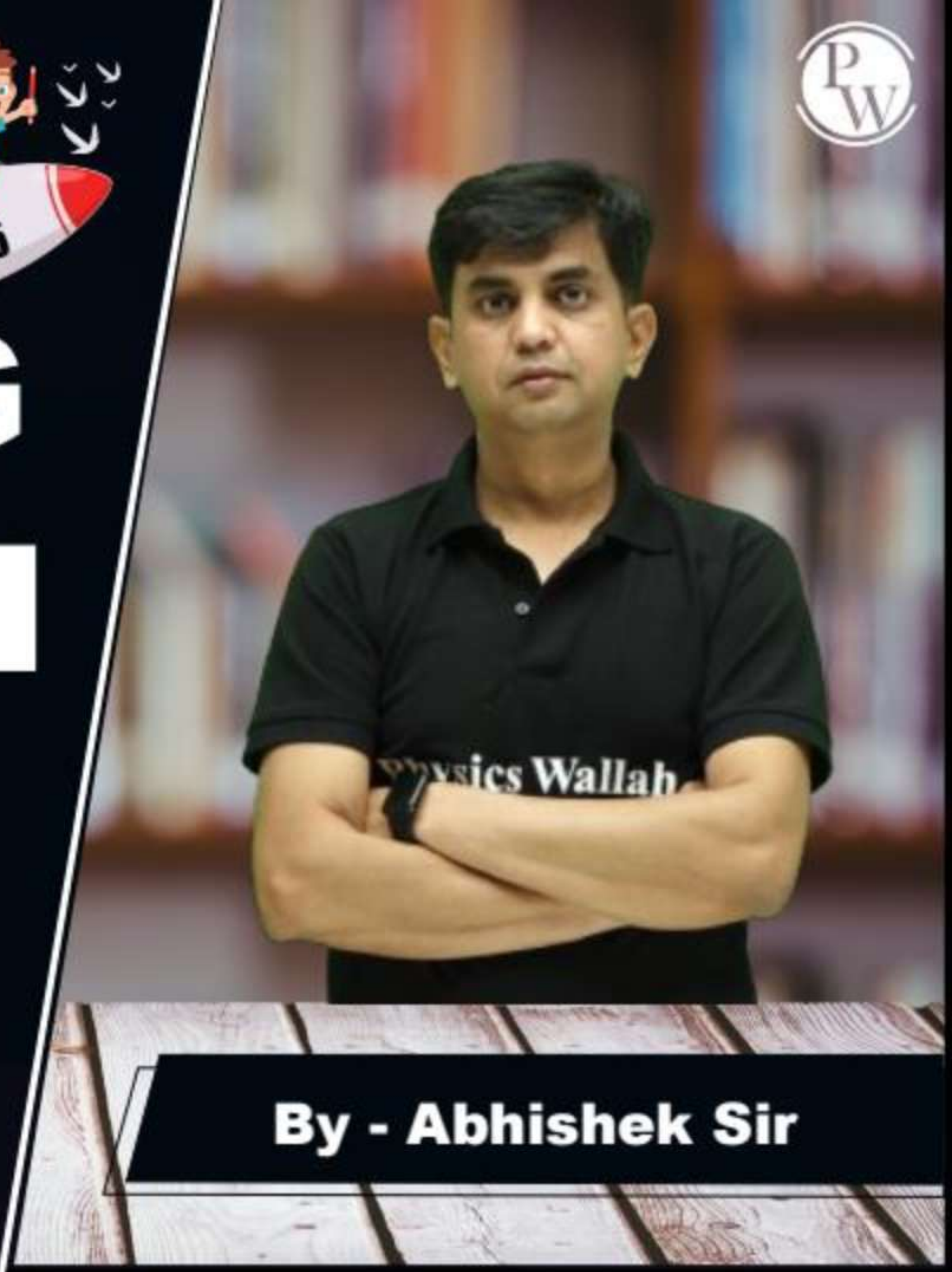
CS & IT ENGINEERING

Computer Network

Flow Control

Lecture No. - 02



By - Abhishek Sir

Recap of Previous Lecture

Topic Network Delay

Topic End to end Delay

Topics to be Covered

Topic: End to end Delay

Topic: Flow Control

ABOUT ME

Hello, I'm Abhishek

- GATE CS AIR - 96
- M.Tech (CS) - IIT Kharagpur
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#Q. Consider two hosts X and Y, connected by a single direct link of rate 10^6 bits/sec. The distance between the two hosts is 10,000 km and the propagation speed along the link is 2×10^8 m/s. Hosts X send a file of 50,000 bytes as one large message to hosts Y continuously. Let the transmission and propagation delays be p milliseconds and q milliseconds, respectively. Then the vales of p and q are:

