CS 653 Mobile Computing *Spring 2014*

Problem Set 4 **Due: Apr 10 (in class)**

Instructions

1. Submit hand-written answers. No soft copies. No printouts.
2. Clearly mention your name and roll number on the answer sheet.
3. Write down all the steps in your solution. Providing the final answer alone is not enough.
4. You may discuss the problems with your classmates, but you must write up the final solution yourself, without looking at the answers of anyone else. Also, please list the names of your collaborators on the first page of your answer sheet.

Problem 1 [5 marks]

Consider a transport flow from a fixed host A, to a wireless client C, via an access point B. The transport protocol running at A is a TCP-like protocol that keeps a window of unacknowledged packets and waits for ACKs from the receiver C. However, unlike TCP, the protocol uses a fixed window value. The one-way delay between A to B and between B and A for all packets is 100 ms each. The wireless link between B and C is the slowest link on the path. The bottleneck link B-C can transmit data packets at the rate of 100 packets/second. (Assume that the data packet size is fixed, so that data can be measured in terms of packets rather than bytes for ease of calculations.) Assume that the reverse link between C and B can send ACKs at a very fast rate with negligible transmission time. Assume that node B has an infinite buffer to store any number of packets that come from A.

a. What is the minimum RTT of a packet between A and C, considering the delay between A-B and the transmission time on the B-C link, and the time taken for an ACK to get back to A?
b. What is the minimum number of unacknowledged packets that A must send in order to fully utilize the bottleneck link? What is the throughput of the transfer in packets/second when A maintains this minimum number of packets in its window?
c. Suppose A maintains a fixed window of 10 packets. What is the average RTT (i.e., the average time from a packet being sent to an ACK coming back) of the packets? And what is the average throughput of the transport flow in packets/second?
d. What is the answer to part (c) if A maintains a fixed window of 50 packets?
e. Generalize the answer to parts (c) and (d) above and come up with an expression for the average RTT and throughput of the data transfer when A maintains a fixed window of N packets. Your answer should handle all possible values of N (you may have different answers for different ranges of N). Plot your answers (i.e., the values of average RTT and throughput) as a function of N.