CS 421: Computer Networks **FALL 2012**

MIDTERM
November 14, 2012
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) Suppose that a Web server is currently serving n clients. How many TCP sockets are used at the server now?

b) (6 pts) If DNS local name servers cache host name-IP address mappings for a long time, e.g., 1 week, will there be a problem in providing correct DNS replies in response to DNS queries?

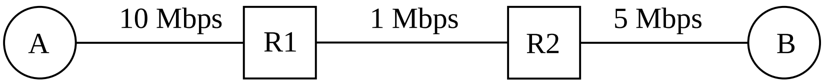
c) (5 pts) In the TCPServer.java code that we discussed in class, why the server does not close the connection socket immediately after it sends the reply message to the client?

d) (6 pts) Why does an application using UDP have more control of when the segment is sent compared with an application using TCP?

e) (6 pts) List two advantages of using cumulative acknowledgements as opposed to selective acknowledgements.

2)

a) (10 pts) Assume that there are 3 links on a path connecting hosts A and B passing through routers R1 and R2 as shown in the following figure. Each link has a distance of 600 km and the transmission rate of each link is shown in the figure. We are transmitting a file composed of **eight packets** from node A to node B using datagram packet switching. Each packet has a length of 1250 Bytes including all headers. Assume that the processing and queuing delays in each intermediate node are negligible and the propagation speed is 2×10^5 km/s. Calculate the total delay incurred in transferring the file from host A to host B.



b) (12 pts) Consider a connection with a 2**0 ms** 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 ms**. 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 **7** and **13,** and **ACK segment** with acknowledgment number **15** are errored, whereas **all other data** and **ACK segments are fully reliable**. The timeout for each data segment is set to **25 ms 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?

c) (12 pts) Answer the above Question b) 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 **ms** starting from the time when the window is set by the sender.

3)

a) (6 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 $k = 1,2,\ldots$, where EstimatedRTT(1) = SampleRTT(1) and $0 < \alpha < 1$.

RTT of the first segment is 12ms. The second segment has an RTT of 28ms, and RTT of the third segment is 24msec. If EstimatedRTT(2) = 16ms, calculate EstimatedRTT(3) generated by the algorithm.

b) (8 pts) Consider a Web client and server that are connected by a link of rate R bps. Suppose that the client wants to download an object of size 15S from the server, where S denotes the maximum segment size (MSS). The round-trip delay between the client and server is constant, given as RTT, where RTT = 3S/R. Assume that the initial value for the ssthresh parameter is very large and there are no lost or errored segments during the whole object transfer. Ignore all protocol headers. Calculate the time for the client to retrieve the object (including TCP connection establishment delay) in terms of S/R.

c) A TCP connection uses a 16 Mbps link which does not buffer any packets. Suppose that there are no other connections using this link and this link is the only congested link for the given connection, i.e., all other links along the connection have much larger available capacity. Assume that the TCP sender has a huge file to send. The receive buffer at the TCP receiver can be assumed infinitely large. Each TCP segment is 1000 bytes, and the round-trip propagation delay for this connection is 100ms.

   i) (8 pts) Calculate the maximum congestion window size, in segments, that this TCP connection can achieve.

   ii) (8 pts) Assuming that the TCP congestion control algorithm is always in the congestion avoidance phase, calculate the average congestion window size (in segments) and average throughput (in bps) for this connection.

d) (8 pts) Two TCP connections are sharing a link with capacity of 100 Mbps ($100\text{x}10^6$ bps). Assume that the bandwidth bottleneck for both connections is this shared link. The roundtrip delays for the connections are 30 ms and 90 ms, respectively. Calculate the average throughputs achieved by each connection.