CS & IT ENGINEERING

COMPUTER NETWORKS

Flow Control

Lecture No-4

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TOPICS TO BE COVERED

- Stop and wait Protocol

Q.5 The values of parameters for the Stop-and-Wait ARQ protocol are as given below:

Bit rate of the transmission channel = 1 Mbps. Propagation delay from sender to receiver = 0.75 ms.

Time to process a frame = 0.25 ms.

Number of bytes in the information frame = 1980. (Payload)

Number of overhead bytes in the information frame = 20. (H)

(Header) Number of bytes in the acknowledge frame = 20.

Assume that there are no transmission errors. Then, the transmission efficiency (expressed in percentage) of the Stop-and-Wait ARQ protocol for the above parameters is ______ . (correct to 2 decimal places).

GATE 2017 (2m)

$B = 1\,\text{mbps} = 10^6\ \text{bits/sec}$

$T_d = 0.75\ \text{msec}$

$P_rd = 0.25\ \text{msec}$

Frame size = data + Header

$= 1980 + 20$

$= 2000\ \text{Byte}$

$= 16{,}000\ \text{bits}$

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

$$= \frac{16000\ \text{bits}}{10^6\ \text{bits/sec}}$$

$= 16 * 10^{-3}\ \text{sec} = 16\ \text{msec}$

Ack size = 20 Byte

$= 160\ \text{bits}$

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

$$= \frac{160\ \text{bits}}{10^6\ \text{bits/sec}}$$

$= 160 * 10^{-6}\ \text{sec}$

$= 0.16 * 10^{-3}\ \text{sec}$

$= 0.16\ \text{msec}$

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

$$= \frac{T_d(\text{frame})}{T_d(\text{frame}) + 2 * P_d + \underset{0}{\cancel{Q_d}} + P_{rd} + T_d(\text{Ack})}$$

$$= \frac{16}{16 + 2 * 0.75 + 0.25 + 0.16}$$

$$= \frac{16}{17.91} = 0.8933$$

$$\boxed{\eta = 89.33\%}$$

Q.6 A link has a transmission speed of 10^6 bits/sec. It uses data packets of size 1000 bytes each. Assume that the acknowledgement has negligible transmission delay, and that its propagation delay is the same as the data propagation delay. Also assume that the processing delays at nodes are negligible. The efficiency of the stop-and-wait protocol in this setup is exactly 25%. The value of the one-way propagation delay(in milliseconds) is ____.

GATE 2015 (2m)

$B = 10^6$ bits/sec

data pkt size or Frame size = 1000 Byte
= 8000 bit

$\eta = 25\% = \frac{1}{4}$

$T_d(\text{Frame}) = \frac{\text{Frame size}}{\text{Bandwidth}} = \frac{8000 \text{ bits}}{10^6 \text{ bits/sec}}$

$= 8 * 10^{-3}$ sec $= 8$ msec

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

$$\frac{1}{4} = \frac{T_d(\text{frame})}{T_d(\text{frame}) + 2 * P_d + \underbrace{\cancel{Q_d}}_{0} + \underbrace{\cancel{P_c}}_{0} + T_d(\underbrace{\cancel{Ack}}_{0})}$$

$$\frac{1}{4} = \frac{8}{8 + 2 * P_d}$$

$$8 + 2 * P_d = 32$$

$$2 * P_d = 32 - 8$$

$$2 * P_d = 24 \text{ msec}$$

$$P_d = \frac{24}{2} \text{ msec}$$

$$\boxed{P_d = 12 \text{ msec}}$$

Q.7 Suppose that the stop-and-wait protocol is used on a link with a bit rate of 64 kilobits per second and 20 milliseconds propagation delay. Assume that the transmission time for the acknowledgment and the processing time at nodes are negligible. Then the minimum frame size in bytes to achieve a link utilization of at least 50% is ___.