[GATE 2017]

(A) p = 50 and q = 100

(B) p = 50 and q = 400

(C) p = 100 and q = 50

(D) p = 400 and q = 50

Ans: D

Solution:-

$\text{Packet Size} = \text{50,000 bytes} = \underbrace{4 * 10^5}_{} \text{ bits}$

$\text{Bandwidth} = 10^6 \text{ bits / sec}$

$$p = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{4 * 10^5 \text{ bits}}{10^6 \text{ bits / sec}} = \underbrace{400 \text{ ms}}_{}$$

$$= \frac{4 * 10^2 * 10^3 \text{ bits}}{10^3 * 10^3 \text{ bits/sec}} = 4 * 10^2 * 10^{-3} \text{ sec}$$

$$= 400 \text{ ms}$$

Distance $= 10{,}000$ Km $= 10^7$ m $= 10^4 * 10^3$ m

Signal Speed $= 2 \times 10^8$ m/s

$$q = \frac{\text{Distance}}{\text{Signal Speed}} = \frac{10^7 \text{ m}}{2 \times 10^8 \text{ m/s}} = 50 \text{ ms}$$

$$= \frac{10^7 \text{ m}}{2 * 10^5 * 10^3 \text{ m/sec}} = \frac{100}{2} * 10^{-3} \text{ sec}$$

#Q. Consider a 100 Mbps link between an earth station (sender) and a satellite (receiver) at an altitude of 2100 km. The signal propagates at a speed of 3×10^8 m/s. The time taken (in milliseconds, rounded off to two decimal places) for the receiver to completely receive a packet of 1000 bytes transmitted by the sender is _______.

[GATE-2022, 2-Marks]

Solution:-

Packet Size = 1000 bytes = $8 * 10^3$ bits

Bandwidth = 100 Mbps = 10^8 bits / sec

$$t_x = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{8 * 10^3 \text{ bits}}{10^8 \text{ bits / sec}} = 0.08 \text{ ms}$$

$$= \frac{8 * 10^3 \text{ bits}}{10^5 * 10^3 \text{ bits/sec}} = \frac{8}{100} * 10^{-3} \text{ sec}$$

Distance = 2100 Km = $21 * 10^5$ m

Signal Speed = 3×10^8 m/s

$$t_p = \frac{\text{Distance}}{\text{Signal Speed}} = \frac{21 * 10^5 \text{ m}}{3 \times 10^8 \text{ m/s}} = 7 \text{ ms}$$

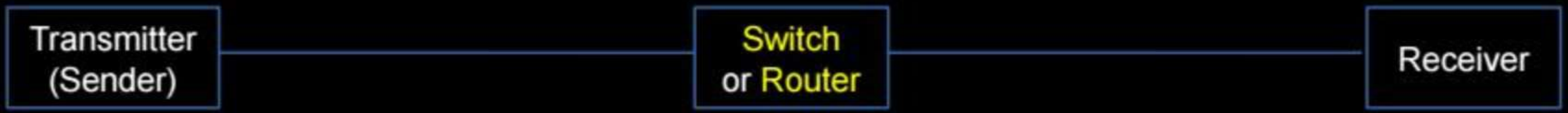
End-to-end delay = $(t_x + t_p)$

= 7.08 ms

Topic : Store and Forward Device

→ Layer-2 or Layer-3 device

→ Switch or Router

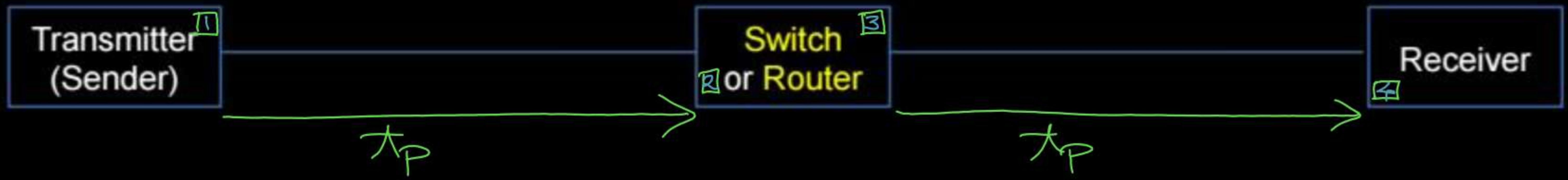


Topic : Store and Forward Device

→ Store and Forward device
[Store, Process and Forward]

