CS 421: Computer Networks **SPRING 2013**

MIDTERM
March 28, 2013
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) (5 pts) If local DNS name servers cache host name-IP address mappings for a long time, e.g., 1 week, will there be a problem in providing correct IP addreses in response to DNS queries?

b) (5 pts) Does FTP use persistent connections or non-persistent connections or both? Explain your reasoning.

c) (5 pts) Give two different types of applications for which an application developer will prefer using UDP instead of TCP.

d) (5 pts) Suppose that we want to transfer a file over a connection with a large packet loss rate. Which one will you prefer: Go-Back-N or Selective Repeat? Explain your reasoning.

e) (6 pts) Give two advantages of using cumulative acknowledgements instead of selective acknowledgements.

f) (6 pts) Suppose that the TCP fast retransmission algorithm is modified such that a segment is retransmitted when **one** duplicate ACK for that segment is received (instead of **three** duplicate ACKs as in the original TCP). What would be a negative effect of this modification?

2)

a) (12 pts) Consider a connection with a **20 msec** roundtrip, delay (including all delays incurred within the network, but excluding the packet transmission time of the sender). We want to transfer a file composed of **16 segments** (with sequence numbers from 1 to 16), where each segment has a transmission time of **1 msec**. Assume that ACK segments have negligibly small size and there is no processing delay at the receiver. Assume also that the processing delay at the sender after an ACK is received is negligible. We assume that the communication between the sender and receiver is full duplex, i.e., sender can send data segments while receiving an ACK segment. **Selective Repeat** protocol is used with a window size of **N = 8** segments. Assume that all data segments are received correctly while the **first transmissions** of the **data segments** with sequence numbers **6** and **10,** and **ACK segment** with acknowledgment number **14** are errored, whereas **all other data** and **ACK segments are fully reliable**. The timeout for each data segment is set to **25 msec starting from the end of the transmission of the segment**. How much time is required to complete the transfer of the whole file and receive the **final ACK** at the sender?

b) (12 pts) Answer the above Question a) when **Go-Back-N** protocol is used with a window size of **N = 8** segments. Each window of the sender has a timeout of **25 msec** starting from the time when the window is set by the sender.

c) (8 pts) A TCP sender is transmitting 512 Byte segments over a 100 Mbps (100×10^6 bits/sec) connection which has a 20 msec round-trip delay. Assume further that a very large amount of data is transferred and no packets are lost or errored. The sender utilization (U_{sender}) is defined as the percentage of time the sender is busy transmitting segments. Assume that the TCP window scaling is not used for this connection. What is the maximum value of U_{sender} possible for this connection? *Hint:* The receive window field in the TCP header is 2 Bytes long.

3)

a) (8 pts) Consider the TCP round-trip time and timeout estimation algorithm:

$$\text{EstimatedRTT} = (0.875 \times \text{EstimatedRTT}) + (0.125 \times \text{SampleRTT})$$

$$\text{DevRTT} = (0.75 \times \text{DevRTT}) + (0.25 \times |\text{SampleRTT} - \text{EstimatedRTT}|)$$

$$\text{Timeout} = \text{EstimatedRTT} + 4 \times \text{DevRTT}$$

Suppose that a TCP connection currently has the values of EstimatedRTT = 24ms and DevRTT = 8ms. The next segment transmitted over the TCP connection experiences a timeout and the acknowledgment for that segment arrives 40ms after the retransmission. The SampleRTT for the segment transmitted next over the TCP connection is measured as 16ms. Calculate the last value of the Timeout obtained for this TCP connection.

b) Assume that the initial sequence number used by a TCP sender is 2000. TCP sender starts in the Slow Start phase of the congestion control algorithm (assume that ssthresh is initially very large) and transmits a TCP segment with length MSS = 1500Bytes. The sender then receives an ACK segment with an acknowledgement number 3500 and a receive window 5000. The sender then sends two segments each with length 1500Bytes. The next ACK segment the sender receives has an acknowledgement number 5000 and a receive window RW.

i) (5 pts) If RW = 3000, what is the maximum number of bytes that the sender can transmit further without getting another ACK segment from the receiver?

ii) (5 pts) If RW = 5000, what is the maximum number of bytes that the sender can transmit further without getting another ACK segment from the receiver?

c) (10 pts) Suppose that a file composed of 127 segments each with size 1000Bytes will be transferred over a TCP connection with a round-trip delay of 20ms and bandwidth of 10Mbps, i.e., 10×10^6 bits/second. Assume that no loss event occurs during the entire file transfer. Further assume that the slow start threshold (ssthresh) at the beginning of the TCP connection is infinitely large. Ignore all processing and queueing delays. How long does it take to transmit the entire file and receive the final ACK?

d) (8 pts) Consider the two TCP connections shown in the following network. Assume that all three links have a capacity of 100Mbps and each link has the same delay. Calculate the average throughputs obtained by each connection.