

CS & IT ENGINEERING

COMPUTER NETWORKS

Flow Control


Lecture No-4



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A stylized laptop with a blue screen and an orange base. The screen displays the text 'TOPICS TO BE COVERED'.

TOPICS TO
BE
COVERED

A dotted orange arrow pointing from the laptop screen to the 'Stop and wait Protocol' box.

**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.
(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



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

$$P_d = 0.75 \text{ msec}$$

$$P_{rd} = 0.25 \text{ msec}$$

$$\begin{aligned} \text{Frame size} &= \text{Data} + \text{Header} \\ &= 1980\text{B} + 20\text{B} \\ &= 2000\text{Byte} \\ &= 16,000 \text{ bits} \end{aligned}$$

$$\begin{aligned} T_d(\text{Frame}) &= \frac{\text{Frame size}}{\text{Bandwidth}} \\ &= \frac{16,000 \text{ bits}}{10^6 \text{ bits/sec}} \\ &= 16 \times 10^{-3} \text{ sec} = 16 \text{ msec} \end{aligned}$$

$$\begin{aligned} \text{Ack size} &= 20 \text{ Byte} \\ &= 160 \text{ bits} \end{aligned}$$

$$\begin{aligned} T_d(\text{Ack}) &= \frac{\text{Ack size}}{\text{Bandwidth}} \\ &= \frac{160 \text{ bits}}{10^6 \text{ bits/sec}} \\ &= 160 \times 10^{-6} \text{ sec} \\ &= 16 \times 10^{-3} \\ &= 16 \text{ msec} \end{aligned}$$

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

$$= \frac{T_d(F)}{T_d(F) + 2 \times P_d + \cancel{Q_d} + P_d + T_d(A)}$$

$$= \frac{16 \text{ msec}}{16 \text{ msec} + 2 \times 0.75 \text{ msec} + 0.25 \text{ msec} + 0.16 \text{ msec}}$$

$$= \frac{16 \text{ msec}}{17.91 \text{ msec}}$$

$$= 0.8933$$

$$\eta = 89.33\%$$

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

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

$$\text{Packet size or Frame size} = 1000 \text{ Byte} = 8000 \text{ bits}$$

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

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

$$P_d = ?$$

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

$$\frac{1}{4} = \frac{T_d(F)}{T_d(F) + 2 \times P_d + \cancel{G_d} + \cancel{P_{dA}} + \cancel{T_d(A)}}$$

$$\frac{1}{4} = \frac{8 \text{ msec}}{8 \text{ msec} + 2 \times P_d}$$

$$8 + 2 \times P_d = 32$$

$$2 \times P_d = 32 - 8$$

$$2 \times P_d = 24$$

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

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

$$B = 64 \times 10^3 \text{ bits/sec}, P_d = 20 \text{ msec} = 20 \times 10^{-3} \text{ sec}$$

$$\text{Frame size} = ? \quad \text{efficiency} \geq 50\%$$

- ☐ A 160
- ☒ B 320
- ☐ C 640
- ☐ D 220

$$\eta \geq 50\%$$

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

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

$$\frac{T_d(F)}{T_d(F) + 2 \times P_d + \cancel{P_d} + \cancel{P_d} + \cancel{T_d(H)}} \geq \frac{1}{2}$$

$$\frac{T_d(F)}{T_d(F) + 2 \times P_d} \geq \frac{1}{2}$$

$$2 \times T_d(F) \geq T_d(F) + 2 \times P_d$$

$$T_d(F) \geq 2 \times P_d$$

$$\frac{\text{Frame size}}{\text{Bandwidth}} \geq 2 \times P_d$$

$$\text{Frame size} \geq 2 \times P_d \times B$$

$$\text{Frame size} \geq 2 \times 20 \times 10^3 \text{ sec} \times 64 \times 10^3 \text{ bits/sec}$$

$$\text{Frame size} \geq 2 \times 20 \times 64 \text{ bits}$$

$$\text{Frame size} \geq \frac{2 \times 20 \times 64^8}{8} \text{ Byte}$$

$$\text{Frame size} \geq 320 \text{ Byte}$$



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

$$B = 4 \times 10^3 \text{ bits/sec}, P_d = 20 \text{ msec}, \eta \geq 50\%$$

Frame size = ?

$$\text{Frame size} \geq 2 \times P_d \times B$$

$$\geq 2 \times 20 \times 10^{-3} \text{ sec} \times 4 \times 10^3 \text{ bits/sec}$$

$$\text{Frame size} \geq 160 \text{ bits}$$

- ☐ A 80 Byte
- ☐ B 80 bits
- ☒ C 160 bits
- ☐ D 160 Byte

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?

$$P = 0.2, \eta = 100$$

GATE 2015

$$\text{Avg No. of transmission required} = \frac{\eta}{1-P} = \frac{100}{1-0.2} = \frac{1000}{0.8} = 125$$

- ☒ 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

H.W

$$\eta \geq 75\%$$

$$\eta \geq \frac{3}{4}$$

A

240 Byte

☒ B

240 bits

C

480 bits

D

None

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 _____.

error Probability = 0.6

Avg No. of transmission For 'n' PKT = $\frac{n}{1-p}$

Avg No. of transmission For 'x' PKT = $\frac{x}{1-p}$

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

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

$$x = 500 \times 0.4$$

$$x = 200$$

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 ____.

H.W

Ans: 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).

H.W

Ans: 0.285 Mbps

