

CSE 123: Computer Networks

Homework 1 Solutions

Total points = 44

Problems

1. Modified HDLC Framing [6 points]

Assume we are following the protocol described in the textbook except our modified HDLC frames have no header or CRC. So a frame is simply a beginning sequence, body, and ending sequence. The following bit sequence arrives over the link

0101 1111 1001 1111 0011 1110 0111 1100 0111 0111 1111 0111

If our modified HDLC protocol was used for framing, and assuming an end frame was sent just before this sequence, mark the following

a. Start of frame

b. End of frame

c. Stuffed bits

6 points total

- 2 pts for a
- 2 pts for b
 - -1 pt if added extra stuffed bits or didn't have all 3
- 2 pts for c
- -1 pt from total if selected error after end of sequence

Note: There would be no bits indicating errors because the string of 7 1's is not within a frame as it comes after the end of frame sequence and before another start of frame sequence arrives.

2. Hamming Distance [6 points]

For this problem, we are using fixed-length bitstrings of length 6 where only some bitstring sequences are allowable in the encoding scheme. Assume that the blue bitstrings are the only ones allowable (codewords) and the grey bitstrings are some of the bitstrings that are not considered allowable.



- What is the hamming distance of this encoding scheme?
 - 2, since the minimum distance (in terms of bit flips) between any two codewords is two
- Is the encoding scheme efficient? Why or why not?
 - No, because it is possible to flip 2 bits of a codeword and not end up at another codeword, such as going from codeword 000000 to 110000.
- How many bit flips can be detected?
 - $2d + 1 = \text{hamming distance}$
 $2d + 1 = 2$
 $2d = 1$
So the answer is 1 because we can detect up to $2d$ bit flips
- How many bit flips can be corrected?
 - $2d = 1$ [from c above]
 $d = \frac{1}{2}$
The answer is 0 because we can detect only up to d bit flips where d needs to be truncated since we can't have a fraction of a bit flip

6 points total

- 1 pt for a correctness
- 1 pt for b correctness
- 2 pts for c
 - 1 pt for work in showing it's $2d$
 - 1 pt for correctness
- 2 pts for d
 - 1 pt for work in showing it's d
 - 1 pt for correctness

3. Two-Dimensional Parity [6 points]

Calculate the two dimensional parity of the data below

1 0 1 1 0 1 1	1
0 1 1 1 0 1 0	0
0 0 0 1 0 0 1	0
1 0 0 1 1 0 0	1
1 0 1 1 0 1 1	1
0 1 0 0 1 0 1	1
1 1 1 0 1 1 1	0
0 1 0 1 1 0 1	0

- Will two dimensional parity catch all 2-bit errors?
 - Yes
- Will it catch all 3-bit errors?
 - Yes
- Think of a scenario in which the two dimensional parity would not catch 4-bit errors. Circle 4 bit positions in the example above to illustrate this.
 - For ease of writing the solutions I highlighted the positions in **magenta** for this case
- Now think of a scenario in which the two dimensional parity would catch 4-bit errors. Draw rectangles around 4 bit positions in the example above to illustrate this (Please use completely different bit positions from part c).
 - For ease of writing the solutions I highlighted the positions in **green** for this case

6 points total

- 2 pts for correct parity bits
 - 1 pt for correctness of column
 - 1 pt for correctness of row
- 1 pt for a correctness
- 1 pt for b correctness
- 1 pt for c correctness
- 1 pt for d correctness

4. CRC [7 points]

Suppose we want to transmit a message 1101 1001 0101 1001 and protect it from errors using the CRC generator $x^7 + x^3 + 1$

- What is the CRC generator sequence? (The CRC generator polynomial represented in a bit sequence)?
 - 10001001
- How many bits with the resulting frame check sequence (aka error-detecting code) be?
 - 7 bits
- What is the transmitted bit sequence (show your work)?

```

                                1101010110101000
                                -----
10001001 (110110010101100100000000
10001001 || || || || || || || || ||
----- || || || || || || || || ||
10100000 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
10100110 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
10111111 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
11011000 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
10100011 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
10101000 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
10000100 || || || || || || || || ||
10001001 || || || || || || || || ||
----- || || || || || || || || ||
                                1101000
```

