

CS 421: COMPUTER NETWORKS

FALL 2005

FINAL
December 27, 2005
150 minutes

Name: _____

Student No: _____

1)

- a) (6 pts) I want to send an e-mail from my gmail account to my friend who has a hotmail account. List all the steps at the application layer that occur when I send this message to my friend (assume each host has all the necessary DNS mappings), and when my friend retrieves the message. For each step explain what messages are sent, who is the sender and the receiver and which application layer protocol is used.
- b) (6 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 first hop router from my computer: the router has a ping time of 90 μ sec for packets of 500 Bytes long and 250 μ sec for packets of 1500 Bytes long (1 μ sec = 10^{-6} sec). Assume that the router simply echoes back the ping request message and transmission rates at both directions are same. What is the propagation delay and transmission rate of the link connecting my computer to the router?
- c) (6 pts) Suppose you are assigned the task of designing a 100 Mbits/sec (100×10^6 bits/sec) point-to-point link which will be set up between the Earth and a new lunar colony. The distance from the Earth to the Moon is approximately 385,000 km, and data travels over that link at the speed of light, i.e., 3×10^5 km/sec. Suppose you are using the Selective Repeat protocol for this link. How large your window size should be, in KBytes, so that your sliding window protocol can use all the available bandwidth (1 KByte = 1024 Bytes)?
- d) (6 pts) Suppose you use 1KByte packets for communication between the Earth and the Moon over the link you are designing. What is the minimum number of bits necessary for representing the sequence numbers corresponding to the window size that you computed in part (c.) so that the Selective Repeat protocol will work properly?
- e) (6 pts) Describe a situation where Go-Back-N is more efficient than Selective Repeat, i.e., describe a situation where Go-Back-N requires less number of packets (data and acknowledgement) to complete a session.

2)

a) You are managing the IP network of a company. The company owns three buildings, which are located next to each other. The number of employees working in each building is 1200 in building 1, 800 in building 2, and 400 in building 3. You decide that each building should have its own subnet. Answer the following questions.

i) (5 pts) You decided to request a single address block from the Internet agency that manages IP addresses so that you can assign contiguous blocks of addresses to the buildings. What is the length of the network portion for the address block that fulfills your request?

ii) (8 pts) Split the block into three chunks, one for each subnet. Assign the chunk with the lowest addresses to building 1, and the chunk with the highest addresses to building 3. 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	Subnet address (CIDR format)
1	
2	
3	

iii) (5 pts) Suppose your company builds a new building where 500 employees will work. 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) Which fields in the IP header of an IPv4 datagram may change at the intermediate routers?

c) (6 pts) Does counting-to-infinity problem occur in OSPF? Why or why not?

3)

- a) (6 pts) Suppose CSMA algorithm is used in a multiple access network. Let d denote the distance between farthest nodes in the network. Do you expect to have more or less collisions when d increases? Fully justify your answer.
- b) (6 pts) Consider an Ethernet LAN using CSMA/CD running at 100 Mbits/sec over a cable of length d with a maximum number of terminals connected to the cable equal to 30. The propagation speed for the signal over the cable is 2×10^8 m/sec and the minimum frame size is 64 Bytes. Compute the maximum value for d such that CSMA/CD algorithm will work properly.
- c) 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. What is the probability that A and B will collide again at the next retransmission attempt?
- d) (8 pts) Given the following 8-bit pattern data 11010010 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.
- e) (5 pts) A new computer A is just attached to an Ethernet based LAN. A wants to send an IP datagram to computer B. Assume A knows B's IP address. How does A know whether B is in the same LAN or it is farther away? If B is in the same LAN as A, what happens next before the Ethernet transmission of the datagram starts?
- f) (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? Are there any advantages of having flat MAC addresses?