EE 122 - Spring 1997
Midterm #1 - 15 % of course grade
March 12, 1997

(closed book)

1) Multiple Choice & Why (17 possible points)

In this problem, you are to select which of the multiple choices are most correct or most appropriate. Please circle the appropriate roman numeral to indicate your selection. Then, you are to explain why your selection is most correct/appropriate. Approximately 1/4 credit is given for the "choice" and 3/4 for the explanation.

A) (4 points) Typing my password as I login to a computer over the network...

i) is perfectly safe.

ii) is okay if I'm close by the remote host.

iii) is okay if my system administrator carefully monitors security.

iv) is okay if my communication channel is encrypted.

v) always compromises security to some extent.

Explain why:

B) (4 points) Converting between the host representation and the network representation is a function of the... (under the OSI model)

i) Network layer.

ii) Transport layer.

iii) Presentation layer.

iv) Physical layer.

Explain why:

C) (4 points) Ethernet switches have ARP tables.

i) True.

ii) False.

Explain why:

D) (4 points) Which of the following networks do not have a physical layer?

i) Ethernet.

ii) Token Bus.

iii) Satellite Communication.

iv) None of the above.

Explain why:

E) (Only 1 point) Richard Edel is...

i) a tenured professor.

ii) an untenured professor.

iii) a grad student.

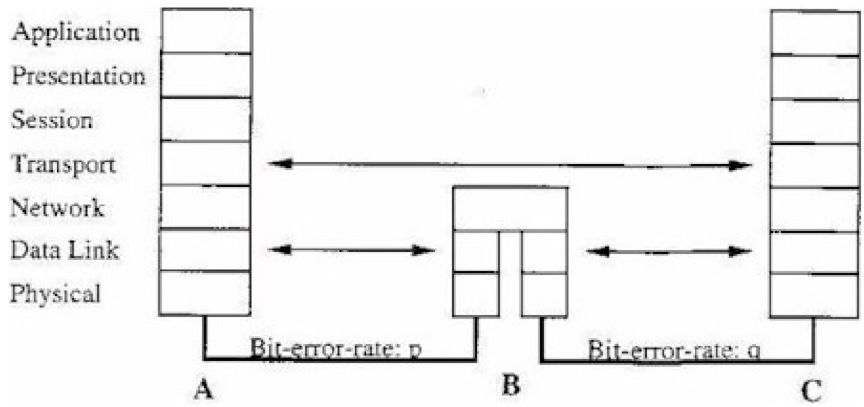
iv) a grad student who feels very uncomfortable when addressed as "professor".

Explain why: No explanation requested.

2) Error Control (28 possible points)

In homework set #2, we analyzed the efficiency of a simple end-to-end error control protocol. In this exam question, we will work with the same simple error control protocol, and we will compare the efficiencies of end-to-end vs. link-by-link error control arrangements.

The figure below depicts the topology. Node A is sending a very large (infinite?) amount of data to Node C. Between nodes A & C is a router B. The link between A and B has bit-error-rate ***p***; the link between B and C has bit-error-rate ***q***. These are independent bit errors. The error control protocol is equivalent to Selective Repeat with an infinite window size. Node A sends data packets which are d bits long (header and data). The acknowledgments (whether sent by the destination transport layer (end-to-end case) or by the data-link layers (link-by-link case)) are ***a*** bits long. (Reference Material)



A) (10 points) Answer the following questions assuming only end-to-end error control is used:

i) What is the expected number of times a data packet will be transmitted by node A before it is successfully acknowledged?

ii) Let's define efficiency to be the fraction of time node C receives useful data (i.e. not corrupted on the way to node C, nor a duplicate copy previously delivered to node C). What is the efficiency of this protocol **over this end-to-end path**?

B) (10 points) Answer the following questions assuming only link-by-link error control is used:

i) What is the expected number of times a data packet will be transmitted by node A before it is successfully acknowledged by router B? What is the expected number of times a data packet will be transmitted by router B before it is successfully acknowledged by node C?

ii) If q > p (i.e. the second link is more likely to have bit errors), what is likely to happen with the buffer within router B?

iii) We will ignore the difficulty from part B,ii. What is the efficiency of this protocol (use the definition from A,ii)? Is this comparable to the end-to-end efficiency of part A,ii? Why or why not?

