Computer Science & Information Technology

Computer Networks

Flow Control

Q1 Consider two hosts are connected directly using point-to-point link. The link bandwidth is 10 Kbps, distance is 5 km, signal propagation speed is 10^5 meter per second and packet size is 200 bits than calculate transmission delay for a packet and one-way propagation delay (in millisecond) ?

(A) 20 and 50

(B) 20 and 500

(C) 200 and 50

(D) 200 and 500

Q2 Consider two hosts S and D are connected directly using point-to-point link. The link bandwidth is 20 Kbps, signal propagation speed is 10^6 meter per second and distance is 40 km. Suppose host S wants to send a data of size 500 bits to host D in one packet. Calculate how much time (in millisecond) it takes to deliver the data completely from S to D?

Q3 Consider two hosts S and D are connected via one packet switch (takes negligible processing delay). Each link bandwidth is 1 Mbps, signal propagation speed is $4 * 10^6$ meter per second and length of each link is 20 km. Suppose host S wants to send a file of size 8000 bytes to host D, by dividing the file into 2000 bits packets. Calculate how much time (in millisecond) it takes to deliver the file completely from S to D ?

Q4 Consider two hosts S and D are connected via two routers over a single path, routers takes negligible processing delay. Each link bandwidth is 100 Kbps, signal propagation speed is 10^6 meter per second and length of each link is 10 km. Suppose host S wants to send a file of size 5000 bytes to host D, by dividing the file into 1000 bits packets. Calculate how much time (in millisecond) it takes to deliver the file completely from S to D ?

Q5 Consider two hosts are connected via point-to-point link using Stop-and-Wait protocol for flow control. The transmission rate of the link is 5 Kbps and the one-way propagation delay of the link is 50 milliseconds. The frame size is 500 bits. Calculate channel utilization in percentage (rounded off to nearest integer) ?

Q6 Consider two hosts are connected via point-to-point link using Stop-and-Wait protocol for flow control. The transmission rate of the link is 2 Mbps and frame size is 4000 bytes. To achieve 50 percent link utilization, calculate one-way propagation delay in milliseconds ?

Q7 Consider two hosts are connected via point-to-point link using Stop-and-Wait protocol for flow control. The transmission delay for a frame and one-way propagation delay of the link are 15 and 30 milliseconds respectively. If link bandwidth is 50 Kbps then calculate throughtput of the link in Kbps ?

Q8 Consider two hosts are connected via point-to-point link using Stop-and-Wait protocol for flow control. The link bandwidth is 4 Kbps, one-way propagation delay of the link are 800 milliseconds. To achieve 50 percent link utilization calculate packet size in bytes ?

Q9

Consider a packet error probability is 0.3 in Stop-and-Wait ARQ. What should be minimum number of transmission required to transmit 140 packets?

Q10 Consider two hosts are connected via point-to-point link using Sliding Window protocol for flow control. The transmission delay for a frame and propagation delay of the link are 10 and 30 milliseconds. Calculate optimal window size ?

(A) 1 (B) 3

(C) 4 (D) 7

Q11 Consider two hosts A and B are connected via point-to-point link using Go-Back-4-ARQ flow control strategy with transmit window size 4. Host A wants to send a file (divided into 10 packets) to host B, if every 6th packet that A transmits gets lost (but no ACKs from B ever get lost), then what is the number of packets that A will transmit for sending the file to B ?

Q12 Consider two hosts connected directly through point-to-point link uses Go Back N ARQ for flow control. The transmission delay and propagation delay (in millisecond) are 2 and 250. What should be minimum number of bits required for sequence number field to achieve full utilization ?

(A) 7 (B) 8

(C) 9 (D) 10

Q13 Consider a 2 Mbps communication link with one-way propagation delay of 120 milliseconds. Go back N ARQ protocol is used on this link to send data with a frame size of 2000 bits. Neglect the transmission time of acknowledgment. The minimum number of bits required for the sequence number field to achieve 50% utilization is ___________ .

Q14 Consider two hosts connected directly through point-to-point link uses Selective Repeat ARQ for flow control. The transmission delay and propagation delay (in millisecond) are 4 and 250. What should be minimum number of bits required for sequence number field to achieve full utilization?

(A) 5 (B) 6

(C) 7 (D) 8

Q15 Consider a 1 Mbps communication link with one-way propagation delay of 80 milliseconds. Selective repeat protocol is used on this link to send data with a frame size of 2000 bits. Neglect the transmission time of acknowledgment. The minimum number of bits required for the sequence number field to achieve 100% utilization is ___________ .

