2.993: Principles of Internet Computing
Homework #4
Due: 3/9/99

1. (*Sliding Window*) Assume the propagation delay and link capacity between two hosts, A and B, are 10 ms and 10 Mbps, repsectively. The size of a packet is 1KB. SWS=RWS=3 and the SeqNum are 0,1,2,...,7. Draw a timing diagram which illustrates packet flow between sender A and receiver B under the following conditions:

(a) (cumulative ACKs) 6 packets are transmitted from A to B, and the first packet gets lost (the first time). (In a sliding window scheme using cumulative ACKs, if packet 0 is lost and packets 1 and 2 are received, it sends no ACK till packet 0 is received. And if packet 0 is received following the receipt of packet 2, then the receiver will send an ACK for packet 2.)

(b) (selective ACKs) Repeat (a) under the assumption that an ACK is sent for every packet received. In this scenario, SWS still limits the number of unacknowledged packets. However, these packets can now be non-contiguous. (Assume a retransmission only after time-out.)

In the timing diagram, clearly label packet and ACK sequence numbers as well as the departure and arrival times.

2. Give at least one reason why the method in 1(a) is preferred over that of 1(b), and vice versa.

3. (*Go Back N*) One of the three functions of a sliding window scheme is the orderly delivery of packets which arrive out of sequence. In go-back-N, the receiver drops packets which arrive out of order. Assume the receiver sends an ACK for every packet it receives.

(a) What is the required buffer size RWS of a receiver if SWS=23?

(b) In sliding window with SWS=RWS=4, the minimum required *SeqNumSize* (the number of available sequence numbers) is 8. Calculate the minimum required *SeqNumSize* for:

i) a sliding window scheme with SWS=4 and RWS=2

ii) a go-back-N scheme with SWS=4

iii) a sliding window scheme with SWS=X and RWS=Y

4. (*End-to-end vs. link-by-link sliding window*) Hosts A and C are connected via a network node B. The two hosts can communicate by (a) establishing an end-to-end single sliding-window connection using node B as a router or by (b) establishing two separate sliding-window connections between A$\longleftrightarrow$B, and B$\longleftrightarrow$C. Assume that each link has an infinite capacity and a delay of 10 ms. Also assume that the window size of every sender is 1KB.

(i) What is the throughput in each of these cases?

(ii) What are the advantages and disadvantages of using scheme (a) over scheme (b)?

5. (*TCP Flow Control*) Refer to Lecture 8 for an example similar to this problem. Trace the window size of the source until it triggers a fast retransmission, based on the following parameters:

RTT = 1

ssthresh = 4

max. flow control window = 7

delay-bandwidth product = 3

bottleneck buffer size = 2