15-744 Computer Networks — Spring 2015
Homework 2
Due by 3/2/2015, 5pm

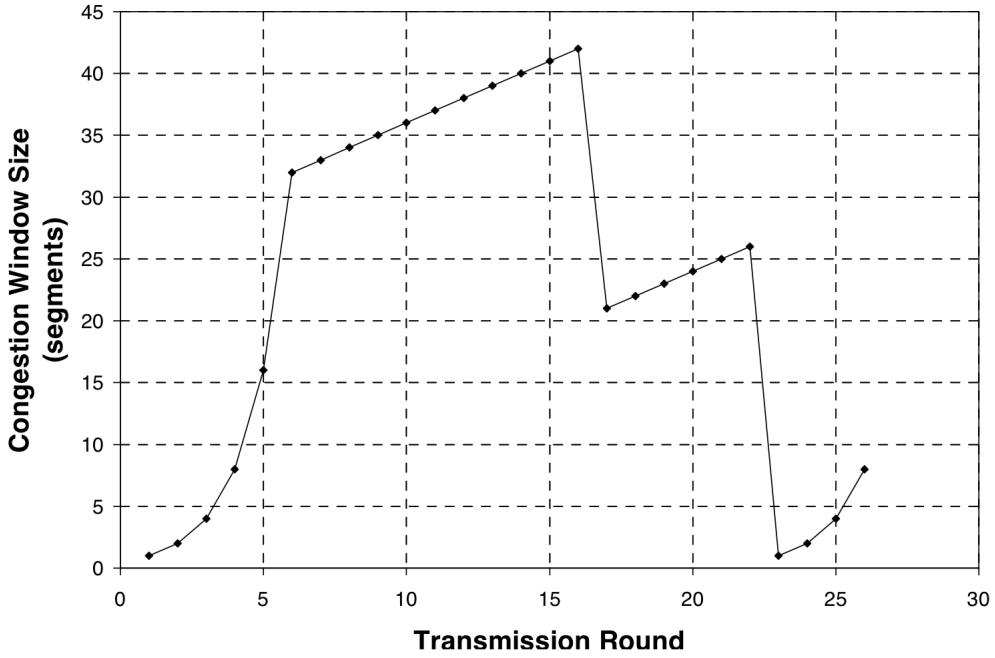
Name:

A Ethernet

1. Which of the following are advantages that RED has over drop-tail queueing?
   (a) Has less burst losses
   (b) Has shorter queueing delays
   (c) Ensures roughly equal throughput for all flows
   (d) Ensures roughly equal throughput for all TCP flows

B Transport and Congestion Control

2. Give one reason that streaming multimedia is run over UDP rather than TCP.
3. Consider the following plot of TCP window size as a function of time:



Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions.

(a) Identify the intervals of time when TCP slow start is operating.

(b) Identify the intervals of time when TCP congestion avoidance is operating (AIMD).

(c) After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

(d) What is the initial value of ssthreshold at the first transmission round?

(e) What is the value of ssthreshold at the 18th transmission round?

(f) What is the value of ssthreshold at the 24th transmission round?

(g) During what transmission round is the 70th segment sent?

(h) Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congesion-window size and of ssthreshold?

4. XCP needs to estimate the number of flows, N, going through the core routers during one control interval. This is so that it can split its throughput increase/decrease appropriately across flows. The duration of the control interval is T (recall that this is the average RTT of all flows). During this interval, the router sees many packets each of which is marked with the round-trip time of the flow (`RTT`) and the sender's congestion window (`Cwnd`). Assume that Cwnd is given as a packet count

   (a) Each packet belongs to one particular XCP flow. How many packets will that flow send *during one control interval of length T?*

   (b) Whenever a router receives a packet, it must update the counter that keeps track of the number of flows. By how much should it increase the counter for a packet with the above markings?

5. Suppose that a router has three input flows and one output flow. It receives the packets listed in the Table below, all at about the same time, in the order listed, during a period in which the output port is busy but all queues are otherwise empty.

Packet	Size	Flow
1	100	1
2	100	1
3	100	1
4	100	1
5	190	2
6	200	2
7	110	3
8	50	3

   Give the order in which the packets are transmitted, assuming :

   - Round robin
   - Fair queueing,
   - Weighted fair queuing with flow 2 having weight 2 and the other two flows having weight 1

   All three flows share the same outbound link, on which the router can transmit one packet per time unit. Assume there is an infinite amount of buffer space.

C Switch Design

6. Consider an $N \times N$ switch (N input ports, N output ports) that implements iSLIP scheduling algorithm. Assume the traffic is uniform distributed and each input port has queued cells for every output.

(a) What is the probability for a given input port to receive grant from a particular output port?

(b) What is the probability to receive no grant for this input port?

(c) What is the asymptotic approximation when N tends to be infinity?

D Tools

7. In this problem, you will get experience using ethereal (or wireshark) to do real network packet analysis. Packet traces are useful for debugging and understanding the packet-level behavior of network protocols, among other things.

   Although many CMU machines may already have ethereal installed, you will need to find a Unix machine that you have admin access on in order to capture packets on that machine. Alternatively, you can download wireshark (http://www.wireshark.org) and install it on your local Unix machine. You may have to run the program with administrator privileges (e.g. sudo ethereal) to obtain access to the network interfaces. Please contact us if you have any problems finding a machine to run ethereal or wireshark on.

   In this problem, we would like you to use ethereal/wireshark to obtain TCP sequence and delay plots for the capture of a large file.

   We would like for you to do the following:

   - Run ethereal / wireshark and be able to capture network traffic.
   - Capture the download of any suitably large file. You may use any file, but the file should take at least 5 seconds to download.

   Based on the resulting packet capture:

   (a) Generate a TCP sequence plot based on the traffic generated by downloading the file. Highlight where losses occur during the transfer.

   (b) Generate a packet delay plot, showing the per-packet delay as a function of the sequence number. (Hint: Statistics *rightarrow* TCP Stream Graph *rightarrow* Round Trip Time Graph).