CS425 Assignment 2

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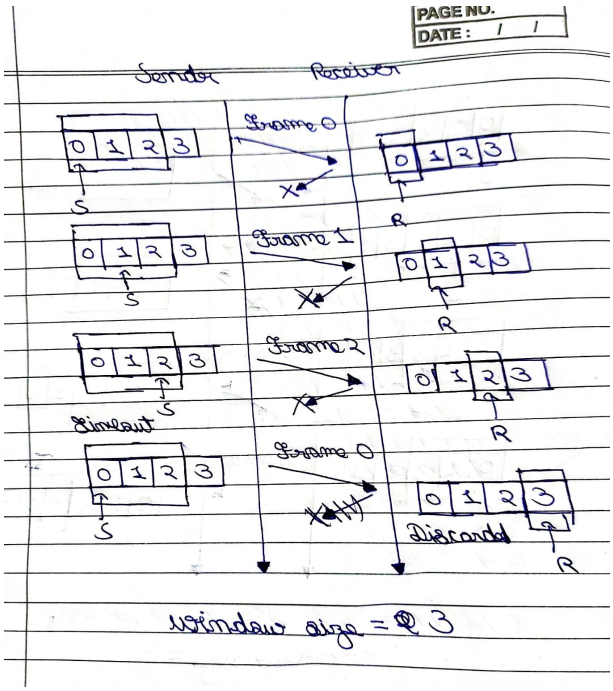
Sol. 2

In the Go-back-N ARQ mechanism using k-bit sequence numbers, the window size limited to 2^{k-1} and not 2^k.

Let's assume we choose the window size to be 2^{k-1}

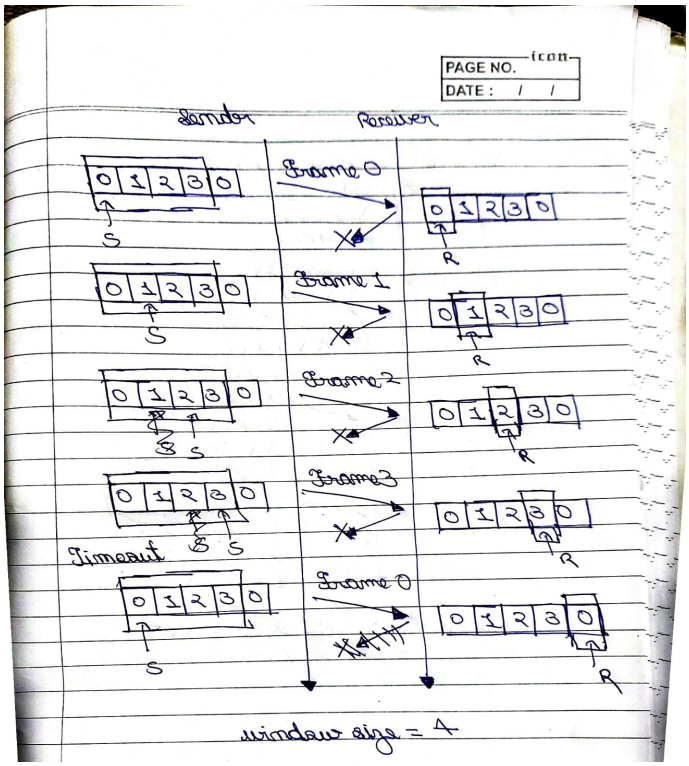
It helps the system in distinguishing whether or not the dataframes are recieved correctly or not and Received Report is a cumulative acknowledgement or whether the data frames were damaged which forces the receiving station to repeat it's previous received report.



S represents sequence number of the frame recently sent and R represents the sequence number of the frame receiver is expecting.

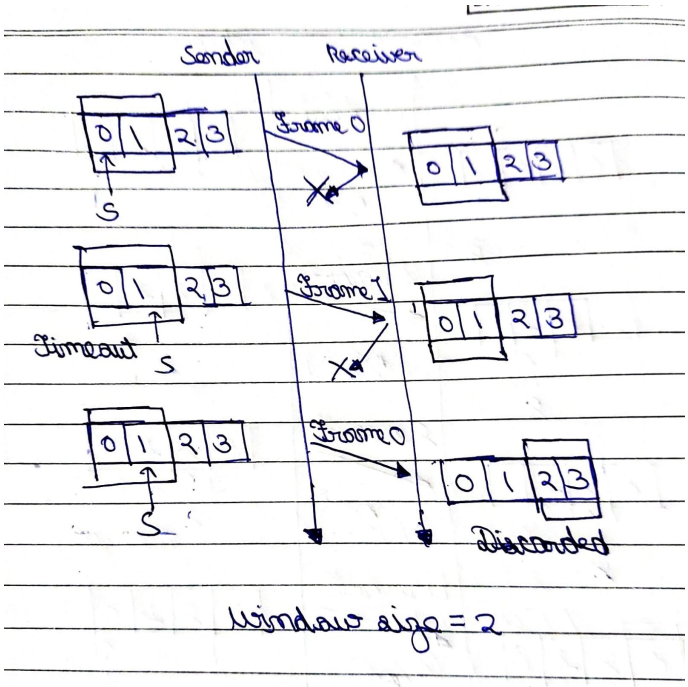
If the window size is chosen to be 3, as seen in the above image frame 0 is resent if the window size is 3, the acknowledgements of frames 0, 1, and 2 are

lost, and the frame 0 timeout has expired. The duplicate frame is successfully deleted since the receiver expects frame 3, not frame 0.

