L \geq 600\ \text{bits}$$

Q.4 There are n stations in a slotted LAN. Each station attempts to transmit with a probability p in each time slot. What is the probability that ONLY one station transmits in a given time slot?

[GATE – 2005]

A. $Np(1-p)^{n-1}$

B. $(1-p)^{n-1}$

C. $P(1-p)^{n-1}$

D. $1-(1-p)^{n-1}$

$$P_{succ} = N \cdot P(1-P)^{N-1}$$

Slotted ALOHA allows a node to transmit continuously at the full rate, R, when that node is the only active node.

already suffered a collision.) Suppose there are N nodes. Then the probability that a given slot is a successful slot is the probability that one of the nodes transmits and that the remaining $N - 1$ nodes do not transmit. The probability that a given node transmits is p; the probability that the remaining nodes do not transmit is $(1 - p)^{N-1}$. Therefore the probability a given node has a success is $p(1 - p)^{N-1}$. Because there are N nodes, the probability that any one of the N nodes has a success is $Np(1 - p)^{N-1}$.

Q.5 Consider a LAN with four nodes S_1, S_2, S_3 and S_4. 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 probability of generation of a frame in a time slot by S_1, S_2, S_3 and S_4 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 0.4404

[GATE – 2015]

$S_1 = 0.1$, $S_2 = 0.2$, $S_3 = 0.3$, $S_4 = 0.4$

$$\boxed{P_{succ} = N \cdot P(1-P)^{N-1}}$$

	S_1	S_2	S_3	S_4	
For S_1	p	$(1-p)$	$(1-p)$	$(1-p)$	
	0.1	0.8	0.7	0.6	= 0.0336
For S_2	$(1-p)$	p	$(1-p)$	$(1-p)$	+
	0.9	0.2	0.7	0.6	= 0.0756
For S_3	$(1-p)$	$(1-p)$	p	$(1-p)$	+
	0.9	0.8	0.3	0.6	= 0.1296
For S_4	$(1-p)$	$(1-p)$	$(1-p)$	p	+
	0.9	0.8	0.7	0.4	= 0.2016
					0.4404

Q.6 Suppose CSMA/CD protocol is used for channel access in an Ethernet LAN and 3 hosts are in LAN. Each host can transmit data in an idle slot (empty slot) with probability 0.8. What is the probability that only one host can transmit data in an idle slot?

A. 0.032

B. 0.096

C. 0.128

D. 0.384

No. of Host $(N) = 3$

each Host transmitting Probability $(p) = 0.8$

Probability that only one Host transmit data in an idle slot (Throughput of channel) $= N \cdot p(1-p)^{N-1}$

$= 0.3 * 0.8 (0.2)^2$

$= 0.3 * 0.8 * 0.2 * 0.2$

$= 0.096$

Q.7 Suppose CSMA/CD protocol is used for channel access in an Ethernet LAN and each host can transmit data in an idle (empty) slot with probability 0.75. The total number of hosts exist in the LAN. When probability that particular host only transmit in an idle slot is 0.1875 is ______.

each Host can transmit data in an idle Host $(P) = 0.75$

Total No. of Host in LAN $= N$

Probability that particular Host only transmit in an Idle slot (throughput of the Host) $= 0.1875$

