



**Data Communication
(CSX-208)**

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Framing and Flow Control Problems

Question 1

Suppose the following bit strings are received by the data link layer from the network layer:

- ***011111100111011111101111101111110011111110***
- ***0111111011101111111011101111110011111100011111110***

where flag and ESC are as 01111110 and 01111100, respectively.

What are the resulting strings after bit stuffing and byte stuffing?

Underlying each bit or byte that has been added in the above strings.

Solution 1(a)

Bit Stuffing:

Original bit stream: *01111110011101111110111110111111001111110.*

After bit stuffing sender bit stream:

01111110011101111101011111001111101001111110.

Receiver bit stream: *01111110011101111110111110111111001111110.*

Byte Stuffing:

Original bit stream: *01111110011101111110111110111111001111110.*

After byte stuffing sender bit stream:

01111110011101111100011111101111011111000111111001111110.

Receiver: *01111110011101111110111110111111001111110.*

Solution 1(b)

Bit Stuffing:

Original bit stream: *011111101110111110111011111100111110001111110*

After bit stuffing sender bit stream:

0111111011101111101011101111101001111100001111110

Receiver bit stream: *011111101110111110111011111100111110001111110*

Byte Stuffing:

Original bit stream: *011111101110111110111011111100111110001111110*

After byte stuffing sender bit stream:

01111110111011111000111111011101111100011111100111110001111110001111100011111000111110

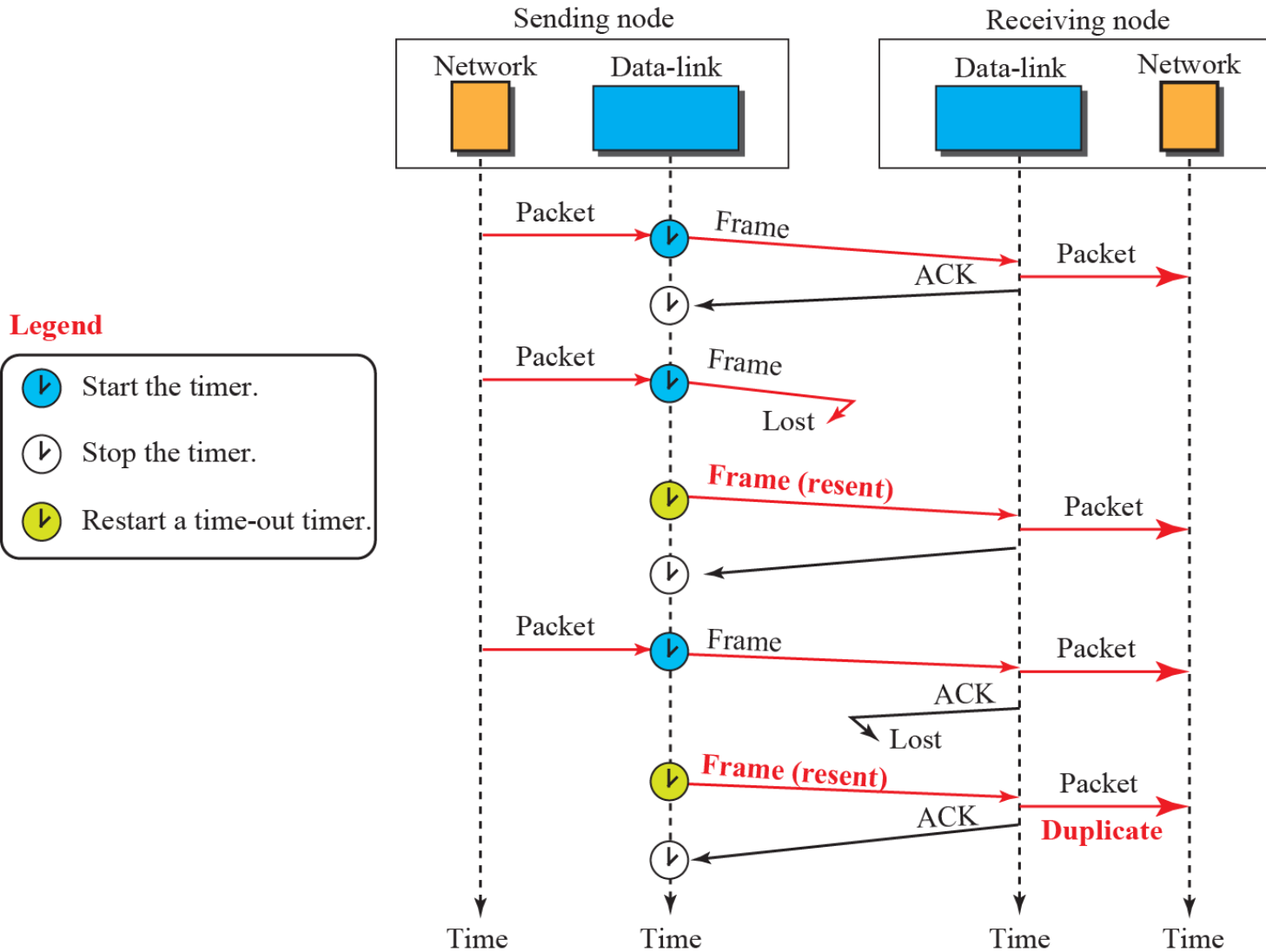
Receiver: *011111101110111110111011111100111110001111110*

Example 2

Prepare a time diagram for sender and receiver for the below example.