GATE CS 2015

$B = 64 * 10^3$ bits/sec , $P_d = 20$ msec , Frame size(L) = ?

efficiency $\geq 50\%$ $\left(\frac{1}{2}\right)$

(A) 160

(B) 320

(C) 640

(D) 220

efficiency $\geq \frac{1}{2}$

$$\frac{\text{useful time}}{\text{total time}} \geq \frac{1}{2}$$

$$\frac{T_d(\text{frame})}{T_d(\text{frame}) + 2*P_d + \cancel{Q_d}_{0} + \cancel{P_{rd}}_{0} + \cancel{T_d(Ack)}_{0}} \geq \frac{1}{2}$$

$$\frac{T_d}{T_d + 2*P_d} \geq \frac{1}{2}$$

$$2*T_d \geq T_d + 2*P_d$$

$$T_d \geq 2*P_d$$

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

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

$$L \geq 2*20*\cancel{10^{-3}}\,\cancel{\text{sec}}*64*\cancel{10^{3}}\,\text{bits}/\cancel{\text{sec}}$$

$$L \geq 40*64 \text{ bits}$$

$$L \geq \frac{40*\cancel{64}^{8}}{\cancel{8}} \text{ Byte}$$

$$\boxed{L \geq 320 \text{ Byte}}$$

$\downarrow$
Frame size

Q.8

A channel has a bit rate of 4 kbps and one-way propagation delay of 20 ms.

The channel uses stop and wait protocol. The transmission time of the acknowledgement frame is negligible. To get a channel efficiency of at least 50%, the minimum frame size should be

GATE-2005 (2m)

$B = 4 \times 10^3$ bits/sec , $\eta \geq 50\%$

$P_d = 20$ msec

(A) 80 Byte

(B) 80 bits

(C) 160 bits

(D) 160 Byte

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

$$L \geq 2 * 20 * \cancel{10^{-3}}\ \cancel{sec} * 4 * \cancel{10^{3}}\ bits/\cancel{sec}$$

$$\boxed{L \geq 160\ bits}$$

Q.9 On a wireless link, the probability of packet error is 0.2. A stop-and-wait protocol is used to transfer data across the link. The channel condition is assumed to be independent from transmission to transmission. What is the average number of transmission attempts required to transfer 100 packets?

GATE 2015 (2m)

$P = 0.2$

$$\text{Total transmission} = \frac{n}{1-P} = \frac{100}{1-0.2}$$

$$= \frac{1000}{0.8}$$

$$= \frac{1000}{8} = 125$$

(A) 100

(B) 125 ✓

(C) 150

(D) 200

Q.10 A channel has a bit rate of 4Kbps and one way propagation delay of 10ms. The channel uses stop & wait protocol. The transmission time of acknowledgement frame is negligible. To get a channel efficiency of atleast 75% the minimum frame size should be

$B = 4 * 10^3$ bits/sec

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

efficiency $\geq 75\% \left(\frac{3}{4}\right)$

min Frame size = ?

(A) 240 Byte

(B) 240 bits

(C) 480 bits

(D) None

$$\text{efficiency} \geq \frac{3}{4}$$

$$\frac{\text{useful time}}{\text{total time}} \geq \frac{3}{4}$$

$$\frac{T_d(\text{frame})}{T_d(\text{frame}) + 2*P_d + \cancel{Q_d} + \cancel{P_{rd}} + \cancel{T_d(\text{ack})}} \geq \frac{3}{4}$$

$$0 \qquad 0 \qquad 0$$

$$\frac{T_d(\text{Frame})}{T_d(\text{frame}) + 2*P_d} \geq \frac{3}{4}$$

$$4 \times T_d(\text{Frame}) \geq 3*T_d(\text{Frame}) + 6*P_d$$

$$T_d(\text{Frame}) \geq 6*P_d$$

$$\frac{\text{Frame size}}{\text{Bandwidth}} \geq 6*P_d$$

$$\text{Frame size} \geq 6*P_d*\text{Bandwidth}$$

$$\text{Frame size} \geq 6*10*10^{-3}\,\cancel{\text{sec}}*4*10^{3}\,\text{bits}/\cancel{\text{sec}}$$

$$\boxed{\text{Frame size} \geq 240\,\text{bits}}$$

Q.11 Consider a wireless link ,where the error probability is 0.6 to transfer data across the link stop & wait protocol is used .the channel condition is assumed to be independent from transmission to transmission. The average number of transmission attempts to transfer x packet is 500. the value of x is _____.

