CS 421: COMPUTER NETWORKS **SPRING 2005**

FINAL
May 18, 2005
150 minutes

Name: _____

Student No: _____

1)

a) (8 pts) The Trivial File Transfer Protocol (TFTP) is an application layer protocol that uses the Stop-and-Wait protocol. To transfer a file from a server to a client, the server breaks the file into blocks of 512 bytes and sends these blocks to the client using the Stop-and-Wait mechanism. Find the efficiency (defined as the fraction of time the sender is busy sending bits into the channel) in transmitting a 1 MByte (1024 x 1024 bytes) file over a 10 Mbits/sec Ethernet LAN that has a diameter of 300 meters and the propagation speed is $2x10^8$ m/s. Assume that there are no transmission errors and that each data packet contains 60 bytes of header. The ACK packets have a total length of 60 bytes, i.e., ACK packets contain no data.

b) (10 pts) Suppose that a TCP connection has an RTT (including all propagation, processing, queuing and store-and-forward delays) of 100 msec. The transmission time for each packet is 5 msec, and ACK packets have negligible transmission times. Assume that the TCP sender is in the Congestion Avoidance phase and it experiences a loss event when the congestion window is 16 segments. How many segments will the sender transmit after the loss event until the sender goes into the Congestion Avoidance phase if **(in both parts you need to justify your answer)**

   i) the loss event is a timeout

   ii) the loss event is three duplicate ACKs

c) (6 pts) What are the possible advantages of having reliability in the link layer even though the transport layer is reliable? **Your answer must be at most 4 sentences.**

d) (6 pts) If the window size in the Selective Repeat protocol is 32, what is the minimum number of bits necessary for representing the sequence number? Justify your answer.

2)

a) (8 pts) The following is a forwarding table at router R, which uses Classless Interdomain Routing (CIDR).

Destination Network	Next Hop
139.179.39.0 / 25	A
139.179.39.128 / 25	B
139.179.72.0 / 26	C
196.101.153.64 / 26	D
139.179.0.0 / 16	E
196.0.0.0 / 8	F

Suppose packets with the following destination IP addresses arrive at router R. Determine to what next hop each of these packets will be delivered (Give **only one** answer for each destination.)

(i) 139.179.39.179
(ii) 139.179.72.68
(iii)196.101.153.136
(iv)139.179.39.108

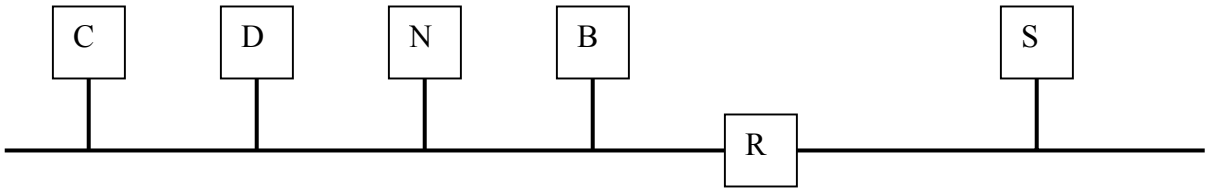
b) (8 pts) I decided to start a small company. I asked my ISP, myISP, to give me enough addresses for 1500 hosts. myISP owns the IP address block 192.1.0.0/16 and allocated a block from this address range and told me to use the following addresses (* can be any number in the range 0-255):

192.1.0.*
192.1.1.*
192.1.2.*
192.1.3.*
192.1.4.*
192.1.5.*

Since the sizes of the Internet routing tables have grown to huge proportions, I decided to announce the **fewest number of routes possible** to exactly cover all my company's IP addresses. Under CIDR, what is the **smallest set of network numbers** that the rest of the world would use to describe my networks (use address/prefix format of CIDR)?

c) (14 pts) You are attaching your computer C to a network and access a simple text only web page. You then exit the web browser and disconnect your computer from the network. The topology of the network is shown below: N is the DNS name server, D is the DHCP server, R is the gateway router, S is the remote server where the requested web page is located and B is another computer on the network. You are running a packet sniffer, e.g., Ethereal, to find out what packets you are sending. Unfortunately, the packet sniffer is not functioning properly and consequently the packets come out in the wrong order and it lists some packets that may not belong to you. Here is a list of the packet types the sniffer gives (note that you may see multiple packets of some types):

- TCP FIN
- ICMP
- DHCP discover
- BGP
- OSPF
- DNS query
- HTTP GET
- ARP
- TCP SYN
- RIP



Use the following table to fill in the packet types that **your computer should be sending** (column 1) and the host name corresponding to the destination IP address for the packet (column 2), e.g., N, B, broadcast, etc. Make sure that you order the packets correctly and add a short explanation on what the packet does (column 3). You may not need all rows in the table. Assume that your computer initially knows the IP address of the name server and the gateway router. Assume that there are no retransmissions, that any caches on your computer are empty, that the ARP table at your computer is initially empty, and that any server you contact has the requested information.

Packet type	Destination IP address	Function of the packet

3)

a) (6 pts) Consider an Ethernet LAN using CSMA/CD running at 100 Mbits/sec over a 2 km cable with no repeaters and with a maximum number of terminals equal to 30. The propagation speed for the signal over the cable is $2x10^5$ km/sec. Compute the minimum frame size for this network.

b) (5 pts) Suppose you want to upgrade the LAN above to 1 Gbits/sec. What will be the minimum frame size after this upgrade? Suppose that we cannot modify the minimum frame size, move the terminals in the network, lay new cable, or change the software configuration of the terminals. What can we do to solve this problem so that CSMA/CD will still work properly after increasing the bit rate?

c) (5 pts) While Ethernet does not implement any reliability mechanism, 802.11 protocol uses link-layer acknowledgements for reliability. Why? **Use at most 4 sentences.**

d) In this problem we will investigate an event known as the **Ethernet capture effect.** Consider a pair of stations A and B, each with an **infinite number** of frames to transmit on an Ethernet LAN. A's frames are numbered as A_1,A_2, and so on, and B's similarly as B_1,B_2,…. Let T = 51.2μs be the exponential backoff base unit. Assume that the network is initially quiet. Suppose A and B simultaneously try to transmit frames A_1 and B_1, respectively. They will experience a collision. Each will detect the collision, jam, abort, and calculate a backoff time. Suppose A chose 0 x T, and B chose 1 x T. Then, A transmits A_1 while B waits. At the end of the transmission, B will try to retransmit B_1 while A will try to transmit its next frame A_2. So there will be another collision.

   i. (5 pts) What is the probability that A and B select backoff times so that A will transmit A_2 before B_1?

   ii. (5 pts) Assume now that A and B chose backoff times in (i) such that A transmitted A_2 before B tried to retransmit B_1, and we go through this again, i.e., after the transmission of A_2 there will be another collision involving A_3 and B_1. What is the probability that A and B select backoff times so that A will transmit A_3 before B_1?

   iii. (3 pts) From the results you obtained above, briefly describe the Ethernet capture effect.

e) (6 pts) Given the following 8-bit pattern data 10011100 and the generator sequence 1101, compute the CRC bits and give the transmitted bit sequence. If the most significant **three** bits in the received sequence contain bit errors, determine whether this error can be detected.

f) (5 pts) A network administrator claims that RTS/CTS control messages are not needed in his 802.11 network since the DATA and ACK packet sizes are small (almost the same size as RTS/CTS packets). Is this correct? Justify your answer. **Use at most 3 sentences.**