# CISC 856 TCP/IP & Upper Layer Protocols
Homework Assignment – SACK Renegable & Non Renegable
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1. Receiver's left window edge is 500 and the data sender sends 6 TCP-PDUs (each containing 100 bytes) with the sequence number starting from 500.
   (i) Draw the timing diagram which shows the behaviour of SACK generation by data receiver if 2nd, 4th and 6th TCP-PDUs are lost in the internet.
   (ii) Show the data sender's retransmission timer and what happens to the timer after the 6th TCP-PDU is lost.

   (Note: Right edge of the SACK block = Last byte of the TCP-PDU + 1)

2. From the data in Question 1,
   (i) Calculate the total length of the SACK option when the data receiver generates the SACK option for TCP-PDU #3 received.
   (ii) Calculate the total length of the SACK option when the data receiver generates the SACK option for TCP-PDU #5 received.

3. In a SACK enabled TCP connection, if the RTO (retransmission timer) times out, would the data sender retransmit only the data which are not SACKed or it would retransmit all the data which are not cum-ACKed? Give reason.

4. If the send buffer contains 100 bytes of renegable data and 400 bytes of non-renegable data, calculate the percentage of send buffer utilization.

5. In a SACK enabled TCP connection, given below is the receive buffer where the data receiver received 3 TCP-PDUs out of which two are out-of-order.
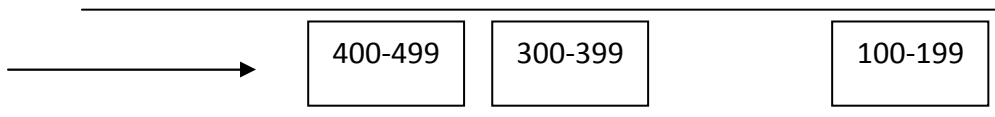
   Draw the SACK option table for the above information. Specify the values of all the SACK option fields.

6. The below timing diagram shows the data sender sends the TCP-PDUs as mentioned in the corresponding TCP-PDUs.
   (i)   Draw the send buffer and receive buffer for the below TCP connection. Specify all the ACK and SACK values. (Assume this connection as SACK enabled connection)
   (ii)   Draw the send buffer and receive buffer for the below TCP connection. Specify all the ACK and NR-SACK values. (Assume this connection as NR-SACK enabled connection)
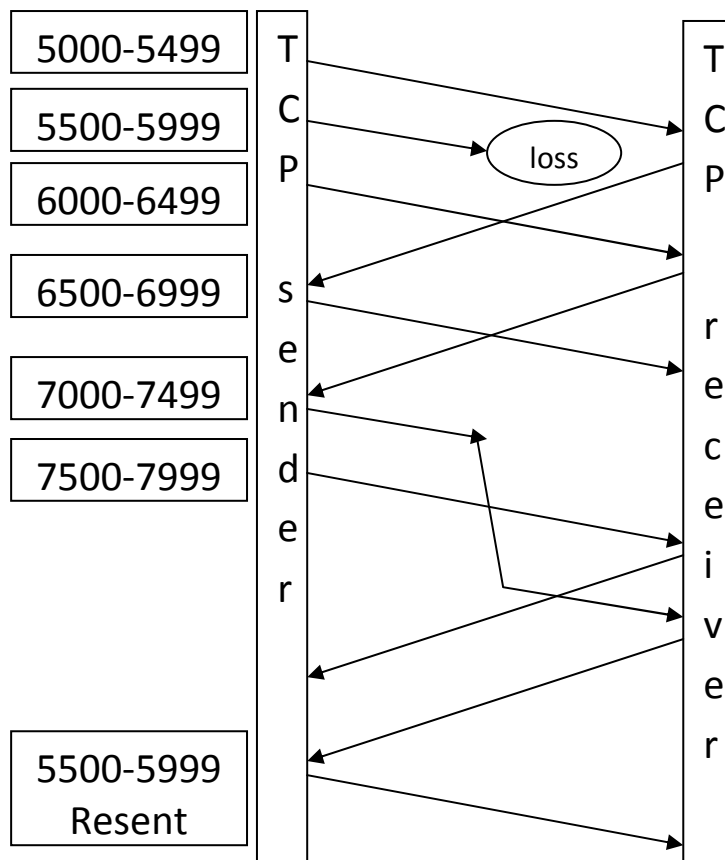
7. Print out the two TCP-PDUs that do the first SACK negotiation in the given pcap file.