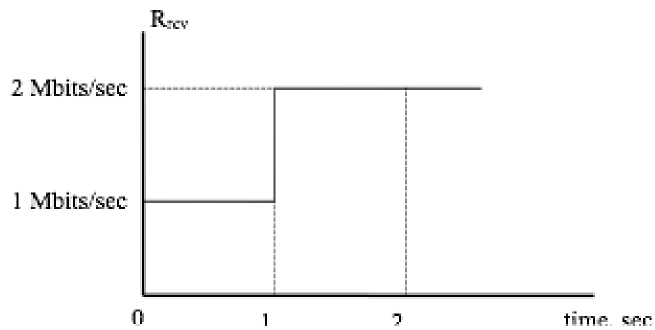
CMSC 417 Computer Networks, Section 2, Fall 2014
Homework 2
Due date: Nov 10, 2014, Monday, 10:00am

1. Suppose that R_{rcv}, the rate at which bits are arriving to a TCP receive buffer, is given in the following figure as a function of time. The application process at the receiver is removing bits from the receive buffer at a constant rate of 1 Mbits/sec (1×10^6 bits/sec). Assume that the receive buffer is initially empty and it has a fixed size of 150,000 Bytes. What is the value of the Receive Window advertised by the receiver at t = 2 sec?



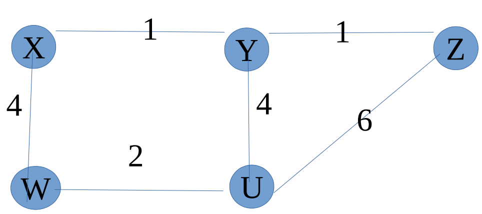
2. Suppose a TCP connection experiences round-trip times (RTT) of 20 msec for 60% of its packets, 40 msec for 30% of its packets and 100 msec for 10% of its packets. Suppose no packets are actually lost. Assume that the estimated RTT (according to the exponential weighted moving average) is equal to the true (ensemble) average of RTT, i.e., EstimatedRTT = average value of RTT = E[SampleRTT].
Assume that the timeout is set to **2 (two)** times the estimated RTT (as in the original version of TCP), i.e., TimeOut = 2 x EstimatedRTT. What fraction of the packets will be assumed lost by the TCP sender?
Currently used versions of TCP estimate both the mean and the mean deviation (the mean deviation is the average absolute distance of RTT samples from the estimated RTT), and sets the timeout to the estimated mean (estimatedRTT) plus **4 (four)** times the estimated deviation (devRTT), i.e., TimeOut = EstimatedRTT + 4 x devRTT. Assume that the TCP connection uses this new method, and the estimated RTT and deviation are equal to their true (ensemble) values, i.e., EstimatedRTT = E[SampleRTT] and devRTT = E[|SampleRTT-EstimatedRTT|]. What fraction of the packets will be assumed lost by the TCP sender?

3. Suppose two applications running at Host A and Host B are communicating using a TCP connection. Assume by time t, Host B has already received all the bytes up to and including byte 300 from Host A and the application running on Host B has read all these bytes from the TCP (socket) buffer at Host B (i.e., all bytes 1...300 are received and given to the application). After time t, Host A is sending 3 TCP segments back-to-back to Host B. Segment 1 has 70 bytes of data in it, segment 2 has 40 bytes of data and segment 3 has 50 bytes of data in it (these are the size of data, not including the headers). Assume, segment 2 arrives first to Host B, then segment 1, and then segment 3. After each segment is received, Host B sends an ACK immediately. Assume there are no packet/ACK losses and no timeouts happened. Assume the size of TCP receive-buffer at Host B for this connection is 2000 bytes. Assume, after time t, the application at Host B will not read data from the corresponding socket before all ACKs corresponding to these 3 segments are sent. What will the acknowledgement and receive-window field values in the three ACK packets sent from Host B to host A?

4. Assume that the bandwidth of a connection is 10 Mbits/sec (10x106 bits/sec) and the round-trip propagation delay for the connection is 15 msec. Assume that each data segment is 1000 Bytes long including the headers. Assuming that no packets are lost, what should be the minimum window size (in terms of data segments) in order to achieve full bandwidth utilization for this connection?

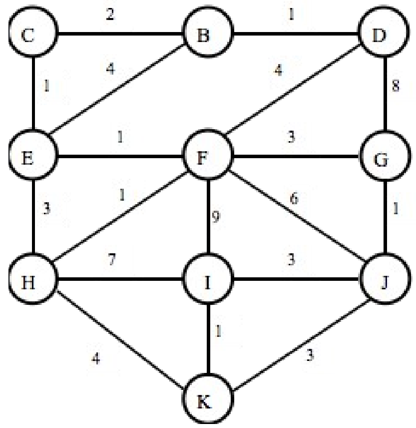
5. The network below uses the distance-vector routing algorithm **without poisoned reverse**. Assume the following:

- Links have the same cost in both directions.
- Nodes exchange their routing info once every second, in perfect synchrony and with negligible transmission delays. Specifically, at every t = k, k = 0, 1, 2, 3,..., each node sends and receives routing info instantaneously, and updates its routing table; the update is completed by time t=k+0.1.
- At time t = 0, the link costs are as shown below and the routing tables have been stabilized. At time t = 0.5, the link **(Y,Z) becomes 16**. There are no further changes in the link costs.
- Route advertisements are **only exchanged periodically**, i.e., there are no immediate route advertisements after a link cost change. Hence the first route advertisement after the link cost change at t = 0.5 occurs at t = 1.0. *Note:* However, whenever a link cost change occurs, two nodes at the endpoints of this link immediately make corresponding changes in their distance tables.
- Give the evolution of the distance table entry for Z at each node for t = 0.1, 0.5, 1.1, 2.1, ..., **until** all distance values stabilize.



Time t	At Node X	At Node Y	At Node W	At Node U
0				
0.5				
….				

6. Execute the Dijkstra algorithm at node B for the network shown below by filling in a table like the one given. In the table you will complete, you need to give the distance (cost) of each node to Node B.



Iteration	**Set M**	C	D	E	F	G	H	I	J	K
0										
1										
2										
...										

7. Solve Question 3.47 in our textbook.

8. Solve Question 6.7 in our textbook.

9. Solve Question 6.11 in our textbook.