CS 421: COMPUTER NETWORKS **SPRING 2006**

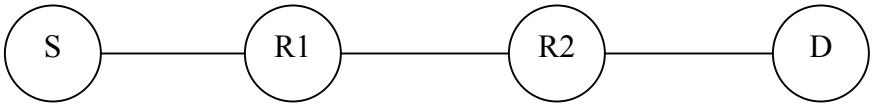
FINAL
May 20, 2006
150 minutes

Name: _____

Student No: _____

1)

a) (12 pts) We want to transfer a file of size M Bytes from S to D in the datagram based packet switching network shown below using UDP as the transport layer protocol. Node S segments the file into packets of size P Bytes and adds a 20 Byte header to each packet, i.e., each packet contains P+20 Bytes. Assume that links (S-R1), (R1-R2) and (R2-D) have transmission rates of R bits/sec, and each link has propagation delay of Δ seconds in each direction. Also assume that there is a fixed processing delay of δ seconds at R1 and R2 and all queuing delays are negligible. Determine the value of the data payload size P that minimizes the total delay of transferring the file from S to D. For simplicity, you can assume that M is an integer multiple of P.



b) (6 pts) What is the difference between flow control and congestion control?

c) (6 pts) Consider the Selective Repeat protocol. Assume that we have a round trip time (RTT) of 20 msec for a connection. Assume that each segment has a size of 1 KByte (1024 Bytes) and the bandwidth of the connection is 1 Mbits/sec. Assume that there are no packet losses in the network. What is the smallest window size (in segments) for which there will be no stalling by the sender, i.e., the sender never stops sending segments?

d) (6 pts) Suppose that no packets are lost during a TCP connection. Is it possible that the fast retransmission mechanism is triggered for this connection? Why or why not? Briefly explain your reasoning.

2)

a) You are managing the IP network of a school. The school owns four buildings, which are located next to each other. The number of students working in each building is 280 in building 1, 190 in building 2, 260 in building 3 and 100 in building 4. You decide that each building should have its own subnet. Suppose you need to assign the subnet addresses to these buildings from the address block 140.118.192.0/21. Answer the following questions.

i) (6 pts) Split the block into four chunks, one for each subnet. Assign the chunk with the lowest addresses to building 1, and the next chunk to building 2, and so on. Use the following table to show the addresses of the three subnets that you have created (show each block in CIDR format, i.e., "a.b.c.d/e").

Building	# of students	Subnet address (CIDR format)
1	280	
2	190	
3	260	
4	100	

ii) (4 pts) Suppose a new school building will be built, where there will be 400 students. Do you have sufficient space in the previously assigned address block for this new building? If your answer is yes, write the subnet address that you will assign to this building in CIDR format.

b) (6 pts) Name three methods/algorithms/protocols that help in making more efficient use of IP addresses.

c) (6 pts) Which is easier to deploy in the Internet: a new Network Layer protocol or a new Transport layer protocol? Why?

d) (8 pts) List the set of CIDR addresses (in the format a.b.c.d/e) that a router will use to advertise the following six address blocks if the router wants to send the **minimum** number of prefixes to its neighbors. Make sure that the prefix(es) that you give includes all the addresses below, but no other addresses are included.

159.218.100.0/22
159.218.104.0/22
159.218.108.0/22
159.218.112.0/22
159.218.116.0/22
159.218.120.0/22

3)

a) Consider the wireless network composed of four nodes, which has a linear topology deployed along a highway, as shown below. The distance between neighboring nodes is equal. Assume all nodes are using 802.11 MAC with RTS/CTS frames. The radio range for each node is fixed, and this radio range is slightly longer than the inter-node distance, i.e., each node can reach only its left and right neighbors. Assume that if there are two simultaneous transmissions within the radio range of the receiver, both transmissions will be unsuccessful.

i. (6 pts) Assume that node A is currently sending a data frame (not an ACK, an RTS, or a CTS) to node B. Node C wants to send a packet to node D. Assume that node C (and only C) ignores the 802.11 MAC and sends the packet, would C's packet arrive successfully at D? Would A's packet arrive successfully at B? Explain your reasoning.

ii. (6 pts) Consider the same situation as above except that all nodes are using the 802.11 MAC. Will C start transmission while A is sending the data packet? Why or why not? If not, how does C know that A is transmitting a data frame?

iii. (4 pts) Using all the information that C receives regarding the 801.11 MAC, is there any way that C can know when A's transmission will end?

b) (6 pts) Why is the collision detection mechanism not implemented in wireless local area networks?

c) (8 pts) Suppose the data bit sequence 110011110 is to be transmitted using the generator sequence 100000111. Compute the CRC bits and the transmitted bit sequence. If the most significant **three** bits in the received sequence contain bit errors, determine whether this error can be detected by the receiver.

d) Suppose that nodes A and B are connected to the same Ethernet. Assume that nodes A and B are trying to retransmit two frames that have already experienced 6 and 3 collisions, respectively, i.e., collision counters are 6 and 3 for nodes A and B. Assume further that all other nodes on the Ethernet are inactive.

i. (5 pts) Assuming that nodes A and B detected the last collision simultaneously, what is the probability that A and B will collide at the next retransmission attempt?

ii. (5 pts) Assume that A and B chose backoff times in (i.) such that they collided again. What is the probability that A and B will also collide at the next retransmission attempt?