Answer Key

Q1	(A)
Q2	65~65
Q3	76~76
Q4	450~450
Q5	50~50
Q6	8~8
Q7	10~10
Q8	800~800
Q9	200~200
Q10	(D)
Q11	17~17
Q12	(B)
Q13	7~7
Q14	(D)
Q15	8~8

Hints & Solutions

Q1 Text Solution:

$$t_x = \frac{200\ \text{bits}}{10\ \text{Kbps}} = \frac{200\ \text{bits}}{10\times10^3\ \text{bits / sec}} = 20\ \text{ms}$$

$$t_p = \frac{5\ \text{km}}{10^5\ \text{m/ sec}} = \frac{5\times10^3\ \text{m}}{10^2\times10^3\ \text{m/ sec}} = 50\ \text{ms}$$

Q2 Text Solution:

$$t_x = \frac{500\ \text{bits}}{20\ \text{Kbps}} = \frac{500\ \text{bits}}{20\times10^3\ \text{bits / sec}} = 25\ \text{ms}$$

$$t_p = \frac{40\ \text{km}}{10^6\ \text{m/ sec}} = \frac{40\times10^3\ \text{m}}{10^3\times10^3\ \text{m/ sec}} = 40\ \text{ms}$$

Total time = $(t_x + t_p)$ = (25 + 40) ms = 65 ms

Q3 Text Solution:

$$t_x = \frac{2000\ \text{bits}}{1\ \text{Kbps}} = \frac{2\times10^3\ \text{bits}}{10^6\ \text{bits / sec}} = 2\ \text{ms}$$

$$t_p = \frac{20\ \text{km}}{4\times10^6\ \text{m/ sec}} = \frac{20\times10^3\ \text{m}}{4\times10^6\ \text{m/ sec}} = 5\ \text{ms}$$

$$N = \frac{8000\ \text{bytes}}{2000\ \text{bits}} = \frac{64\times10^3\ \text{bits}}{2\times10^3\ \text{bits}} = 32$$

Total time $= (N \times t_x + t_P) + (t_x + t_P)$

= (32 × 2 + 5) + (2 + 5) ms = 76 ms

Q4 Text Solution:

$$t_x = \frac{1000\ \text{bits}}{100\ \text{Kbps}} = \frac{1000\ \text{bits}}{100\times10^3\ \text{bits / sec}} = 10\ \text{ms}$$

$$t_p = \frac{10\ \text{km}}{10^6\ \text{m/ sec}} = \frac{10\times10^3\ \text{m}}{10^3\times10^6\ \text{m/ sec}} = 10\ \text{ms}$$

$$N = \frac{5000\ \text{bytes}}{1000\ \text{bits}} = \frac{40\times10^3\ \text{bits}}{10^3\ \text{bits}} = 40$$

Total time

$= (N \times t_x + t_p) + (t_x + t_p) + (t_x + t_p)$

= (40 × 10 + 10) + (10 + 10) + (10 + 10) ms

= 450 ms

Q5 Text Solution:

$$t_x = \frac{500\ \text{bits}}{5\ \text{Kbps}} = \frac{500\ \text{bits}}{5\times10^3\ \text{bits / sec}} = 100\ \text{ms}$$

$t_p = 50\ \text{ms}$

Cycle time

$= (t_x + 2t_p) = (100 + 2 \times 50) = 200$ ms

$$\eta = \frac{t_x}{\text{Cycle time}} = \frac{100\ \text{ms}}{200\ \text{ms}} = \frac{1}{2}$$

$$= \frac{1}{2} \times 100\% = 50\%$$

Q6 Text Solution:

$$t_x = \frac{4000\ \text{bytes}}{2\ \text{Kbps}} = \frac{32\times10^3\ \text{bits}}{2\times10^6\ \text{bits / sec}} = 16\ \text{ms}$$

$$\eta = \frac{t_x}{\text{Cycle time}}$$

$$\frac{1}{2} = \frac{t_x}{(t_x+2t_p)}$$

$$t_x = 2t_p$$

$$t_p = \frac{t_x}{2} = \frac{16\ \text{ms}}{2} = 8\ \text{ms}$$

Q7 Text Solution:

t_x = 15 ms

t_p = 30 ms

Cycle time = $(t_x + 2t_p)$ = (15 + 2 × 30) = 75 ms

$$\eta = \frac{t_x}{\text{Cycle time}} = \frac{15\ \text{ms}}{75\ \text{ms}} = \frac{1}{5}$$

Throughput = η × Bandwidth

$$= \frac{1}{5} \times 50\ \text{kbps} = 10\ \text{kbps}$$

Q8 Text Solution:

$$\eta = \frac{t_x}{\text{Cycle time}}$$

$$\frac{1}{2} = \frac{t_x}{(t_x+2t_p)}$$

$$t_x = 2t_p$$

Packet size = $(2\ t_p)$ × Bandwidth

= (2 × 800 ms) × 4 kbps

= $64 \times 10^2 \times 10^{-3}$ sec × 10^3 bits/sec

= 6400 bits

= 800 bytes

Q9 Text Solution:

