ECE 461 – Internetworking

Problem Sheet 6

Problem 1. Consider the state of a sliding window at the sending side of a TCP connections as shown in Figure 1. (Each number corresponds to one byte).

(a) Explain the difference between the advertised window and the usable window.
(b) Start with the state shown in Figure 2. How many bytes can be transmitted in the shown state? What are the sequence numbers of the bytes that can be transmitted?
(c) Start with the state shown in Figure 2. Show how the advertised and usable windows change when the sender transmits a 2-byte long segment.
(d) Start with the state shown in Figure 2. Show how the advertised and usable windows change when a segment with *(AckNo=5, Window size = 5)* is received.
(e) Start with the state shown in Figure 2. Show how the advertised and usable windows change when a segment with *(AckNo=3, Window size = 5)* is received.

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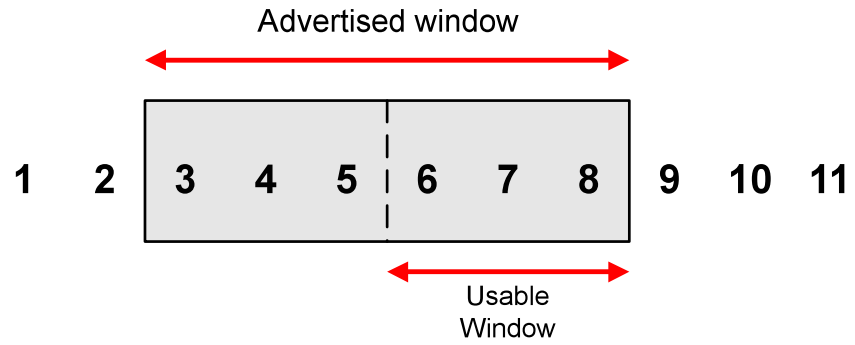
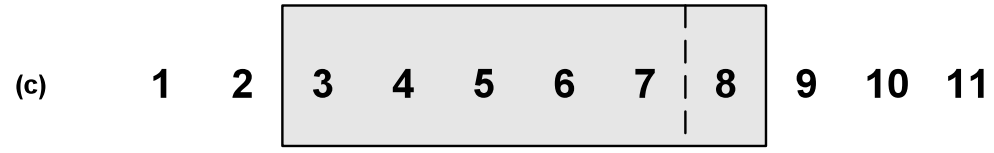
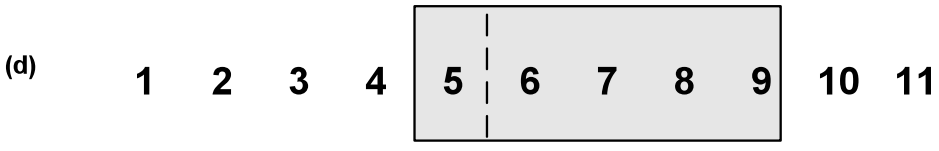
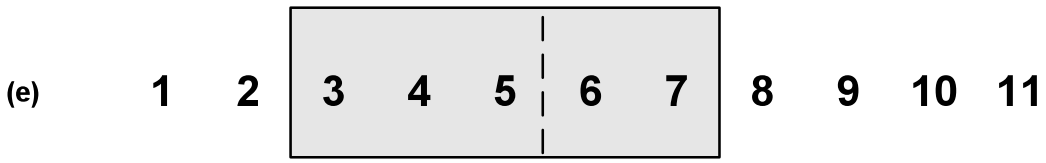


Figure 1.

(a) The advertised windows is the maximum number of unacknowledged bytes that the sender can transmit. The advertised window is set (=advertised) by the receiver. The usable windows is the advertised window minus the number of bytes which have been transmitted but have not been acknowledged.
(b) The sender can transmit 3 bytes with sequence number 6,7,8.







Problem 2. Consider a TCP connection with a roundtrip delay of 10 milliseconds. What is the maximum achievable throughput of the TCP connection? How does the throughput change if the roundtrip time increases to 40 milliseconds?

Problem 3. Assume that we have a TCP connection between A and *B*. Assume that A uses slow start and congestion avoidance with the following initial values:

Congestion window (at time=0): *cwnd=12* segment.
Slow-start threshold: *ssthresh=5* segments.
For the purposes of this problem, assume that MSS= 100 Bytes.

Assume that the following events occur at A:
Time t = 0: A sends segment with 100 bytes to B, starting with SeqNo=0.
Time t = 1: A receives an ACK with AckNo=100
Time t = 2: A sends segment with 100 bytes to B, starting with SeqNo=100.
Time t = 3: A sends segment with 100 bytes to B, starting with SeqNo=200.
Time t = 4: A receives an ACK with AckNo=100.
Time t = 5: A sends segment with 100 bytes to B, starting with SeqNo=300.
Time t = 6: A receives an ACK with AckNo=100.
Time t = 7: A sends segment with 100 bytes to B, starting with SeqNo=400.
Time t = 8: A receives an ACK with AckNo=100.

a. Describe the actions performed by TCP Tahoe at time t=8, and describe the values of cwnd and ssthresh after the actions are performed.

b. Describe the actions performed by TCP Reno at time t=8, and describe the values of cwnd and ssthresh after the actions are performed.

c. For both TCP Tahoe and TCP Reno, describe the actions performed when a timeout occurs between times t=5 and t=6.