CS & IT ENGINEERING

Computer Network

1500 Series

Lecture No.- 03

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Recap of Previous Lecture

Topic One topic

Topic Two topic

Topics to be Covered

Topic Flow control

Topic

[NAT]

#Q. Consider an error-free 64-kbps satellite channel used to send 512-byte data frames in one direction, with very short acknowledgements coming back the other way. What is the maximum throughput(in Kbps) for window sizes of 15. The earth-satellite propagation time is 270 msec. Ans: 64

$B = 64 * 10^3$ bits/sec

$P_d = 270$ msec

Frame size = 512 Byte

= 512 * 8 bits

$$T_d(\text{Frame}) = \frac{\text{Frame size}}{\text{Bandwidth}} = \frac{\overset{64}{\cancel{512}} * \cancel{8} \,\cancel{\text{bits}}}{\underset{8}{\cancel{64}} * 10^3 \,\cancel{\text{bits}}/\text{sec}} = 64 * 10^{-3} \text{ sec} = 64 \text{ msec}$$

$$\text{Throughput} = \frac{W_s * \text{Framesize}}{\text{Total time}}$$

$$= \frac{15 \times 512 * 8 \text{ bits}}{T_d(F) + 2 * P_d + \cancel{Q_d}_{0} + \cancel{P_{rd}}_{0} + \cancel{T_d(A)}_{0}}$$

$$= \frac{15 * 512 * 8 \text{ bits}}{64 \text{ msec} + 2 * 270 \text{ msec}}$$

$$= \frac{15 * 512 * 8 \text{ bits}}{604 * 10^{-3} \text{ sec}}$$

$$= 101.71 * 10^{3} \text{ bits/sec}$$

$$= 101.71 \text{ KbPs}$$

Throughput can not greater than Bandwidth so

maximum throughput = 64 KbPs

$$\text{Throughput} = \eta * B$$

$$\text{Throughput} = 1 * B$$

$$\boxed{\text{Throughput} = B}$$

$$\eta = \frac{\text{useful time}}{\text{total time}}$$

$$1 = \frac{W_s * T_d(F)}{T_d(F) + 2 * P_d}$$

$$\frac{1}{1} = \frac{W_s * 64}{64 + 2 * 270}$$

$$W_s = \frac{604}{64}$$

$$W_s = 9.43 \simeq \underline{\underline{10}}$$

[MSQ]