Throughput of the Host $= p(1-p)^{N-1}$

$$0.1875 = 0.75 * (0.25)^{N-1}$$

$$\boxed{N = 2}$$

Note: (1) Throughput of Host $= p(1-p)^{N-1}$

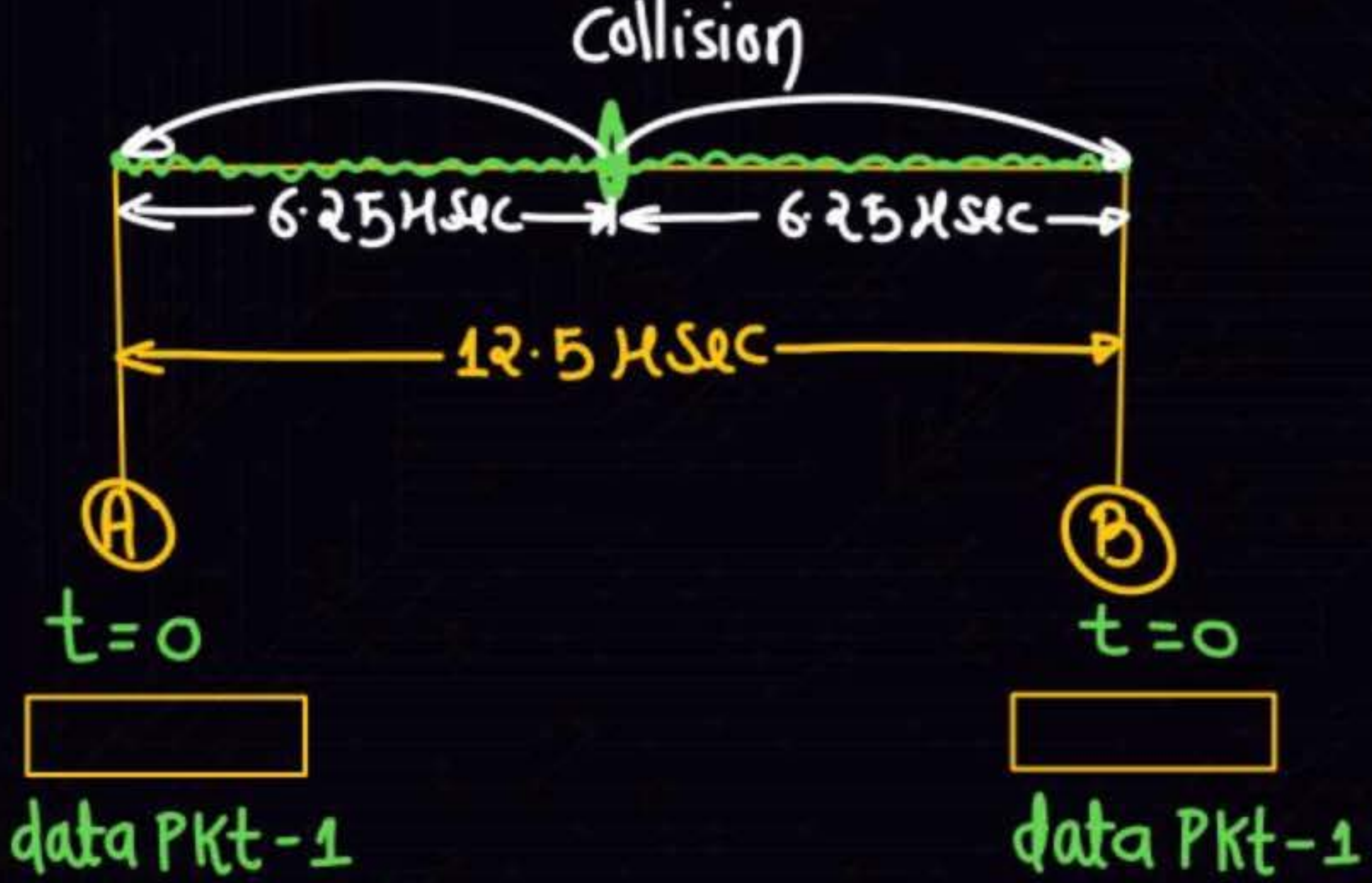
(2) throughput of the channel $= Np(1-p)^{N-1}$

Q.8

Suppose two nodes, A and B are attached to opposite ends of the cable with propagation delay of 12.5 μsec. Both nodes attempt to transmit at time t=0. Frames collide and after first collision, A draws k=0 and B draws k=1 in the exponential backoff protocol. At what time (in μ seconds) is A's packet completely delivered at B, if Bandwidth of the link is 10 Mbps and packet size is 1000 bits for the following,

(a) With Purging 137.5 μsec

(b) Without Purging 125 μsec



At t=0 Both A & B start transmitting the data PKt
At t=6.25 Both A and B data PKt Has been collide
At t=12.5 Both A and B Received the Collision signal

$K = 0$ $\qquad$ $K = 0$

$WT = P_d$

$\boxed{WT = 12.5\ \mu sec}$ → A can't immediatly it Has to wait for one propagation delay

$t = 12.5\ \mu sec + 12.5\ \mu sec = 25\ \mu sec$

At $t = 25\ \mu sec$ A start retransmitting the data pkt

Pkt size = 1000, B: $10 * 10^6$ bits/sec

$$T_d(pkt) = \frac{1\cancel{000}\ \text{bits}}{\cancel{10} * 10^6\ \cancel{\text{bits}}/\text{sec}}$$