Store and Forward delay = Queuing delay at device + Processing delay by device
+ Transmission delay

Topic : End-to-End Delay



→ Suppose each link have same bandwidth and same propagation delay

→ Time required for a packet to be transmitted from Transmitter to Receiver

End-to-end delay = (Transmission delay + Propagation delay)
+ (Queuing delay at device + Processing delay by device)
+ (Transmission delay + Propagation delay)

Example 5 :-

Consider two hosts A and B are connected through one intermediate switch (switch takes negligible processing delay). Suppose each link bandwidth is 1 Kbps and each link propagation delay is 200 milliseconds. Calculate amount of time required (in milliseconds) to transmit one 10 byte packet from hosts A to B?

Solution:-

Packet Size = 10 bytes = 80 bits

Bandwidth = 1 Kbps = 10^3 bits / sec

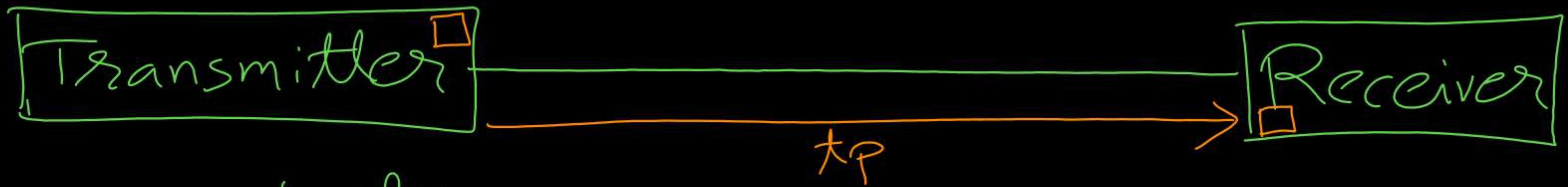
$$t_x = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{80 \text{ bits}}{10^3 \text{ bits / sec}} = 80 \text{ ms}$$

$$t_p = 200 \text{ ms}$$

$$\text{End-to-end delay} = (t_x + t_p) + (t_x + t_p) = (80+200)+(80+200) \text{ ms}$$