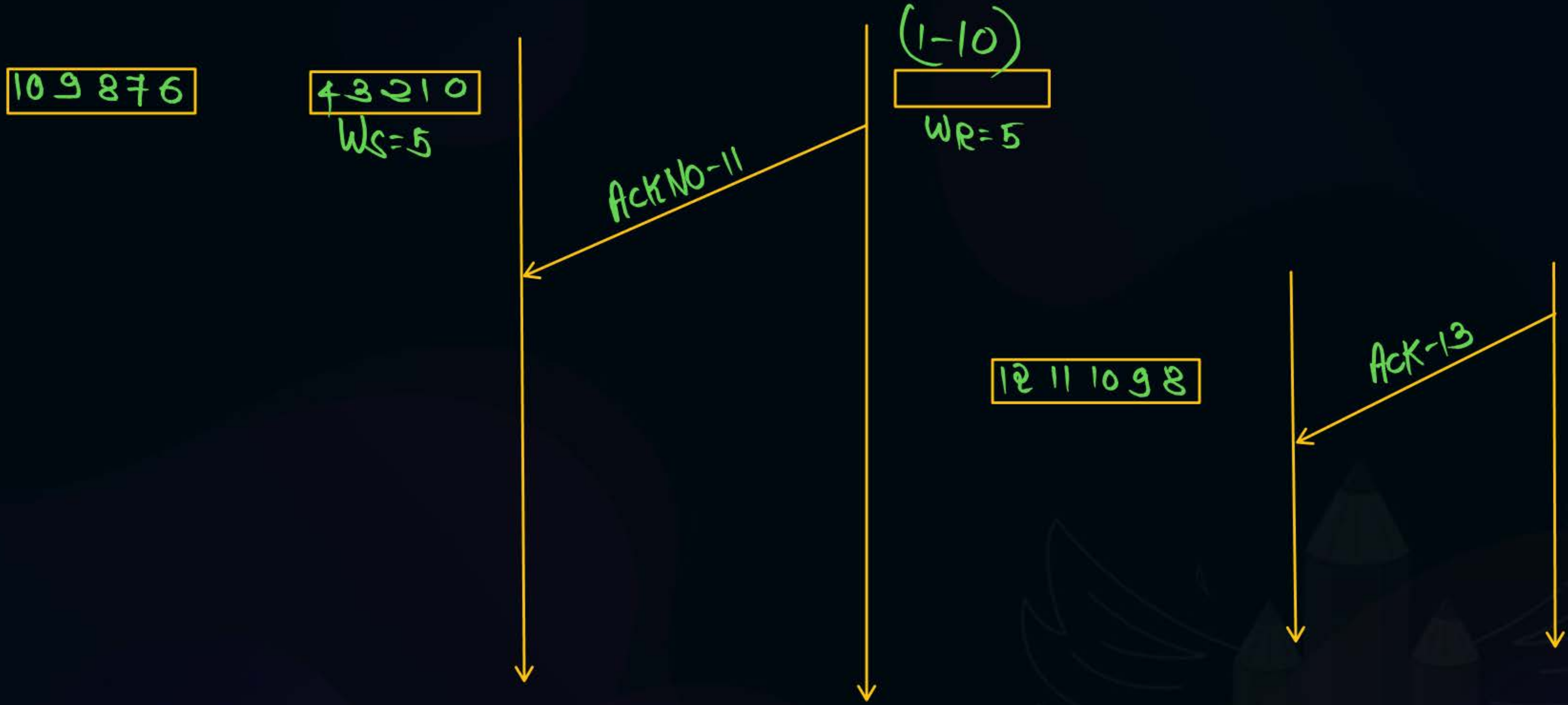
#Q. In a sliding window protocol with RWS = SWS =5, a very large set of possible sequence numbers (assume no wrapping), and in-order packet arrivals,) ~~In a sliding window protocol with RWS = SWS =5, a very large set of possible sequence numbers (assume no wrapping~~), and in-order packet arrivals, which of the following scenario is possible?

A. The receiver can receive, frame number 5 if currently expecting frame is 11.

B. The receiver can receive, frame number 6 if currently expecting frame is 11.

C. The receiver can receive, frame number 7, if currently expecting frame is 13.

D. The receiver can receive, frame number 8, if currently expecting frame is 13



10 9 8 7 6
4 3 2 1 0
Ws=5
(1-10)
WR=5
AckNo-11
12 11 10 9 8
Ack-13

[MCQ]

#Q. The distance from earth to a distant planet is approximately 9×10^{10}m. What is the channel utilization if a stop -and-wait protocol is used for frame transmission on a 64 Mbps point-to-point link?

Assume that the frame size is 32KB and the speed of light is 3×10^{8} m/sec. Calculate the efficiency in percentage.

A. 6.8266×10^{-6}

B. 5.8266×10^{-6}

C. 4.8266×10^{-6}

D. 6.8266×10^{-4}

$d = 9 * 10^{10}$ m

$B = 64 * 10^{6}$ bits/sec

Frame size = 32KB = 32 * 1024 * 8 bits

$v = 3 * 10^{8}$ m/sec

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

$$P_d = \frac{\cancel{9}^{3} * \cancel{10^{10}}\ \cancel{m}}{\cancel{3} * \cancel{10^{8}}\ \cancel{m}/sec}$$

$$P_d = 3 * 10^2 sec$$

$$P_d = 300 sec$$

$$T_d(F) = \frac{\text{Framesize}}{\text{Bandwidth}}$$

$$= \frac{\cancel{32} * 1024 * \cancel{8}^{4}\ \cancel{bits}}{\cancel{64} * 10^6\ \cancel{bits}/sec}$$

$$\cancel{2}$$

$$= 4096 * 10^{-6} sec$$

$$= 0.004096 sec$$

$$\eta = \frac{\text{Usefultime}}{\text{totaltime}}$$

$$\eta = \frac{T_d(F)}{T_d(F) + 2 * P_d}$$

$$\eta = \frac{0.004096}{0.004096 + 2 * 300}$$

$$\eta = \frac{0.004096\ \cancel{sec}}{600.004096\ \cancel{sec}}$$

$$\eta = 6.8266 * 10^{-6}$$

$$\eta = 6.8266 * 10^{-4} \%$$

[NAT]

(in Kbps)

#Q. What is the throughput of the system if it uses the Stop-and-Wait ARQ protocol for transmitting 1000 bytes frame with the bit rate of 40 Kbps. However the receiver can transmit 100 bytes acknowledgment with the rate of 8 Kbps. The system experience propagation delay of 50 milliseconds?