The first frame is sent and acknowledged. The second frame is sent, but lost. After time-out, it is resent. The third frame is sent and acknowledged, but the acknowledgment is lost. The frame is resent. However, there is a problem with this scheme. The network layer at the receiver site receives two copies of the third packet, which is not right. In the next section, we will see how we can correct this problem using sequence numbers and acknowledgment numbers.

Flow diagram for Example 2



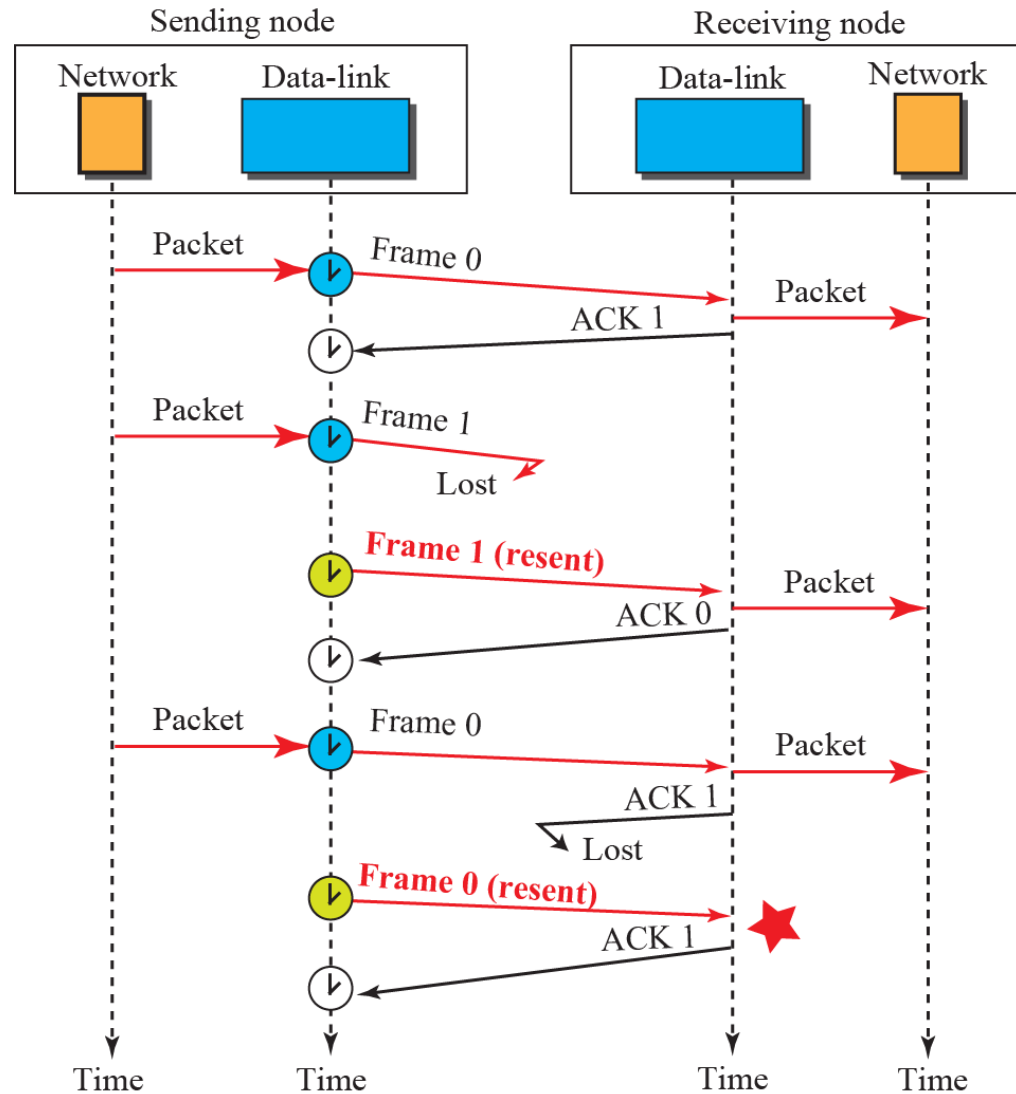
Example 3



Draw a figure for the below statements and shows “how adding sequence numbers and acknowledgment numbers can prevent duplicates”.