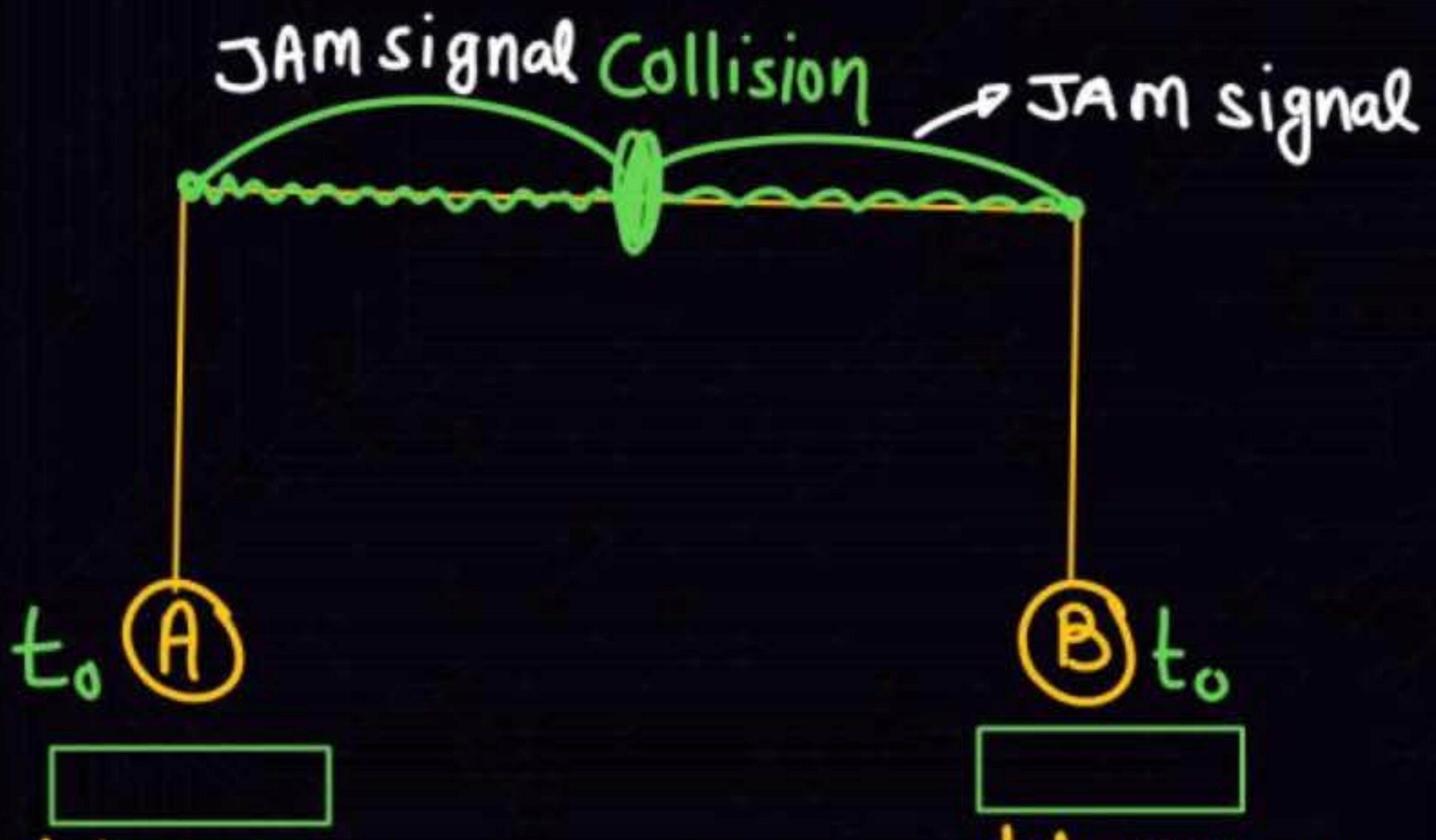
$$= 100 * 10^{-6}\ sec = 100\ \mu sec$$

At $t = 25\ \mu sec + 100\ \mu sec = 125\ \mu sec$

At $t = 125\ \mu sec$ A complete its transmission

At $t = 125\,\mu sec + \overset{(P_d)}{12.5}\,\mu sec = 137.5\,\mu sec$ A's packet completly delicuered to B

Concept of Purging (cleaning)



data Pkt-1

$n = 1$

$K \to 0 \text{ to } 2^n - 1$

$K \to (0, 1)$

data Pkt-1

$n = 1$

$K \to 0 \text{ to } 2^n - 1$

$K \to (0, 1)$

A	B	
0	0	→ Collision
0	1	→ A won
1	0	→ B won
1	1	→ Collision

If we choose $\begin{array}{cc} A & B \\ (0, & 1) \\ K & K \end{array}$

WT of A = K * slot duration

WT of A = 0 * slot duration

WT of A = 0

WT of B = K * slot duration

= 1 * slot duration

Concept of Purging (cleaning)

$\boxed{\text{WT OF } A = P_d}$

WT OF B = K * slot duration = 1 * slot duration

Q.9 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 - 2008]

$p = 0.2$

No. of Host = N

throughput of the Host = 0.16

A. 1

B. 2

C. 3

D. 4

Throughput of the Host $= p(1-p)^{N-1}$

$$\cancel{0.16} = \cancel{0.2}(0.8)^{N-1}$$

$$0.8 = (0.8)^{N-1}$$

$$(0.8)^{1} = (0.8)^{N-1}$$

$$N-1 = 1$$

$$\boxed{N=2}$$


THANK YOU
GW
SOLDIERS !