CSCI1690
SeungJi Lee

Homework 1

1. Problem 1: Packet switching vs. Circuit switching
    a. The networks such as the Internet are a shared network of millions and millions of people. Thus, the medium must effectively send the data of large number of people. The packet switching acknowledges this point since it keeps transferring data, thus sending the overall data as fast as possible. However, the circuit switching dedicates the communication channel for connection between two nodes. This means that when the two nodes do not constantly send data, the communication channel is empty, in other words, wasted. Thus, the speed of overall data transfer is slower than the packet switching.

    b. Packet switching: packet switching queues the packets that arrives when the network communication channel is busy. However, when there are too many packets coming in, the packet switching will simply drop the packet after queuing a certain number of packets. As the demand progressively increases, the end user will experience slower performance until the network cannot handle any more traffic.

    Circuit switching: Circuit switching establishes a connection from one end to the other end. However, when another user wants to connect to busy user, the circuit switching simply does not establish the connection. Moreover, as the demand increases, the user will find it more and more impossible to connect to the other as the line will be always busy.

    c. As the load increases, the queuing delay will increase, since increase in load will cause the packet to be queued. Morever, the increase in load will increase the chance of dropping packet and thus will increase the chance of the packet never reaching the destination.

2. Problem 2: Modulation and Encoding
    a)
        a. By Shannon's theorem, C = (3300 – 300) * $\log_2$(10^(30/10) +1) = 3000 * $\log_2$(1001), which is about 30 Kbps. Thus, this connection cannot support 56 Kbps modem.

        b. One can increase the bandwidth of the connection or the signal-to-noise ratio in order to support a 56Kbps modem.

        c. If the modem is restricted to use only a binary signal, then the level is the minimum. As shown in the email from Professor Fonseca, 2B*$\log_2$(M) = C. So the less M (level), the lower the C is. Then, the restriction of level to two will slow down the connection.
    b)

a. 7E 01 7D 7E 65 7D 7D 7D 7E 61 7E

b. The worst case is when every byte needs to be escaped. So you need to transmit 2n bytes. But you also need to signify the start and the end. Thus, you need to send 2n+2 bytes.

c)

a. The worst case scenario is when all bits are 1's. Then every 5 bits to send, we need to insert a 0. That is, we need to send (8n + (8/5)n) bits. Adding the start and end mark, we need to send total of (48/5)n + 16 bits.
b. With HDLC, we can detect a bit-stuffing error when we have more than 6 consecutive 1's. This should not happen as if 1's are part of the data, then a 0 should be inserted after five 1's. If 1's are part of the ending mark, then, it should only have 6 consecutive 1's followed by a zero. Thus, this scheme should never send 7 or more consecutive 1's.

3. Problem 3: Bandwidth, Delay, and Windows
   a. Propagation delay = distance/speed = 8 * 10^5/(2*10^8) = 5*10^(-4) sec.

   b. Transmission delay = size/bandwidth = (1250 * 8)/(10^7) = 10^(4-7) = 10^(-3) sec.

   c. Let's say we want to send a 1250-byte packet. Then, we need 10^(-3) seconds to transmit the entire packet. However, since there is a propagation delay, the receiving side receives the entire packet 5*(10^-4) seconds later. Then, the receiving side sends an ack, which has a negligible transmission delay. Then, we receive the ACK, 2*(propagation delay) after we send the entire packet. Thus, the throughput is 10^4 / (10(-3)+10^(-3)) = 5*10^6 bps = 5 Mbps.

   d. The transmission delay to send a 1250-byte packet is 10^(-3) seconds. The total delay between the end of a frame and the receiving of ACK is 10^(-3). So we have 10^(-3) seconds when the pipe is empty. So we can send one packet during that time. Thus, the send window size should be 2.

   e. We will need at least 2*SWS sequence numbers. In this case, we will need 4 or more sequence numbers.

4. Problem 4: Ethernet Networks
   a. Bridge B5 will be entirely disabled. Also B2:A, B6:I will be disabled.