CS 421: Computer Networks **SPRING 2008**

MIDTERM
April 10, 2008
120 minutes

Name: ______________________________

Student No: ___________________________

Show all your work very clearly. Partial credits will only be given if you carefully state your answer with a reasonable justification.

Q1	
Q2	
Q3	
TOT	

1)

a) I own a company named mycomp. The following table gives the DNS records for mycomp.

Name	Type	Value	TTL
mycomp.com	A	142.198.13.118	86400
bafa.mycomp.com	A	142.198.11.98	86400
golcuk.mycomp.com	A	142.198.15.235	86400
mycomp.com	NS	ss1.mycomp.com	86400
mycomp.com	NS	myser.myorg.org	86400
mycomp.com	MX	golcuk.mycomp.com	86400
www.mycomp.com	CNAME	bafa.mycomp.com	86400

i) (4 pts) If you type http://www.mycomp.com into your web browser, to which IP address does your browser connect?

ii) (4 pts) If you send an e-mail to boss@mycomp.com, to which IP address does your e-mail get delivered?

iii) (4 pts) The TTL field for all the records are chosen as 86400 seconds (1 day). What might be a possible disadvantage of choosing a longer TTL value?

iv) (4 pts) What might be a possible disadvantage of choosing a shorter TTL value?

b) (5 pts) Why does your e-mail client first contact with your local SMTP server when you send an e-mail instead of directly contacting with the SMTP server of your e-mail's recipient?

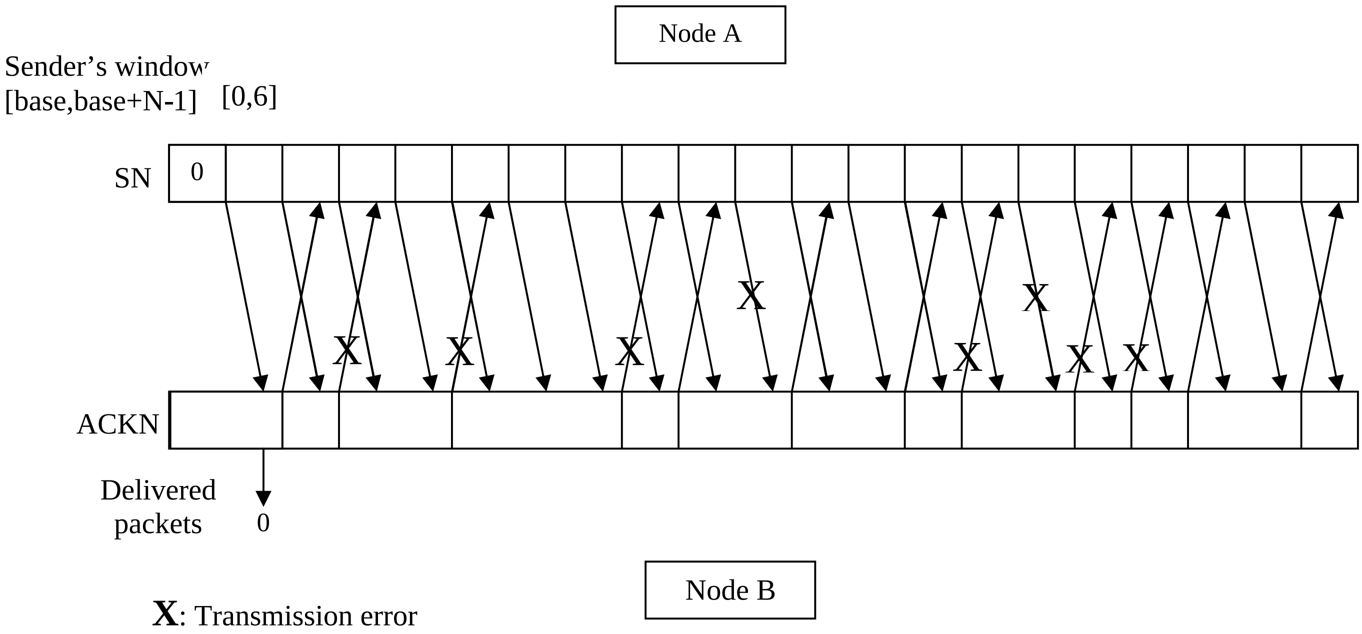
c) (5 pts) Suppose you want to implement a reliable transport protocol for a connection with a very low packet loss and error rate, e.g., 10^{-12}. Which one of the Go-Back-N and Selective Repeat protocols will you prefer? Why? Explain your reasoning.