$$= 560 \text{ ms}$$

$$\boxed{\text{Ans} = 560}$$



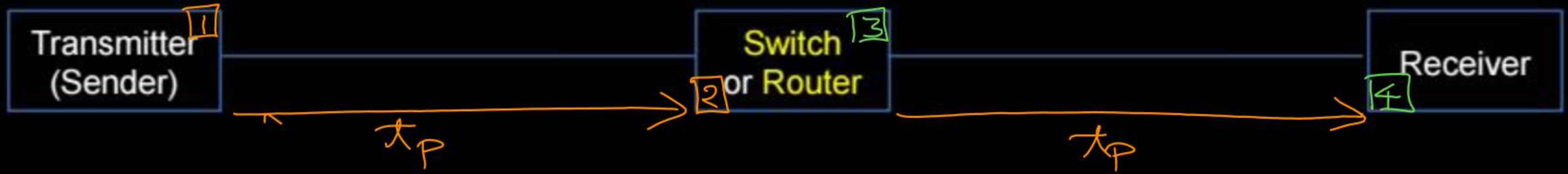
one packet :-

End to End delay $= (t_x + t_p)$

For N packet :-

End-to-End delay $= (N * t_x) + t_p$

Topic : End-to-End Delay



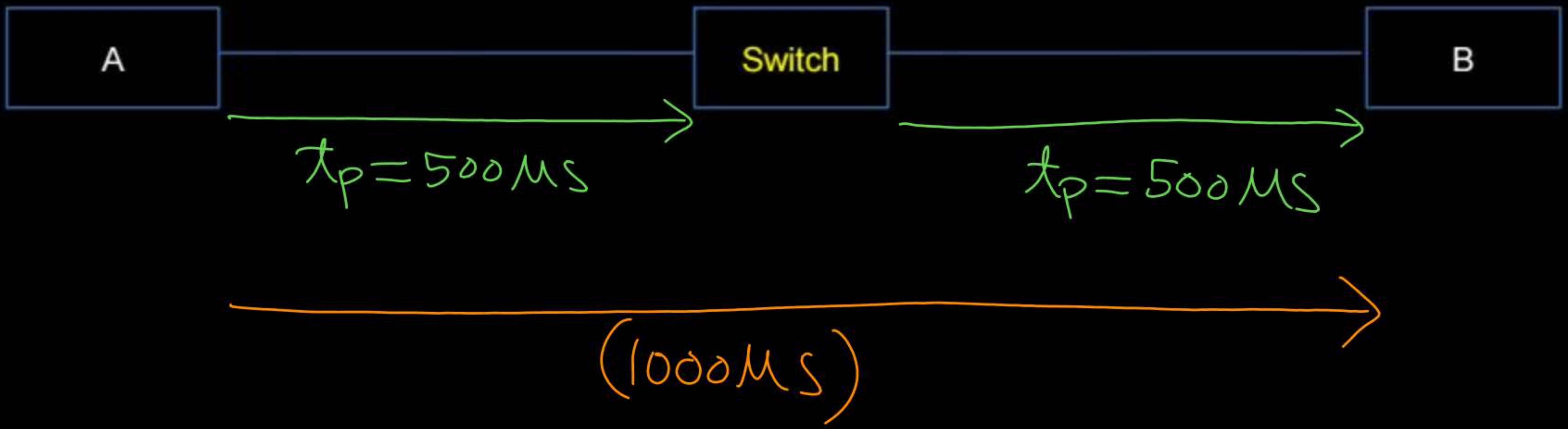
→ Suppose each link have same bandwidth and same propagation delay

→ Time required for N packet to be transmitted from Transmitter to Receiver

End-to-end delay = (N * Transmission delay) + Propagation delay
+ (Queuing delay at device + Processing delay by device)
+ (Transmission delay + Propagation delay)

Example 6 :-

Consider two hosts A and B are connected through one intermediate switch (switch takes negligible processing delay). Suppose packet size is 20 bytes, each link bandwidth is 2 Mbps and each link propagation delay is 500 microseconds. Calculate amount of time required (in microseconds) to transmit a file of 100 bytes from hosts A to B?



Solution:-

Packet Size = 20 bytes = 160 bits

Bandwidth = 2 Mbps = $2 * 10^6$ bits / sec

$$t_x = \frac{\text{Packet Size}}{\text{Bandwidth}} = \frac{160 \text{ bits}}{2 * 10^6 \text{ bits / sec}} = 80\ \mu s = \frac{160}{2} * 10^{-6} \text{ sec}$$

t_p = 500 μs

File Size = 100 bytes

Packet Size = 20 bytes

$$\boxed{\text{Number of packets } (N) = \frac{\text{File Size}}{\text{Packet Size}}} = \frac{100 \text{ bytes}}{20 \text{ bytes}} = 5$$

$$\underbrace{\text{End-to-end delay}} = (N * t_x + t_p) + \underbrace{(t_x + t_p)} = (5 * 80 + 500) + (80 + 500)\ \mu s$$

$$= \underbrace{1480\ \mu s}$$

#Q. Two hosts are connected via a packet switch with 10^7 bits per second links. Each link has a propagation delay of 20 microseconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 10000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last bit of the data in microseconds is _______.

[GATE 2015]

IIT-K

H.W.

#Q. Consider a source computer (S) transmitting a file of size 10^6 bits to a destination computer (D) over a network of two routers (R1 and R2) and three links (L1, L2, and L3). L1 connects S to R1; L2 connects R1 to R2; and L3 connects R2 to D. Let each link be of length 100 km. Assume signals travel over each link at a speed of 10^8 meters per second. Assume that the link bandwidth on each link is 1Mbps. Let the file be broken down into 1000 packets each of size 1000 bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D.

[GATE 2012]

IIT-D

H.W.

(A) 1005 ms

(B) 1010 ms

(C) 3000 ms

(D) 3003 ms

#Q. Consider a network path P—Q—R between nodes P and R via router Q. Node P sends a file of size 10^6 bytes to R via this path by splitting the file into chunks of 10^3 bytes each. Node P sends these chunks one after the other without any wait time between the successive chunk transmissions. Assume that the size of extra headers added to these chunks is negligible, and that the chunk size is less than the MTU.

Each of the links P—Q and Q—R has a bandwidth of 10^6 bits/sec, and negligible propagation latency. Router Q immediately transmits every packet it receives from P to R, with negligible processing and queueing delays. Router Q can simultaneously receive on link P—Q and transmit on link Q—R.

Assume P starts transmitting the chunks at time $t = 0$. Which one of the following options gives the time (in seconds, rounded off to 3 decimal places) at which R receives all the chunks of the file?

[GATE 2024]

H.W.
IISC

(A) 8.000 (B) 8.008 (C) 15.992 (D) 16.000

2 mins Summary

Topic ~~Network Delay~~

Topic End to end Delay

THANK - YOU