The first frame is sent and acknowledged. The second frame is sent, but lost. After time-out, it is resent. The third frame is sent and acknowledged, but the acknowledgment is lost. The frame is resent.

Flow diagram for Example 3

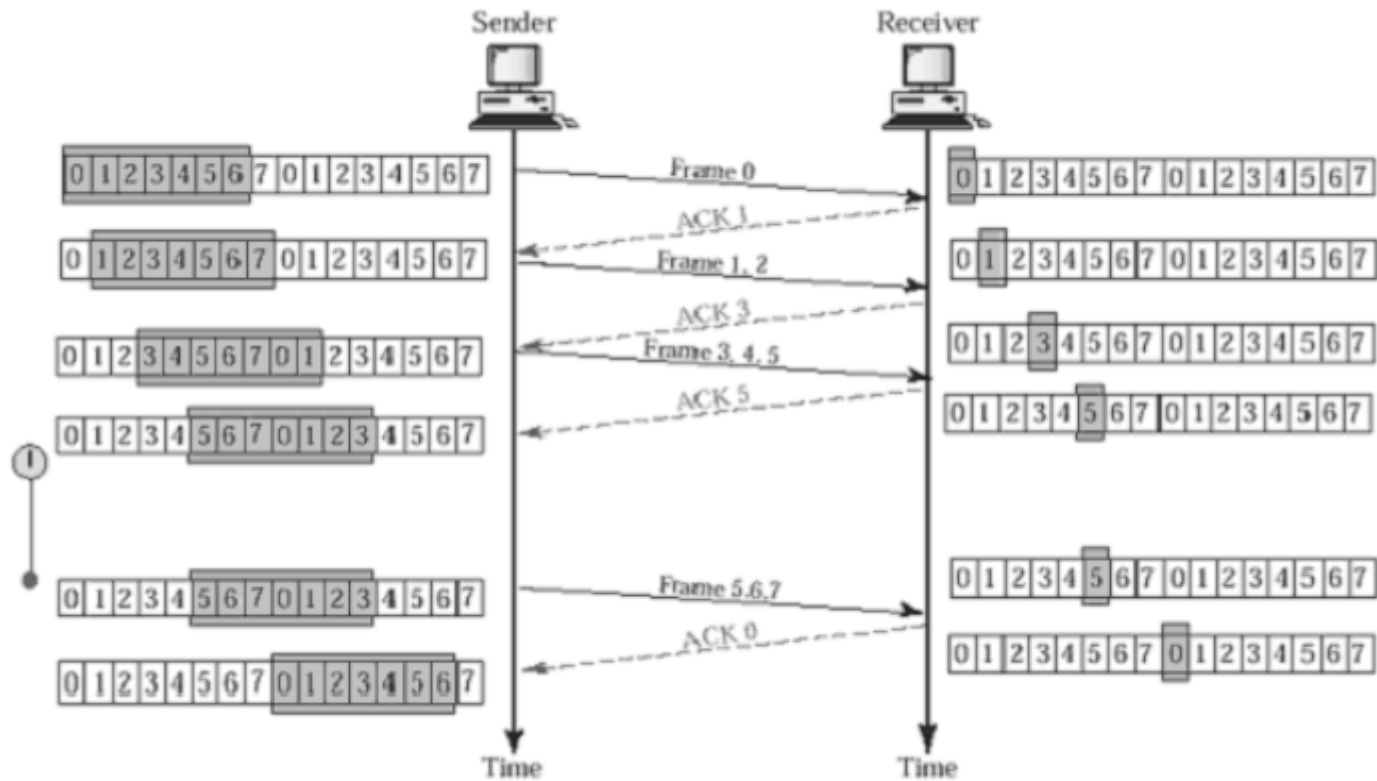


Question 4

Draw the sender and receiver windows for a system using Go-back-N ARQ, where a 3 bit field is used and given the following:

- (a) Frame 0 is sent; Frame 0 is acknowledged.
- (b) Frames 1 and 2 are sent; Frames 2 is acknowledged.
- (c) Frames 3, 4, and 5 are sent; Frames 3 and 4 is acknowledged; Timer for Frame 5 expires.
- (d) Frames 5, 6, and 7 are sent; Frames 5 through 7 are acknowledged.