Transmitted sequence = 11011001010110011101000

- d. How large of burst of errors can be detected?
- i. 7 bits

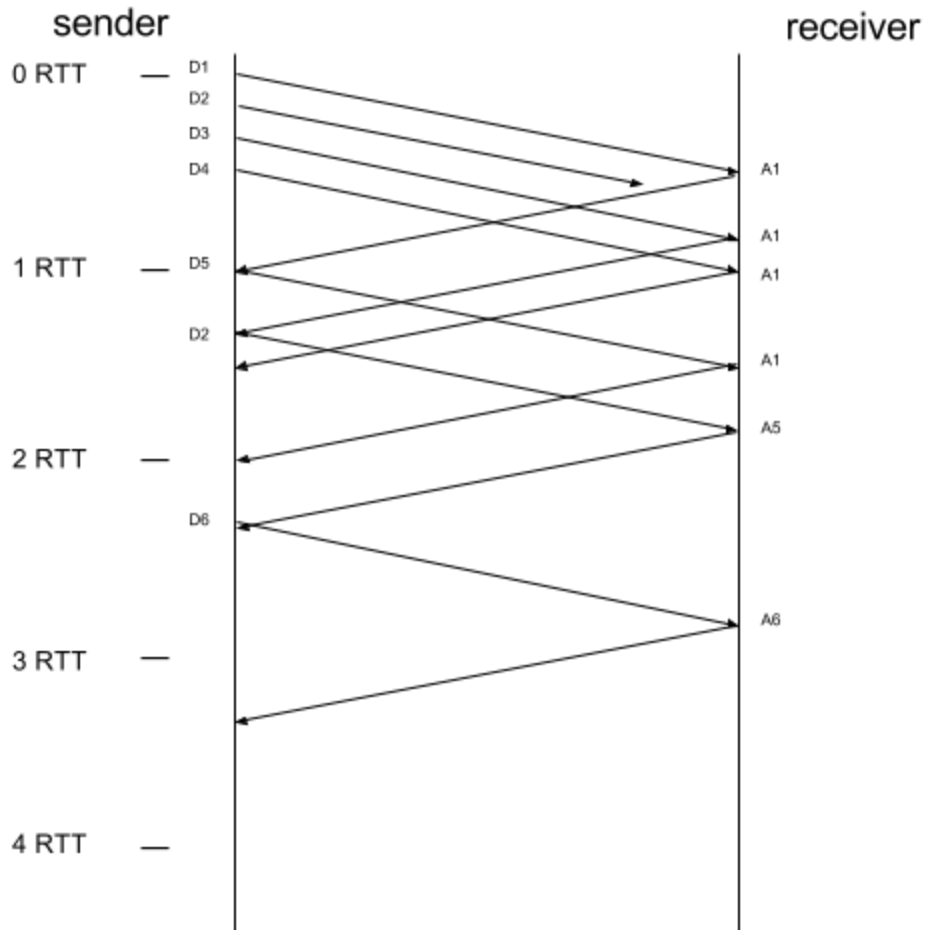
7 points total

- 1 pt for a correctness
- 1 pt for b correctness
- 4 pts for c
 - 1 pt for having some padding
 - 1 pt for correct setup other than padding
 - 1 pt for using Module-2 arithmetic (XOR)
 - 1 pt for correct transmitted sequence
- 1 pt for d correctness