Frame size = 1000 Byte = 8000 bits

B = 40 Kbps

$$T_d(F) = \frac{\text{Frame size}}{\text{Bandwidth}}$$

$$= \frac{800\cancel{0} \text{ bits}}{4\cancel{0} * 10^3 \cancel{\text{bits}}/\text{sec}}$$

$$= 200 * 10^{-3} \text{sec} = 200 \text{msec}$$

Ack size = 100 Byte = 800 bits

B = 8 Kbps = $8 * 10^3$ bits/sec

$$T_d(A) = \frac{\text{Ack size}}{\text{Bandwidth}} = \frac{\cancel{800} \text{ bits}}{\cancel{8} * 10^3 \cancel{\text{bits}}/\text{sec}}$$

$$= 100 * 10^{-3} \text{sec} = 100 \text{ msec}$$

P_d = 50 msec

$$\text{Throughput} = \frac{\text{Frame size}}{\text{Total time}}$$

$$= \frac{8000 \text{ bits}}{T_d(F) + 2 \times P_d + \cancel{Q_d}^{\,0} + \cancel{P_{od}}^{\,0} + T_d(A)}$$

$$= \frac{8000 \text{ bits}}{200 + 2 \times 50 + 100 \text{ msec}}$$

$$= \frac{\cancel{8000} \text{ bits}}{\cancel{400} \times 10^{-3} \text{ sec}}$$

$$= 20 \times 10^{3} \text{ bits/sec}$$

$$= \underline{\underline{20 \text{ Kbps}}}$$

[NAT]

#Q. Suppose you are designing a sliding window protocol for a 1-Mbps point-to-point link to the stationary satellite revolving around the Earth at an altitude of 3×10^4 km. Assuming that each frame carries 1 KB of data, what is the minimum number of bits you need for the sequence number in the following cases?

Assume the speed of light is 3×10^8 m/s.

(a) RWS = 1 (GB-N)

(b) RWS = SWS (SR)

$B = 10^6$ bits/sec

$d = 3 * 10^4$ km

Framesize = 1 KB = 1024 Byte
= 8 * 1024 bits
= 8192 bits

$v = 3 * 10^8$ m/sec $= 3 * 10^5$ km/sec

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

$$P_d = \frac{\cancel{3} * 10^{\cancel{4}}\ km}{\cancel{3} * 10^{\cancel{5}}\ \cancel{km}/sec}$$

$$P_d = 0.1\ sec$$

$$T_d(F) = \frac{\text{Frame size}}{\text{Bandwidth}}$$

$$= \frac{8192\ \cancel{bits}}{10^6\ \cancel{bits}/sec}$$

$$= 8192 * 10^{-6}\ sec$$

$$= 0.008192$$

$$\eta = \frac{\text{useful time}}{\text{total time}}$$

$$1 = \frac{N * T_d(F)}{T_d(F) + 2 * P_d}$$

$$N = 25$$

$$= \frac{25 * 0.008192}{0.008192 + 2 * 0.1}$$

$$= 0.99$$

$$N = \frac{T_d(F) + 2 * P_d}{T_d(F)}$$

$$N = \frac{0.008192 + 2 * 0.1}{0.008192}$$

$$N = \lceil 25.41 \rceil = 26$$

minimum sequence No. required in GBN = $N+1$ (If N is window sender size)

$= 26+1 = 27$

$27 = 2^K$

$2^5 = 2^K$

$\boxed{K = 5 \text{ bit}}$

minimum seq. No. required in SR = $N+N = 2N = 2*26 = 52$

$2^K = 52$

$2^K = 2^6$

$\boxed{K = 6 \text{ bit}}$

[NAT]

#Q. A 3000 km long trunk is used to transmit frames using Go-Back-N protocol. The propagation speed is 6 microsec/km and trunk data rate are 1.544 Mbps. The ack time is not considered. Frame size of 64 bytes. What is the maximum number of bits of sequence number also calculate the maximum window size at the sender size if 100% need to be achieved?