Solution 4

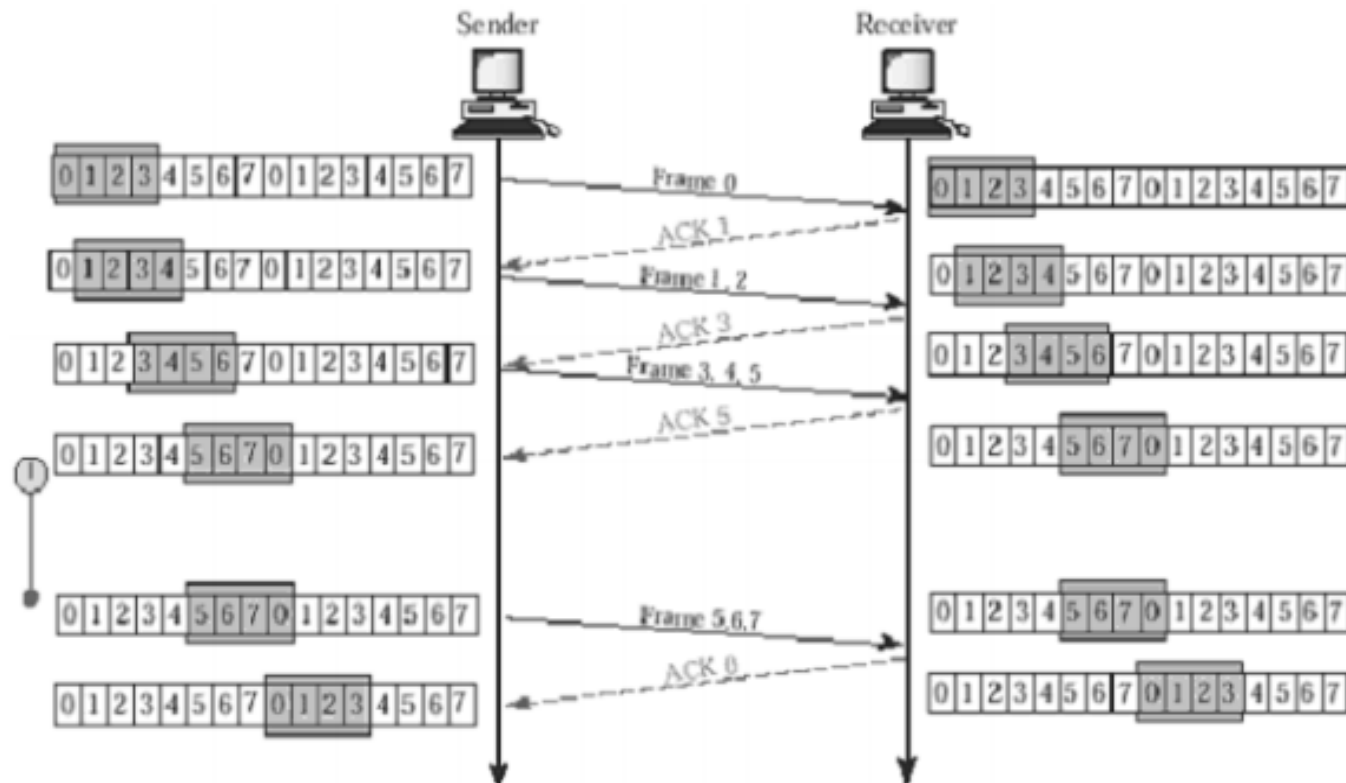



Question 5

Draw the sender and receiver windows for a system using Selective-repeat ARQ, where a 3 bit field is used and given the following:

- (a) Frame 0 is sent; frame 0 is acknowledged.
- (b) Frame 1 & 2 are sent; and acknowledged.
- (c) Frame 3, 4 & 5 are sent; NAK 4 is received.
- (d) Frame 4, 6 & 7 are sent; and acknowledged.

Solution 5





Q6. A Go-back-N ARQ uses a window of size 15. How many bits are needed to define the sequence number?

Q7. A Selective Repeat ARQ is using 7 bits to represent the sequence numbers. What is the size of the window?

Q8. A computer is using a sliding window of size 7. Complete the following sequence numbers for 20 packets:

0,1,2,3,4,5,6,.....

Q9. A computer is using the following sequence numbers. What is the size of the window?

0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,0,1.....



Solution

Q6. A Go-back-N ARQ uses a window of size 15. How many bits are needed to define the sequence number?

Ans: $N=16$ $SW=15$, $\# \text{ bits} = 4$

Solution

Q7. A Selective Repeat ARQ is using 7 bits to represent the sequence numbers. What is the size of the window?

Ans: Window size of the selective repeat $= \frac{2^m}{2} =$

$$\frac{2^7}{2} = 64$$

Solution

Q8. A computer is using a sliding window of size 7. Complete the following sequence numbers for 20 packets:

0,1,2,3,4,5,6,.....

Ans: 0, 1, 2, 3, 4, 5, 6, 7, 0, 1, 2, 3, 4, 5, 6, 7, 0, 1, 2, 3

Solution

Q9. A computer is using the following sequence numbers. What is the size of the window?

0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,0,1.....

Ans: $N=16$ $SW=N-1=15$.