**P22. Consider the GBN protocol with a sender window size of 4 and a sequence number range of 1,024. Suppose that at time t, the next in-order packet that the receiver is expecting has a sequence number of k. Assume that the medium does not reorder messages. Answer the following questions:**

1. **What are the possible sets of sequence numbers inside the sender’s window at time t? Justify your answer.**

Because the receiver is expecting a sequence number of k for the next in-order packet, the k-1 packet and packet before k-1 should have been received. So the sender’s window could be [k-4, k-1], [k-3, k], [k-2, k+1], [k-1, k+2], [k, k+3].

Because receiver is expecting k, the sender must have sent k-1, so [k-4, k-1] is possible.

And Because receiver is expecting k, the sender should not have receive k’ACK, so [k, k+3] is possible.

**b. What are all possible values of the ACK field in all possible messages currently propagating back to the sender at time t? Justify your answer.**

The possible values of the ACK field currently propagating back to the sender at time t are k-4, k-3, k-2, k-1.

Because the sequence number of k is being expected, the ACK’ value should be no more than k.

AS the sender has sent all k-4 packets and received ACK for k-4-1 from the receiver, it will be no less than n-4.

**P24. Answer true or false to the following questions and briefly justify your answer:**

1. **With the SR protocol, it is possible for the sender to receive an ACK for a packet that falls outside of its current window.**

True. Due to timeout, the packet could be retransmitted. The receiver could receive two same packet and send two ACK for it. When the sender receives the first ACK, it current window will move. And the second ACK will fall outside its current window.

1. **With GBN, it is possible for the sender to receive an ACK for a packet that falls outside of its current window.**

True. The reason is same as a. If timeout, the GBN will send all the packets after the packet who is the last one which does not receive ACK. So the packet will be sent twice. The ACK could also be sent twice. And when the first ACK is received, the window will move. And the second ACK will fall outside its current window.

1. **The alternating-bit protocol is the same as the SR protocol with a senderand receiver window size of 1.**

True. A sender window size of 1 will wait for ACK when it sends a packet which is same as alternating-bit protocol.

**d. The alternating-bit protocol is the same as the GBN protocol with a sender and receiver window size of 1.**

True. It is same as c. A sender window size of 1 will wait for ACK when it sends a packet which is same as alternating-bit protocol.

**P26. Consider transferring an enormous file of L bytes from Host A to Host B. Assume an MSS of 536 bytes.**

1. **What is the maximum value of L such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.**

There are 4 bytes = 4\*8 bits = 32 bit.

So the sequence number of bits are 2^32.

So the maximum value of L from host A to host B is 2^32bits = 4GB.

1. **For the L you obtain in (a), find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.**

The segment will be divided into 2^32/MSS = 8012999 piece.

So the total number of bytes of the header is 8012999 \* 66B = 528857934B.

The transmitted data = (2^32+528857934) = 4.824\*10^9B.

So it takes 4.824\*10^9\*8bit / 155\*10^6bps = 249s.