$d = 3000\,km$

Propagation time For 1 km = $6\,\mu sec$

Propagation time For 3000 km = $3000 * 6\,\mu sec$

$= 18000\,\mu sec$

$= 18000 * 10^{-6}\,sec$

$= 18 * 10^{-3}\,sec = 18\,msec$

$B = 1.544 * 10^{6}$ bits/sec

Frame size $= 64 * 8$ bits

$= 512$ bits

$$T_d(F) = \frac{512\text{ bits}}{1.544 * 10^{6}\text{ bits/sec}}$$

$= 331.6 \times 10^{-6}\,sec$

$= .33 * 10^{-3}\,sec = .33\,msec$

$$\eta = \frac{\text{useful time}}{\text{total time}}$$

$$1 = \frac{N * T_d(F)}{T_d(F) + 2 * P_d}$$

$$N = \frac{T_d(F) + 2 * P_d}{T_d(F)}$$

$$N = \frac{.33 + 2 * 18}{.33}$$

$$N = \frac{36.33}{.33}$$

$$N = 110.09 \simeq 111$$

min sequence No. required in GBN = 111+1 = 112

$$2^K = 112$$

$$2^K = 2^7$$

$$\boxed{K = 7\text{ bit}}$$

[NAT]

#Q. Consider two hosts are connected with direct link having data transfer rate 10 Mbps and signal speed 3 ms per km, distance between them is 10 km and packet size is 5000 Bytes. The sequence number field in frame format is 4 bits long, and go back N ARQ protocol is used for flow control then the maximum amount of time that sender remain Idle (in ms) is __. (4 msec)

$B = 10\text{ mbps} = 10 * 10^6$ bits/sec , $d = 10$ km

Propagation time for 1 km = 3 msec

Propagation time for 10 km = 10 * 3 msec = 30 msec

Packet size = 5000 Byte
= 40,000 bits

$$T_d(F) = \frac{\cancel{40},000 \text{ bits}}{\cancel{10} * 10^6 \text{ bits/sec}}$$