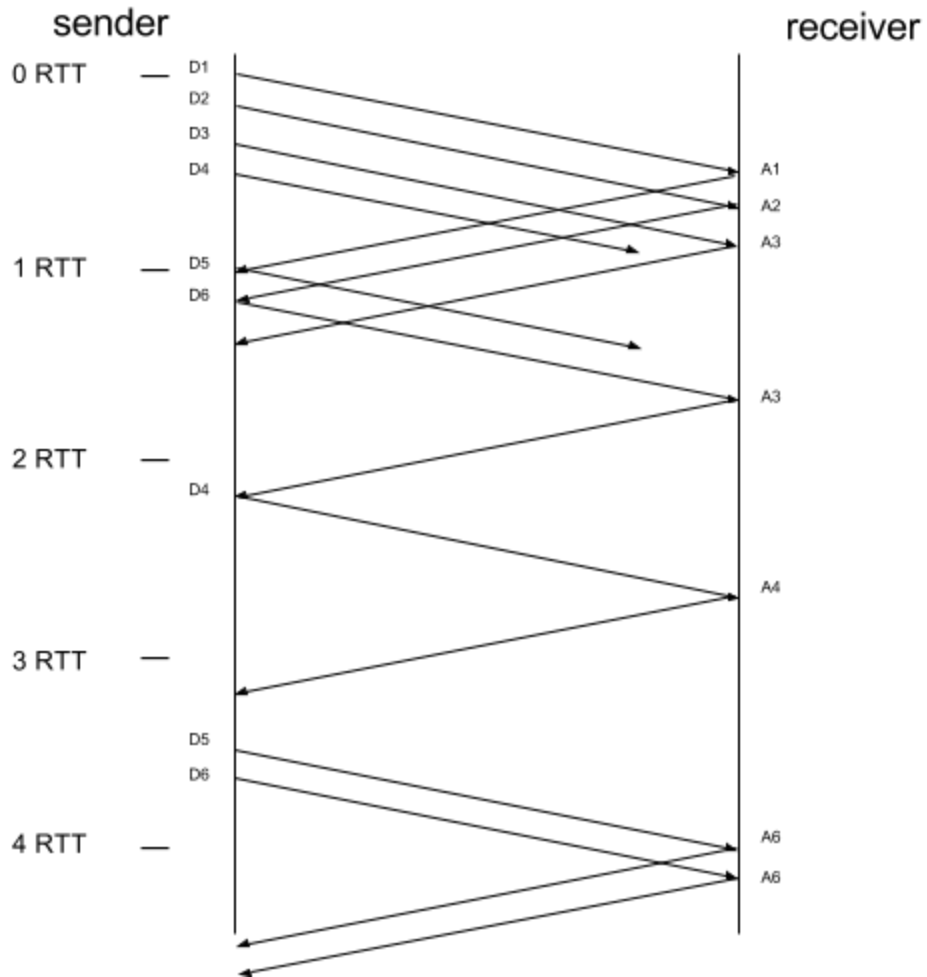
5. Sliding Window Protocol [7 points]

Draw a timeline diagram for the sliding window algorithm with $SWS = RWS = 4$ frames, for each of the following two situations. Use a timeout interval of about $2.5 \times RTT$. Assume fast retransmission with selective retransmission is implemented and that packets with sequence numbers 1-6 will be sent. For fast retransmission, if more than 1 duplicate ACK is received, only retransmit on the first duplicate ACK.

- a. Frame 2 is lost on the first transmission.



b. Frames 4 and 5 are lost on their first transmissions.



