CS 421: COMPUTER NETWORKS **SPRING 2009**

FINAL
May 29, 2009
150 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) (8 pts) I wrote down a UDP based ping program, which can send ping request packets of variable size. I made some measurements using this tool by pinging the nearest router from my computer: the router has a ping time of 2 ms for ping request packets of 125 Bytes long and 9 ms for ping request packets of 1000 Bytes long. Assume that ping reply packets are negligibly small and ignore all processing delays. What is the round-trip propagation delay and transmission rate of the link connecting my computer to the router?

b) (8 pts) Assume that the bandwidth of a connection is 1 Mbps ($1x10^6$ bits/sec) and the round-trip propagation delay for the connection is 20 msec. Assume that each data packet is 250 Bytes long and the ACK packets are 25 Bytes long. Assuming that no packets are lost, what should be the minimum window size (in data packets) in order to achieve full bandwidth utilization when Selective Repeat protocol is used? What is the minimum number of bits necessary to represent the sequence numbers for proper operation using this window size?

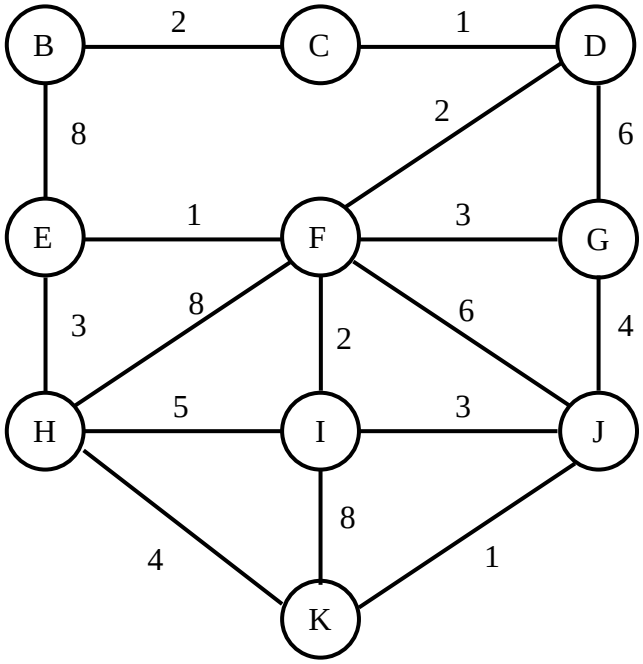
c) (5 pts) Assume that you want to reliably transfer a large file over a connection with a high packet loss rate and large delay. Which of the two reliable data transfer protocols will you choose in order to transfer the file more quickly: Go-Back-N or Selective Repeat? Fully justify your answer.

d) (5 pts) In TCP, will the loss of an acknowledgment of a segment always result in a retransmission of that segment? Why or why not?

e) (8 pts) Suppose that the TCP congestion window, CongWin, at a TCP sender is currently 7 KB and the slow start threshold, ssthresh, 10 KB (assume that 1KB=1000 Bytes). Assume that the maximum segment size, MSS, is 1000 Bytes. After the sender sends 7 segments for a total of 7 KB of data and receives all the ACKs for the data transmitted, what will be the final value of CongWin in units of KB?

2)

a) (8 pts) Execute the Dijkstra algorithm **at node B** for the network shown below by filling in the following table. In the table, you need to give both the distance *D(v)* and the previous node *p(v).*



iter.	*N*	*D(C), p(C)*	*D(D), p(D)*	*D(E), p(E)*	*D(F), p(F)*	*D(G), p(G)*	*D(H), p(H)*	*D(I), p(I)*	*D(J), p(J)*	*D(K), p(K)*

b) (6 pts) You are given the assignment of setting subnet addresses for 4 buildings of your company. The number of Internet connected PCs in each building is given in the following table. Assume that the 131.155.192.0/19 address block is given to you for this purpose. Use the following table to show the addresses of the four subnets that you created.

Building	# of PCs	Subnet address (CIDR format)
1	2200	
2	1620	
3	550	
4	500	

c) (8 pts) Suppose host A transmits a 1900 Byte IP packet (including the 20 Byte IP header) over a 2-hop path to host B. The MTU of the first link (A to router) is 900 Bytes (IP header plus data), and the MTU of the second link (router to B) is 500 Bytes (IP header plus data). Assuming that IP header does not contain any options, indicate the length (in Bytes), more flag, and offset field values **(specify the offset values in units of 8 bytes)** of the fragment(s) transmitted over each link in the tables below.

First link

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			

Second link

Fragment	Length	Offset	Flag
1			
2			
3			
4			
5			
6			

d) (5 pts) State the two main reasons why the Internet has a hierarchical routing architecture.

e) (5 pts) Suppose that a router has a packet destined for a host in another autonomous system (AS). In the processing of this packet at the router, does intra-AS routing algorithm take any role? If so, what is its role?

3)

a) (8 pts) Given the following 8-bit pattern data 11011011 and the generator sequence 10101, compute the CRC bits and give the transmitted bit sequence. If the **least significant three** bits in the received sequence contain bit errors, determine whether this error can be detected by the receiver.

b) 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 4 and 2 collisions, respectively, i.e., collision counters are 4 and 2 for nodes A and B. Assume further that all other nodes on the Ethernet are inactive.

   i. (5 pts) 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 once more. What is the probability that A and B will collide again at the next retransmission attempt?

c) (6 pts) Consider an Ethernet LAN using CSMA/CD running at 100 Mbits/sec over a cable of length d. The propagation speed for the signal over the cable is $2x10^8$ m/sec and the minimum frame size is 64 Bytes. Compute the maximum value for d such that CSMA/CD algorithm will work properly.

d) (5 pts) IP addresses are hierarchical resulting in a more scalable routing architecture. On the other hand, MAC addresses are flat. Why is the scalability issue not as significant in the link layer as the network layer?

e) (5 pts) Although Ethernet uses a CRC mechanism for error detection, it is still considered as an unreliable protocol. Why?