$= 4 * 10^{-3}$ sec = 4 msec

GBN

SeqNo = K bit, K = 4 bit

W_S	W_R
$2^K - 1$	1
$2^4 - 1$	1
15	1

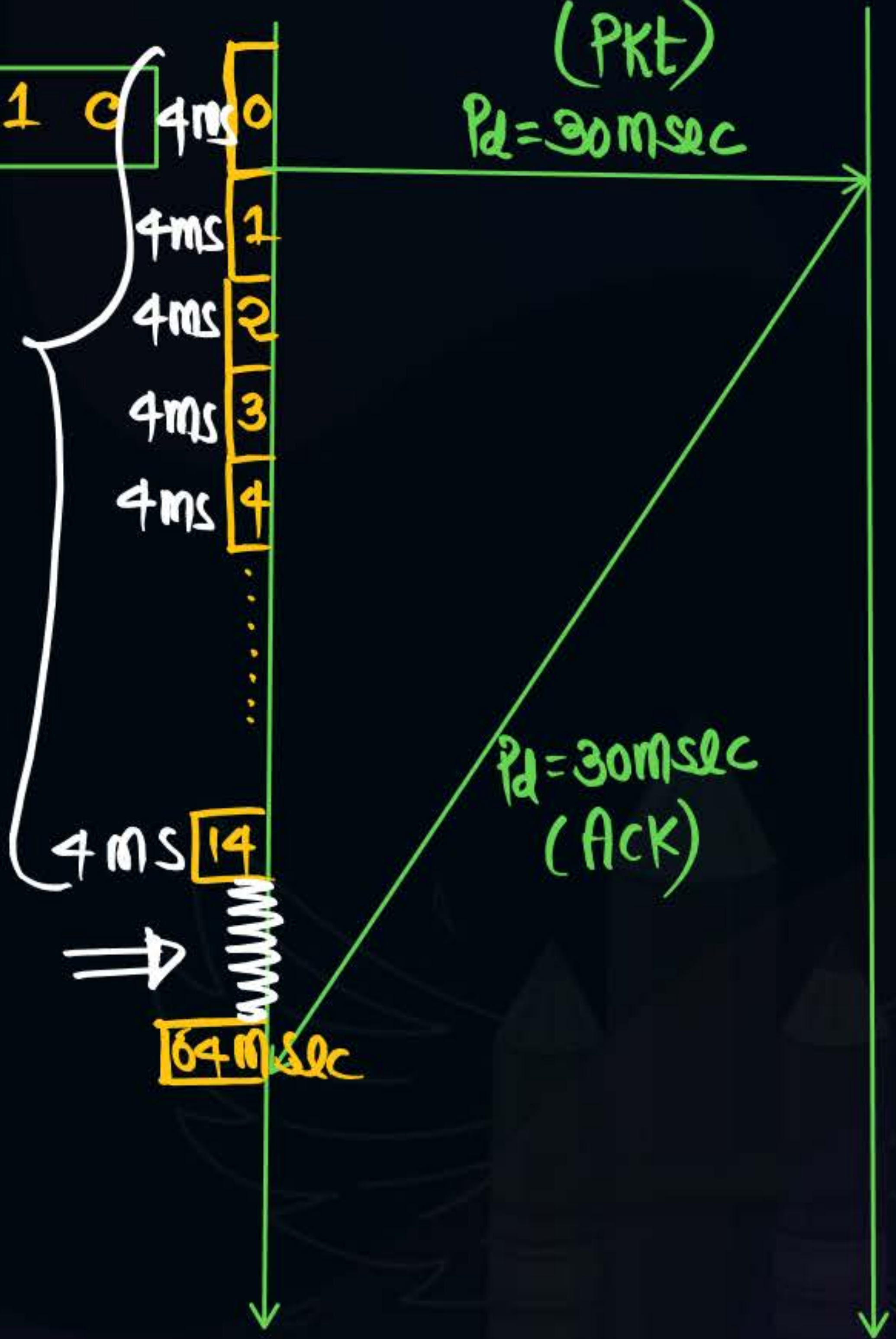
N

14 ..... 6 5 4 3 2 1 0

$W_S = 15$

$15 * 4\text{msec}$
$= 60\text{msec}$

Waiting time ⇒
= 4msec



maximum Amount of time sender Remain idle = Total time − useful time

$= T_d(F) + 2 * P_d - N * T_d$

$= 4\,msec + 2 * 30 - 15 * 4\,msec$

$= 64\,msec - 60\,msec$

$= 4\,msec$

[NAT]

#Q. In selective repeat ARQ, packet size is 2000 bytes transmission time for one packet is 1ms. If distance between hosts is 10 km and signal speed is 4ms per km. (4ms/km) and frame sequence number is 6 bits long in frame format then the throughput (in Mbps) is______. (up to two decimal places)

$\boxed{\text{H.W}}$

$$\frac{T_d}{1} = \frac{L}{B}$$

Ans: 6.32mbPs

[MCQ]

#Q. A 100 km long cable runs at the 10Mbps data rate. The propagation speed in the cable is 2/3 the speed of light in vacuum. How many bits fit in the cable?

A) 50,000 bits

B) 5,000 bits

C) 25, 000 bits

D) 2, 500 bits

$d = 100 km$

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

$v = \frac{2}{\cancel{3}} * \cancel{3} * 10^8$ m/sec $= 2 * 10^8$ m/sec $= 2 * 10^5$ Km/sec

$P_d = \frac{d}{v} = \frac{100 \text{ KM}}{2 * 10^5 \text{ Km/sec}} = 50 * 10^{-5}$ sec

Capacity of Link $= B * P_d = 10 * \cancel{10^6}$ bits/$\cancel{sec}$ $* 50 * \cancel{10^{-5}}$ $\cancel{sec}$

$= 10 * 10 * 50 = 5000$ bits

2 mins Summary

Topic One

Topic Two

Topic Three

Topic Four

Topic Five

Flow control

THANK - YOU