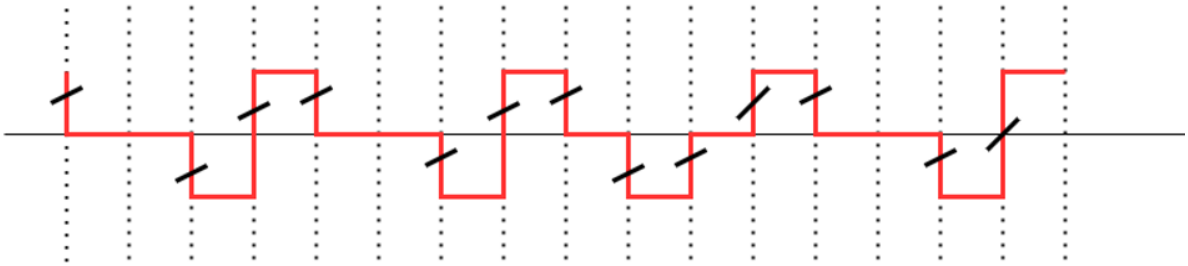
Question No. 1:

a: Show the encoding of the bit stream 1100110010101100 using Pseudoternary encoding scheme assuming that the last signal level before the start of this bit stream has been positive. What is the total number of signals transitions?

Solution:

13 transitions



b: Suppose you want to send the bit stream 011110111010. Show the final bit stream transmitted if checksum is used for adding error detecting bits with 4-bit word size.

Solution:

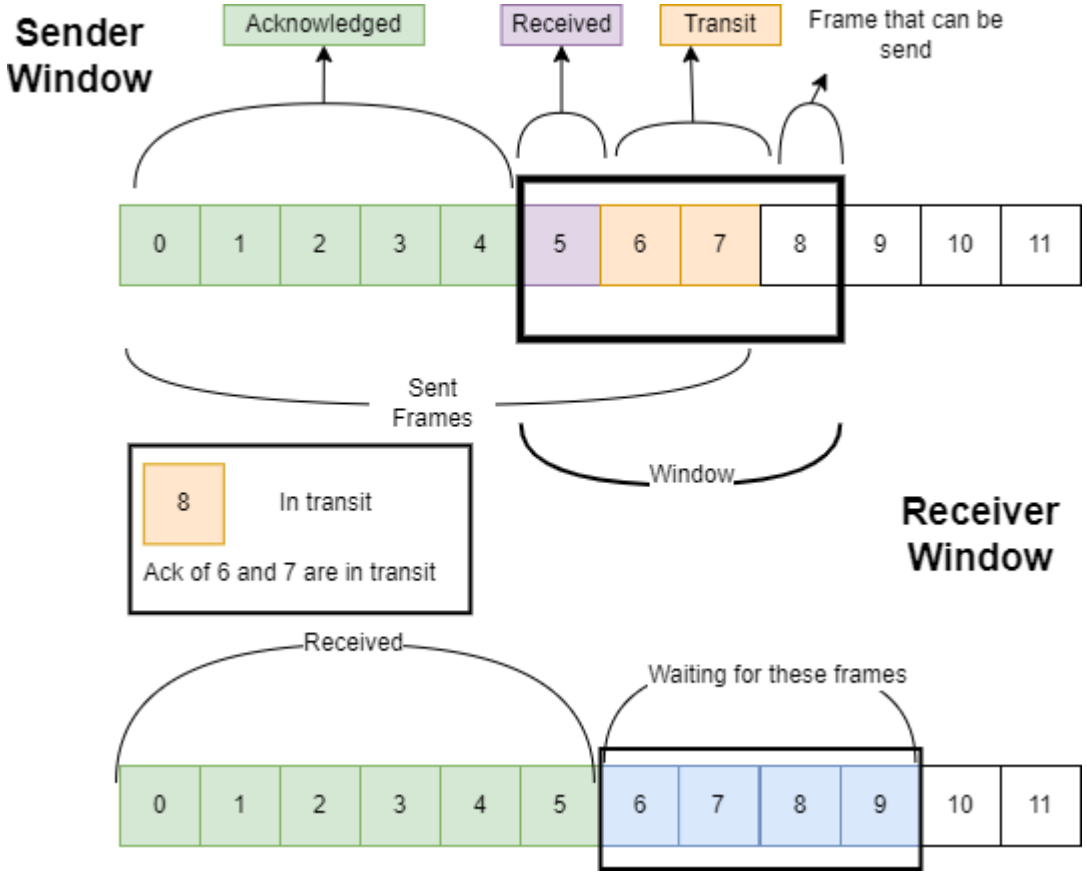
0111 + 1011 + 1010 = 11100
After wrapping: 1101
After 1's complement: 0010
Final bit stream 011110111010**0010**

C: Suppose a sender S is sending 12 frames (numbered 0 to 11) to a receiver R using sliding window flow control protocol. The window size used is 4. Consider a time at which the sender has sent frames 0 to 7, and has received acknowledgements for the frames 0 to 4. The receiver has received frames 0 to 5. Draw a diagram to clearly show the position of the sender and receiver windows at this time with brief (1-2 sentences max for each window) justification. Also show on the diagram which frames are in transit. Assume that there is no error or loss in transmitting any frame.