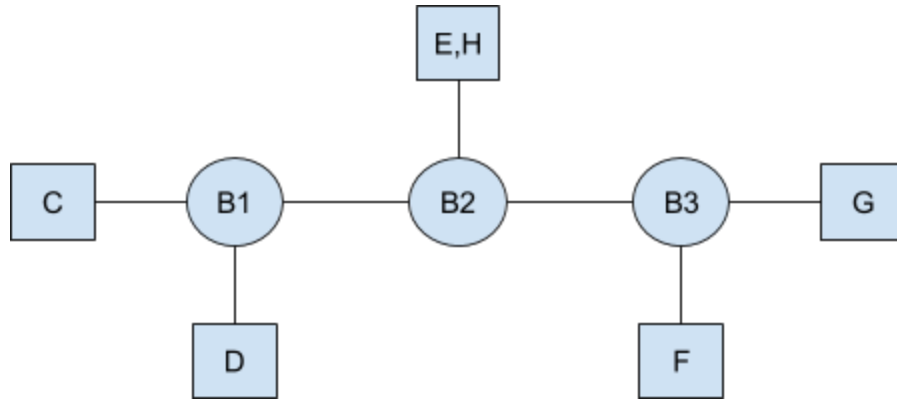
7 pts total

- 3 pts for a
 - 1 pt for sending first window and dropping frame 2
 - 1 pt for ACKing 1 until 2 gets retransmitted
 - 1 pt for fast-retransmission of 2
- 4 pts for b
 - 1 pt for sending first window and dropping frame 4
 - 1 pt for dropping frame 5
 - 1 pt for fast-retransmission of 4
 - 1 pt for timeout and retransmission of 5 and 6

General -1 pt for oddities in each answer

6. Learning Bridges [6 points]

Use the diagram below to answer the following questions. Assume the circles are bridges and the rectangles are LANs with hosts represented by letter(s) inside the rectangle. All bridges have empty tables at the beginning and the events below occur in the order presented.



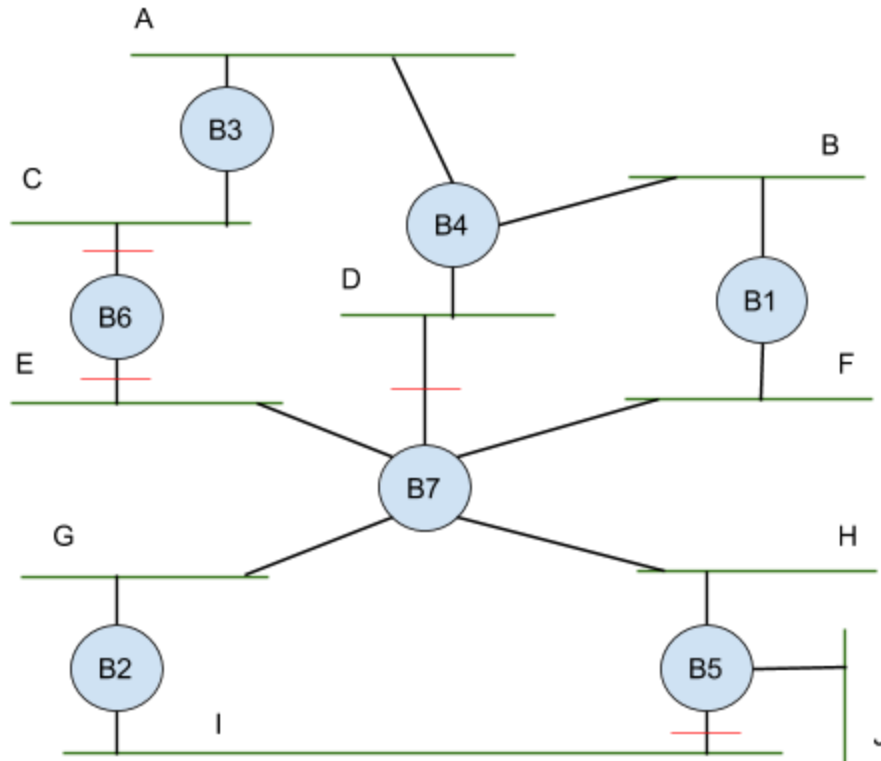
- H sends a packet to D, who receives the packet?
 - All hosts
- G sends a packet to H, who receives the packet?
 - E and H
- D sends a packet to G, who receives the packet?
 - C and G
- H sends another packet to D, who receives the packet?
 - E and D
- H sends a packet to E, who receives the packet?
 - All hosts
- E sends a packet to C, who receives the packet?
 - All hosts

6 points total

- 1 pt for correctness of each of a-f

7. Spanning Tree Question [6 points]

Given the extended LAN shown below, indicate which ports are not selected by the spanning tree algorithm.



6 points total

- 2 pts for B6
 - 1 pt for each cut of B6 (2 possible)
- 2 pts for B7
 - 1 pt for cutting the top link
 - 1 pt for not cutting any other links
- 2 pts for B5
 - 1 pt for cutting the bottom link
 - 1 pt for keeping the connection to J open

General -1 each wrongly pruned link