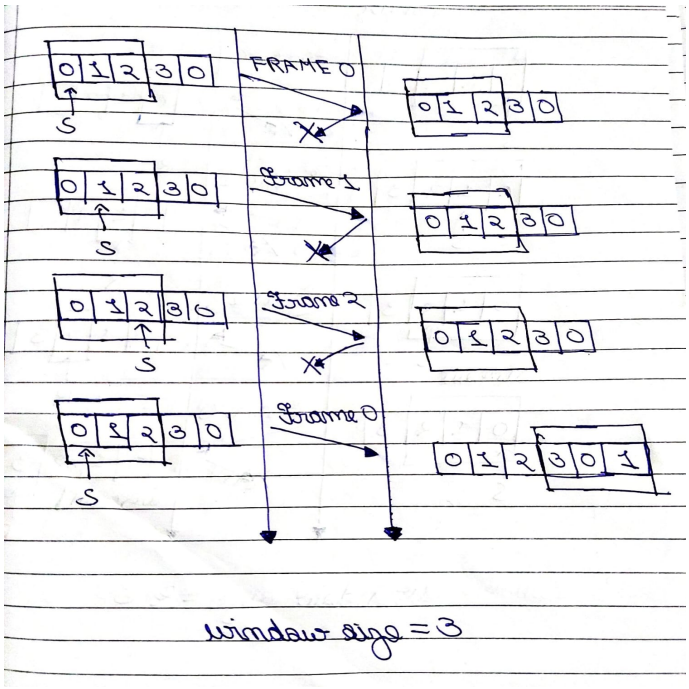


If the window size is chosen to be 4, in this case, the sender sends frame 0 once again if the window size is 4 and the acknowledgements for frames 0, 1, 2, and 3 are lost. The receiver anticipates frame 0 this time. As a result, the receiver will mistakenly see frame 0 as the start of the subsequent cycle.

Sol. 3
The maximum window size = 2^{k-1} which prevents packet from being misindentified.
If the window size will be more than 2^{k-1}, the sender may send fresh packets that the receiever will interpret as retransmission.
Let k = 2, The size of the window should be atmost 2 (2^{k-1}), let us compare the window size of 2 and 3.



As seen in the image above, frame 0 is transmitted again if the window size is 2, the acknowledgements for frames 0 and 1 are lost, and the frame 0 timer has expired. The duplicate frame is appropriately rejected since the receiver expects frame 2, not frame 0.



If the window size is 3, the sender sends frame 0 again and the acknowledgements for frames 0, 1, and 2 are not received. The receiver anticipates frame 0 this time. As a result, the receiver will falsely see frame 0 as the start of the next cycle.

Sol. 4
Let the number of bits in a frame be x
Given minimum efficiency = 50%.
Bit Rate => 4kbps
Propagation Delay => a = $\frac{Propagationdelay}{Transmissiontime}$
= $\frac{20.10^{-3}}{x/4.10^3}$
Efficiency is atleast 50% gives U = $\frac{1}{1+2a}$ = $\frac{1}{1+160/x}$ >= 1/2
x >= 160
Atleast 160 bits are required for an efficiency of 50%.

Sol. 5
a) The probability that one bit is in error is 0.001.
So, the probability that one bit is not in error = 1 - 0.001 = 0.999.
Therefore, the probability that 4 bits are not in error is 0.999^4 = 0.996.
So, the final probability that the received frame contains no error is 0.996.

b) Probabilty that the recieved frame contains atleast one error can be calculated from the result in the first part i.e. 1 - 0.996 = 0.004.

c) The odd number of mistakes can all be detected by 1 parity bit, while the even number of faults cannot. The frame will not detect 2 and 4 bit errors since it has 5 bits (4 data bits + 1 parity bit). Thus, the probability that the frame's fault cannot be detected.
Probability that 2 bits are in error + Probability that 4 bits are in error :

$\binom{5}{2}$ x $(10^{-3})^2$ x $(1-10^{-3})^3$ + $\binom{5}{4}$ x $(10^{-3})^4$ x $(1-10^{-3})$ = 9.97 x 10^{-6}