Solution:

Sender Window: At sender side, since the acknowledgement of frames 0 to 4 has been received. So, the window is containing the frames from 5 to 8. The frame 5 has already arrived at receiver end, however the ack has not been reached at the sender side. Once the ack will be received, the window will slide.

Receiver Window: Receiver has received the frames 0 to 5 successfully. Therefore, it is waiting for the next 4 frames as the size of the window mentioned is 4.

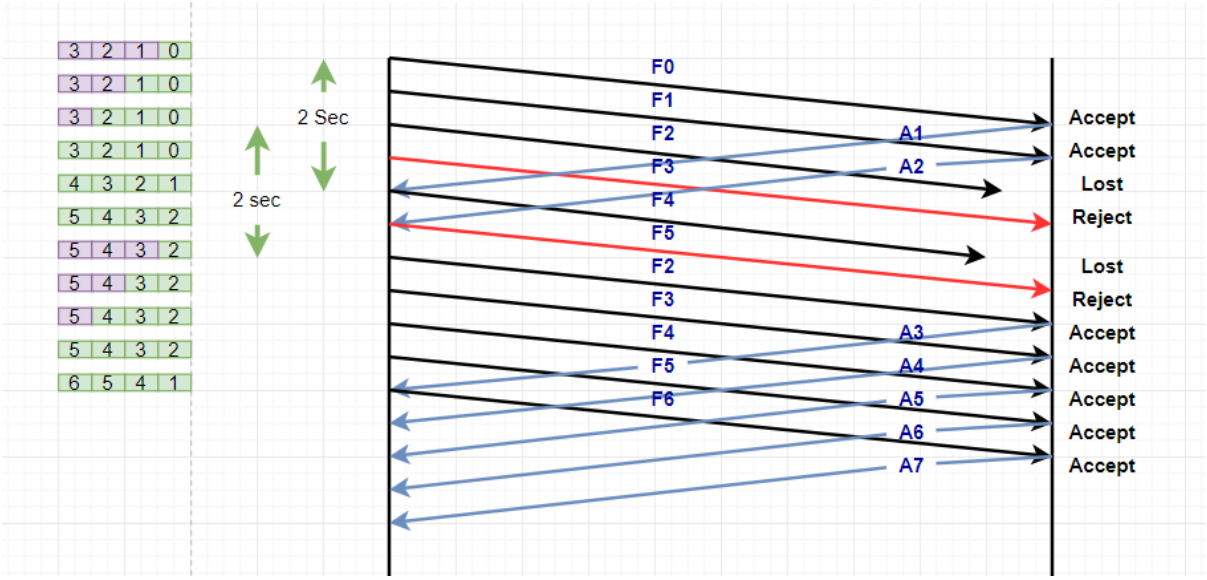


Question No.2

a: Consider a sender S sending 7 frames (numbered 0 to 6) to a receiver R. Go-back-N is used as the error control method with 3-bit sequence number and window size of 4. Processing time at the receiver is negligible, ACKs are sent immediately on receive (no piggybacked ACK), the time for any frame to travel over the link (either from S to R or from R to S) is 1 time unit (constant for all frames), and the timeout duration is 2 time units. Assume that when frame 2 and frame 4 are sent

for the first time, the frames are lost. No other frames are lost. Show clearly with a diagram (as shown in class for describing ARQ protocols) the flow of the frames between S and R, clearly showing the data frame numbers, type of frame, and sequence numbers in each frame. No explanation is needed, just show the diagram.

Solution:



b: Suppose you want to do error control between a sender S and a receiver R. If the probability of frame loss/corruption is low and the total delay for a frame to reach from S to R is high, which of Go-back-N and Selective-Repeat ARQ methods would you use? Briefly justify your answer.

Solution: Selective Repeat ARQ

Reason:

1. **Given: Probability of frame loss/corruption is low.**
   If we use Go Back N in this case then we have to retransmit all the frames in a window again even if there is only one corruption. However, in Selective Repeat, we only send the corrupted frame. Therefore, to avoid unnecessary transmission we use Selective Repeat ARQ.
2. **Given: the total delay for a frame to reach from S to R is high.**
   This implies that the distance between S and R is large. There are chances that the packet may reach out of order. Selective Repeat ARQ accept the packets even if they reach out of order and prevent retransmissions.