2)

a) (8 pts) Assume that the bandwidth of a connection is 100 Mbps (100×10^6 bits/sec) and the round-trip propagation delay for the connection is 20 msec. Each data packet is 2,500 Bytes long and the ACK packets have negligible lengths. Assume that you use the Selective Repeat protocol. What should be the minimum window size (in segments) in order to achieve a bandwidth utilization of at least 80%, i.e., $U_{sender} \geq 0.8$? What is the minimum number of bits necessary to represent the sequence number for proper operation of the Selective Repeat protocol?

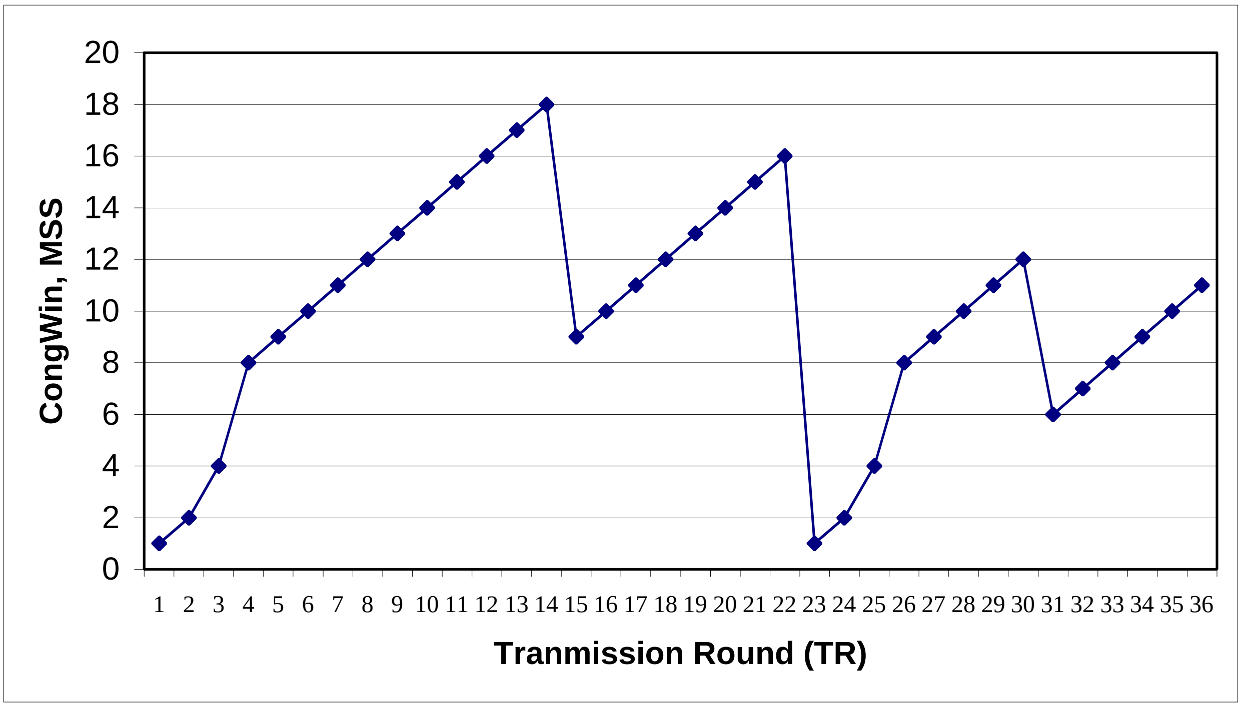
b) (15 pts) Consider a 1 Mbits/sec channel with a 20 msec one-way propagation delay, i.e., 40 msec roundtrip propagation delay. We want to transfer a file of size 15000 Bytes. Each packet has a total size of 1625 Bytes including the 125 Bytes header, i.e., each packet contains 1500 Bytes of data. When there is data to be transmitted, each packet contains the maximum number of bytes. Assume that ACK packets are of 125 Bytes long and there is a processing delay of 1 msec after a packet is fully received at the receiver until the transmission of the corresponding ACK is started. **Selective Repeat** protocol is used with a window size of N = 5 packets. Assume that every 4^{th} packet crossing the forward channel is lost while ACKs are not lost or corrupted. How much time is required to complete the transfer of the whole file and receive the final ACK at the sender? Assume that the timeout for each packet is set to 60 msec starting from the end of the transmission of the packet.