Avg. No. of transmission for 'n' Pkts $= \frac{n}{1-P}$

Avg. No of transmission for 'x' Pkts $= \frac{x}{1-P}$

$$500 = \frac{x}{1-0.6}$$

$$\frac{500}{1} = \frac{x}{0.4}$$

$$x = 500 * 0.4$$

$$\boxed{x = 200}$$

Q.12 Consider stop and wait ARQ for flow control, data transfer rate of channel is 32 Kbps, one way end to end propagation delay is 16 ms and frame size is 32 Bytes then the efficiency in percentage is <u>20</u>.

$B = 32\,Kbps$

$B = 32 * 10^3$ bits/sec

$P_d = 16$ msec

Frame size $= 32$ Byte

$= 32 * 8$ bit

$= 256$ bit

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

$$= \frac{\cancel{32} * 8 \text{ bits}}{\cancel{32} * 10^3 \cancel{\text{bits}}/\text{sec}}$$

$$= 8 * 10^{-3} \text{ sec} = 8 \text{ msec}$$

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

$$= \frac{T_d(\text{Frame})}{T_d(\text{frame}) + 2 * P_d + \underbrace{\cancel{Q_d}}_{0} + \underbrace{\cancel{P_{cd}}}_{0} + \underbrace{\cancel{T_d(\text{ack})}}_{0}}$$

$$= \frac{8}{8 + 2 * 16}$$

$$= \frac{\cancel{8}}{\cancel{40}} = \frac{1}{5}$$

$$\boxed{\text{efficiency} = 20\%}$$

Q.13

Consider packet size is 1000 Bytes, distance between two hosts is 2000 KM, 1 Mbps link with $2*10^8$ meter/sec signal speed, if stop and wait protocol is used then the throughput is ____ (in Mbps).

Packet size or Frame size = 1000 Byte

= 8000 bits

, $d = 2000$ km

$v = 2*10^8$ m/sec

$v = 2*10^5$ km/sec

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

$$T_d(\text{frame}) = \frac{\text{Frame size}}{\text{Bandwidth}} = \frac{8000 \text{ bits}}{10^6 \text{ bits/sec}} = 8*10^{-3} \text{ sec} = 8 \text{ msec}$$

$$P_d = \frac{d}{v} = \frac{2000 \text{ km}}{2*10^5 \text{ km/sec}} = 10*10^{-3} \text{ sec} = 10 \text{ msec}$$

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

$$= \frac{T_d(\text{frame})}{T_d(\text{frame}) + 2 * P_d + \underbrace{\cancel{Q_d}}_{\approx 0} + \underbrace{\cancel{Q_d}}_{\approx 0} + \underbrace{\cancel{P_d}}_{\approx 0}}$$

