UNIVERSITY OF CENTRAL PUNJAB

(Faculty of IT)

Computer Communications and Networks (CCN)

Assignment No 3 **Date : 06 Jun 2023**

Total Marks: 100 **Due Date : 13 Jun 2023**

1. What actions will be taken in each of following scenarios in TCP, at sender or receiver side:-

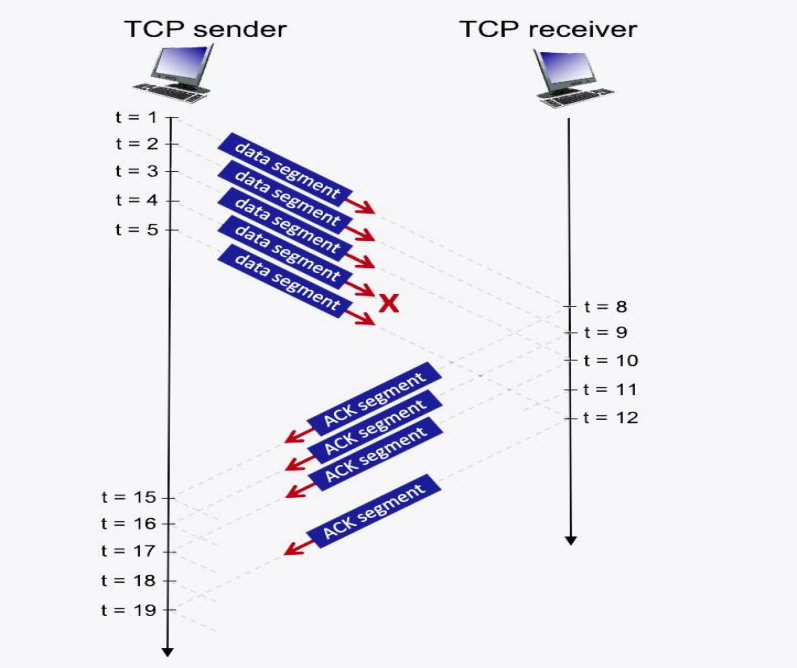
   (a) Segments with sequence numbers 1, 2, 3, 4 & 5 are sent. If sender is receiving ACK 2 again and again, what is the meaning of that. And what action sender will perform. Write down all possibilities.

   (b) Segments with sequence numbers 45, 46 & 47 are transmitted back to back. Assume all packets are successfully received, but the first ACK sent by receiver goes missing. What actions will be performed by receiver TCP, on receiving segments. How sender will know about successful transfer of all segments.

   (c) Application layer sends data to transport layer (TCP) and each segment contains following data. How sending and receiving sides assign sequence and acknowledgement numbers in TCP headers. Assume ISN as 200. Draw timing diagram showing the data transfer.
   Segment 1: 20 bytes
   Segment 2: 40 bytes
   Segment 3: 15 bytes

2. Consider given figure. TCP sender wants to send 15 segments to receiver, and sends an initial window of 5 segments at t = 1, 2, 3, 4, & 5, respectively. Suppose the initial value of sequence number is 50, and every segment sent contains 512 bytes. The delay between the sender and receiver is 7 time units; so the first segment arrives at receiver at t = 8, and ACK for this segment arrives back at t = 15.

   As shown, 4th segment is lost, but *none* of the ACKs are lost. Assume there are no timeouts; and all segments received out of order are dropped.



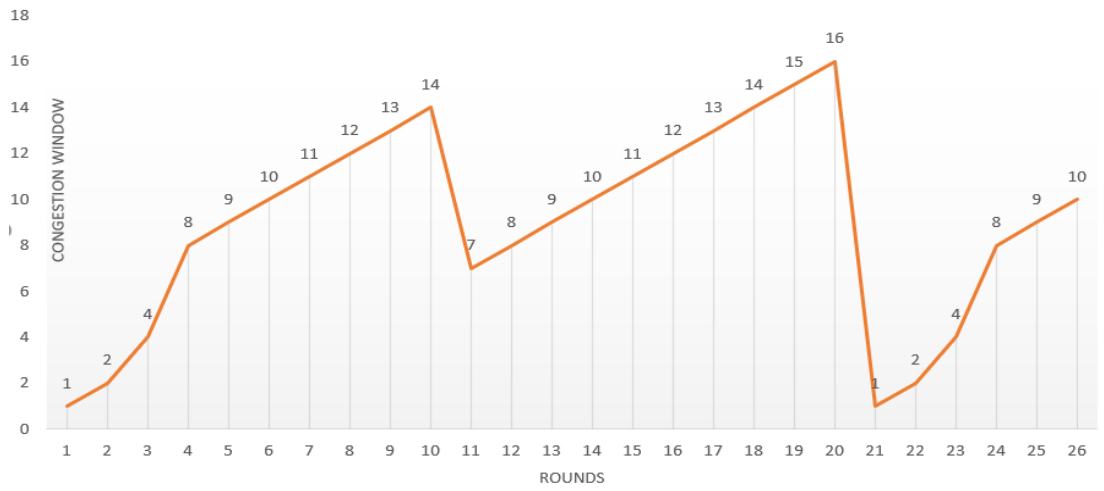
   Answer the following questions:
   a) What are the sequence numbers for each of the 15 data segments
   b) What are the values of ACK fields in each of the ACK segments

3. Consider sending a large file from one host to another over a TCP connection that has no loss.

   (a) Suppose TCP uses AIMD for its congestion control without slow start. Assuming cwnd increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times; how long does it take for cwnd increase from 6 MSS to 12 MSS (assuming no loss events).

   (b) What is the average throughout (in terms of MSS and RTT) for this connection up through time = 6 RTT?

4. Consider the following figure. Assuming TCP Reno is the protocol experiencing the behavior in the figure, answer the following questions. In all cases, you should provide a **short discussion justifying your answer** :-



   (a) Identify intervals of time when TCP slow start is operating; why SS is needed here.
   (b) Identify intervals of time when TCP congestion avoidance is in operation; why CA needed here.
   (c) Identify the intervals of time for fast recovery; what is the need for fast recovery here.
   (d) Identify time where packet loss is due to timeout.
   (e) How many ssthreshold values are used here; write all intervals and ssthreshold values.
   (f) Is there any triple duplicate ACK event; if yes identify time intervals.

5. Consider the effect of using slow start on a line with a 10 msec RTT. The receiver window is 24 KB and the maximum segment size is 2 KB. Suppose a packet is dropped when window size became 16 KB (no pkt drops afterwards), how long does it take before the first full window can be sent? (Show it through a graph).

6. Suppose that the two measured sample RTT values are 110 ms and 115 ms. Compute the TCP Timeout Interval after each of these samples is obtained. Assume the value of estimated RTT as 103 ms, and value of Dev RTT as 6 ms, just before the first of these samples were obtained. Take the value of $\alpha = 0.125$ and $\beta = 0.25$ for these calculations.

Assignment Guidelines:

*Assignment is to be done **individually** and submitted in **hard copy**.*

Assignment should have a cover page; should mention your Name, ID, Section and Assignment number.

*Assignments will **NOT be accepted after the due date.***

***Marking Criteria:** 30% marks will be awarded for complete submission of assignment; 70% evaluation will be based on Assignment Test, to be conducted in class.*