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CN
Tutorial 9

Ans 1:

Given,

No. of packets = 11

Window size = 3

Error control strategy = Go back N.

Given, every 6th packet that A transmits gets lost but no acknowledgement from B gets lost.

Then,

Sender	Receiver	Sender	Receiver
1		9	
2	1	10	9
3	2	11	10
4	3		11
5	4		
6	5	Total 17 packets are sent.	
7			
8			
	7		
	8		

[Timeout for 6]

6	
7	6
8	7
9	8
10	
11	
	10
	11

[Timeout for 9]

Ans 2: In Selective Repeat Protocol,
only those frames which time out are resent again.
Hence,

Initially, frames through 1 to 5 are transmitted.
5 4 3 2 1

Then, 1 times out, it is resent,

1 5 4 3 2

Then, a new frame 6 is transmitted,

6 1 5 4 3 2

Then, 2 times out and 3 times out, which are resent,

3 2 6 1 5 4

Then, 7, a new frame is inserted. Hence, the outstanding packets are:-

7 3 2 6 1 5 4

Ans 3: In stop and wait protocol, minimum sequence number is 2.
This is because the sender window size is 1.

In Go back N ARQ, minimum sequence number is $N+1$
because N frames are sent.

In Selective Repeat ARQ, minimum sequence number is $2N$.

Ans 4: If Go Back N Protocol has a very high error rate, it utilizes a lot of bandwidth. This is because for every error, a complete window is retransmitted.

For Selective Repeat Protocol, the bandwidth wastage is comparatively low, due to the fact that only those frames which are lost or whose acknowledgements are lost are retransmitted.

Ans 5: Given,

Frame size = 1 KB

Bandwidth = 1.5 Mbps

One-way latency = 50 ms

$$\begin{aligned}\text{Transmission delay} &= \frac{\text{Frame Size}}{\text{Bandwidth}} \\ &= \frac{1 \times 8 \times 10^3}{1.5 \times 10^6} \\ &= 5.33 \text{ ms}\end{aligned}$$

Propagation delay = 50 ms

$$\text{Efficiency} = \frac{\text{Window size}}{1 + 2a} = 60\%$$

$a = \text{Propagation delay} / \text{Transmission delay}$

Window Size = 11.856

Minimum Sequence Number = $2 \times \text{Window size} = 23.712$

No. of bits required = $\log_2(23.712) \approx \underline{\underline{5 \text{ bits}}}$

$$\begin{aligned}\text{Ans 6: Window Size} &= \frac{\text{Bandwidth} \times \text{RTT}}{\text{Packet Size}} \\ &= \frac{155 \times 10^6 \times 60 \times 10^{-3}}{53 \times 10^8} \\ &= \underline{\underline{21.93}}\end{aligned}$$

Hence, Window Size = 21 packets.