c) (15 pts) Consider the use of Go-Back-7 protocol for communication from Node A to Node B. Assume that when the sender reaches at the end of the window, i.e., all packets in the window are sent but not ACK'd, the sender goes into timeout, i.e., it goes to the beginning of the window and retransmits all packets in the window, as if the timeout occurred. In the following figure, indicate the sequence number (SN) for packets sent from A to B, the ACK number (ACKN) for packets sent from B to A, the times and SN of the packets at B delivered to the application layer, and the window kept at A. **Note that packets received during the transmission of another packet will be immediately processed, but the corresponding action, e.g., update of SN/ACKN, will take effect with the start of transmission of the next packet.**



3)

a) (8 pts) Consider the figure below showing the Congestion Window for a TCP Reno connection as a function of time. The x-axis (time axis) denotes the Transmission Round (**TR**), where each tick corresponds to one round-trip-time (RTT) (assume that data packets and ACKs have negligible transmission times). The y-axis is the Congestion Window in segments at the beginning of each TR. Use the table provided below in order to identify the time intervals during which Congestion Control algorithm is in a certain phase, i.e., Slow Start (**SS**) or Congestion Avoidance (**CA**), the value of the Slow Start threshold (**ssthresh**) during that time interval and the reason for the phase change which ends that time interval for TR = 1,…,36.



Time Interval [starting TR,ending TR]	Phase (SS or CA)	ssthresh (in segments)	Event causing phase change at the end of this interval
[1 ,]			
[,]			
[,]			
[,]			
[,]			
[, 36]			

b) (8 pts) Consider the RTT estimation algorithm for setting the retransmission TimeOut used by TCP as we discussed in the class:

$$\text{EstimatedRTT}(k+1) \leftarrow (1 - \alpha)\ \text{EstimatedRTT}(k) + \alpha\ \text{SampleRTT}(k+1)$$

for k = 1,2,…, where EstimatedRTT(1) = SampleRTT(1). Assume that $\alpha = 1/8$.

The first segment of the TCP connection times out in its first transmission attempt, RTT of this first segment in its second transmission attempt is 1 msec, RTT of the second segment in its first transmission attempt is 2 msec, and RTT of the third segment in its first transmission attempt is 1 msec. What value of EstimatedRTT(2) will be generated by the above algorithm?

c) (8 pts) Assume that the congestion window of a TCP flow was 12 segments long when a **timeout** occurred. Assume that there are no segments or acknowledgments of this flow that were in transit when the timeout occurred. The round trip delay for the flow is fixed and is equal to 40 msec. The transmission time for a segment is 5 msec. The receive window is fixed at 100 segments for the entire duration of the connection. How long will it take for the flow to reach the Congestion Avoidance phase after the timeout, assuming that no further segments are lost until reaching the Congestion Avoidance phase?

d) Consider the following network. Hosts A, B and C are connected to each other via router R. The bandwidths of the links A-R and R-B are R1 and R2, respectively, while the bandwidth on the link C-R is infinitely large. There are two TCP connections: A-B and C-B, and the roundtrip delays for both connections are equal. Let x and y denote the throughputs achieved by connections A-B and C-B, respectively. Assume that TCP's AIMD algorithm reaches the steady-state for both connections.

i) (6 pts) Assume that R1>R2/2. What are the values of x and y (as functions of R1 and R2)?

ii) (6 pts) Assume that R1<R2/2. What are the values of x and y (as functions of R1 and R2)?