P_b = 0.3

N = 140

Total transmission

$= N + N \times P_b + N \times P_b^2 + N \times P_b^3 + \ldots$

$= N \times \left[1 + P_b + P_b^2 + P_b^3 + \ldots\right]$

$$= N \times \frac{1}{(1-P_b)} = \frac{N}{(1-P_b)}$$

$$= \frac{140}{(1-0.3)} = \frac{140}{0.7} = 200$$

Q10 Text Solution:

t_x = 10 ms

t_p = 30 ms

Cycle time = $(t_x + 2t_p)$ = (10 + 2 × 30) ms = 70 ms

Optional window size

$$= \left\lceil \frac{\text{Cycle time}}{t_x} \right\rceil = \left\lceil \frac{70 \ \text{ms}}{10 \ \text{ms}} \right\rceil = 7$$

Q11 Text Solution:

$$\begin{array}{ccccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ \checkmark & \checkmark & \checkmark & \checkmark & \checkmark & \times & \multicolumn{3}{c}{\underbrace{\hphantom{7\quad 8\quad 9}}_{\text{discord}}} \\ \hline & & & & & 6 & 7 & 8 & 9 \quad 10 \\ & & & & & \checkmark & \checkmark & \times & \underbrace{\hphantom{9\quad 10}}_{\text{discord}} \\ \hline & & & & & & & 8 & 9 \quad 10 \\ & & & & & & & \checkmark & \checkmark \quad \checkmark \end{array}$$

Q12 Text Solution:

$t_x = 2$ ms, $t_p = 250$ ms

Cycle time = $(t_x + 2\ t_p) = (2 + 2 \times 250)$ ms = 502 ms

Optimal window size (N)

$$= \left\lceil \frac{\text{Cycle time}}{t_x} \right\rceil = \left\lceil \frac{502 \ \text{ms}}{2 \ \text{ms}} \right\rceil = 251$$

Minimum no. of bits for sequence no. of field

$$= \lceil \log_2 (N + 1) \rceil \text{ bits}$$

$$= \lceil \log_2 (252) \rceil \text{ bits}$$

= 8 bits

Q13 Text Solution:

$$t_x = \frac{2000 \ \text{bytes}}{2 \ \text{Mbps}} = \frac{2 \times 10^3 \ \text{bits}}{2 \times 10^6 \ \text{bits / sec}} = 1 \ \text{ms}$$

$t_p = 120$ ms

Cycle time = $(t_x + 2t_p) = (1 + 2 \times 120)$ ms = 241 ms

For 50% utilization

$$N = \left\lceil \frac{\text{Cycle time}}{2t_x} \right\rceil = \left\lceil \frac{241 \ \text{ms}}{2 \times 1 \ \text{ms}} \right\rceil = 121$$

Minimum of bits for sequence no.

$$= \lceil \log_2 (N + 1) \rceil \text{ bits}$$

$$= \lceil \log_2 (122) \rceil \text{ bits}$$

= 7 bits

Q14 Text Solution:

$t_x = 4$ ms, $t_p = 250$ ms

Cycle time = $(t_x + 2t_p) = (4 + 2 \times 250) = 504$ ms

Optimal window size

$$N = \left\lceil \frac{\text{Cycle time}}{t_x} \right\rceil = \left\lceil \frac{504 \ \text{ms}}{4 \ \text{ms}} \right\rceil = 126$$

Minimum no. of bits for sequence no.

$$= \lceil \log_2 (2N) \rceil \text{ bits}$$

$$= \lceil \log_2 (252) \rceil \text{ bits}$$

= 8 bits

Q15 Text Solution:

$$t_x = \frac{2000 \ \text{bits}}{1 \ \text{Mbps}} = \frac{2 \times 10^3 \ \text{bits}}{10^6 \ \text{bits / sec}} = 2 \ \text{ms}$$

$t_p = 80$ ms

Cycle time = $(t_x + 2t_p) = (2 + 2 \times 80)$ ms = 162 ms

Optimal window size

$$N = \left\lceil \frac{\text{Cycle time}}{t_x} \right\rceil = \left\lceil \frac{162 \ \text{ms}}{2 \ \text{ms}} \right\rceil = 81$$

Minimum no. of bits for sequence no.

$$= \lceil \log_2 (2N) \rceil \text{ bits}$$

$$= \lceil \log_2 (162) \rceil \text{ bits}$$

= 8 bits