$$= \frac{8}{8 + 2 * 10} = \frac{8}{28}$$

$$\text{Throughput} = \text{efficiency} * \text{Bandwidth}$$

$$= \frac{8}{28} * 1\,\text{Mbps}$$

$$\text{throughput} = 0.285\,\text{Mbps}$$

OR

$$\text{Throughput} = \frac{\text{Length of Frame}}{\text{total time}}$$

$$= \frac{8000\text{ bits}}{28\text{ msec}}$$

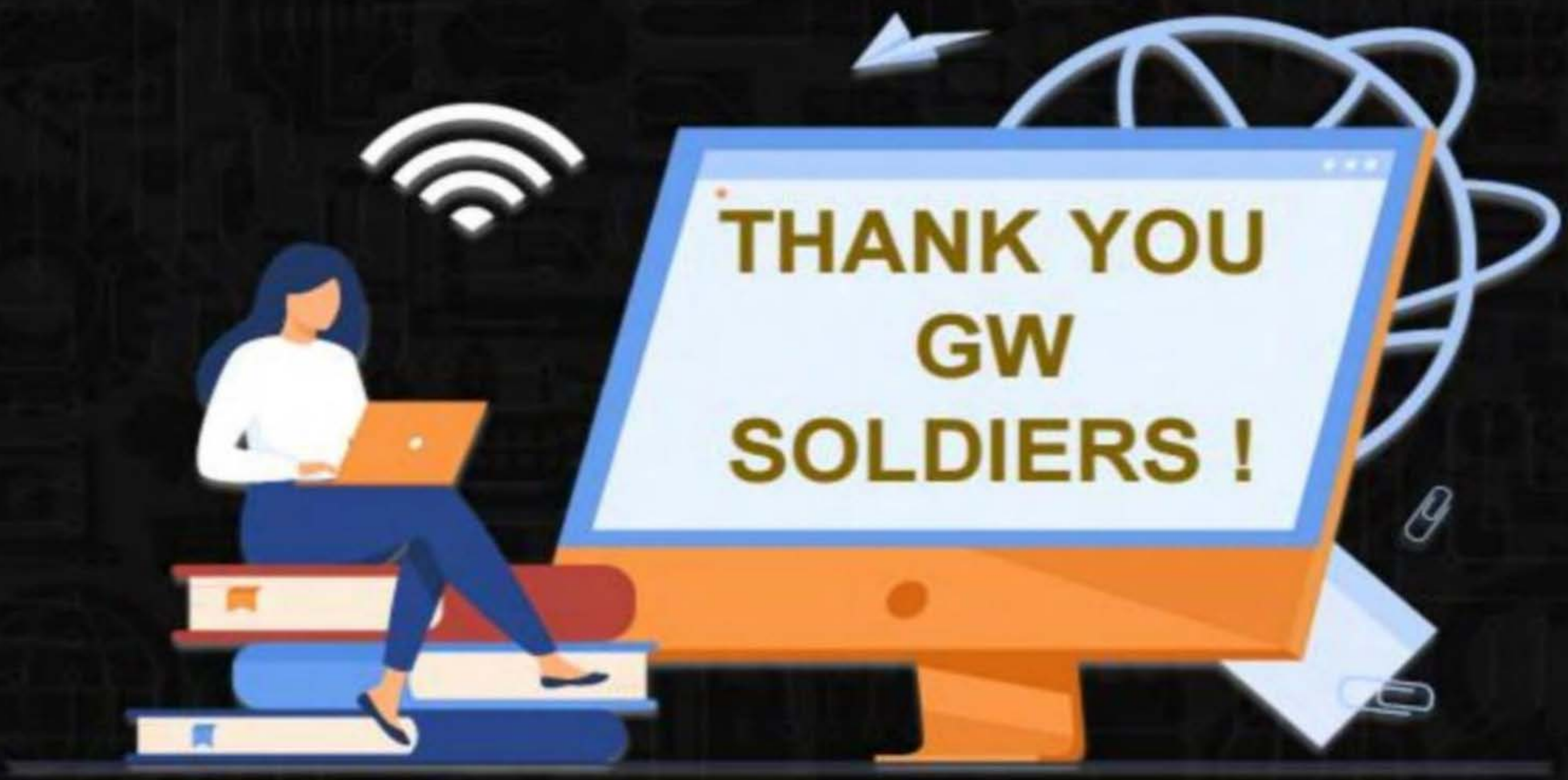
$$= \frac{8000\text{ bits}}{28 * 10^{-3}\text{ sec}}$$

$$= \frac{8 * 10^{3+3}}{28}$$

$$= \frac{8}{28} * 10^{6}\text{ bits/sec}$$

$$= 0.285 * 1\,\text{Mbps}$$

$$= 0.285\,\text{Mbps}$$


THANK YOU
GW
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