C) **(8 points) Let's say that p = 10^(-8) and q = 10^(-4). What kind of real-world situation would this be?**

3) TCP/IP (35 possible points)

Assume we have the network topology depicted in the figure. The nodes labeled Ri are routers; all other nodes are end hosts. The network numbers for the networks (i.e. the IP addresses ending in ".0") are listed beside the Ethernet/FDDI. The network addresses for the hosts/routers are listed beside the connection to the network; these addresses only indicate the host part (i.e. the last byte of the IP address). The tables (below) show the Ethernet addresses for each node (FYI, the broadcast Ethernet address is "f f : f f : f f : f f : f f : f f") and the routing tables for selected nodes. All networks depicted in the figure use a netmask of 255.255.255.0 (or 0xffffff00 if you prefer hexadecimal). At the beginning of the problem, the ARP tables for all hosts are empty; the ARP tables for the routers include the link-layer addresses for other directly-reachable routers (i.e. no end hosts). (Reference Material)

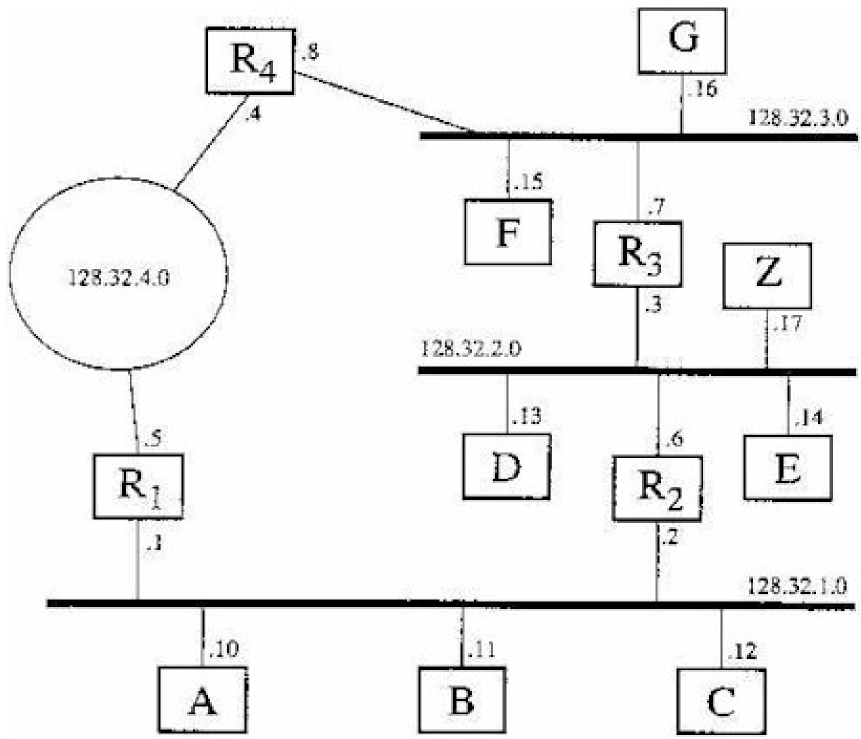


Table 1: Ethernet addresses, by IP address.
(Really refers to network interface w/IP given address.)

IP Address	Ethernet Address	IP Address	Ethernet Address
128.32.1.1	08:00:20:21:77:b2	128.32.2.14	08:00:09:24:a4:11
128.32.1.2	00:a0:c9:2a:1f:69	128.32.2.17	08:00:20:7e:82:91
128.32.1.10	00:a0:c9:2a:1f:53	128.32.3.7	08:00:20:1a:df:ff
128.32.1.11	00:a0:c9:2a:1e:d8	128.32.3.8	08:00:20:1b:52:7d
128.32.1.12	00:60:8c:36:b2:7f	128.32.3.15	08:00:20:0b:2a:8b
128.32.2.3	00:60:8c:52:d0:00	128.32.3.16	08:00:20:7e:d3:27
128.32.2.6	08:00:20:81:b9:d0	128.32.4.4	08:00:07:46:29:4c
128.32.2.13	08:00:20:23:79:ee	128.32.4.5	08:00:07:17:9b:7d

Table 2: Routing tables for selected nodes.

Router or Host	Destination	Next Hop
A: 128.32.1.10	128.32.1.0/24	direct, ethernet port 1
	default	128.32.1.1 (R_1)
R_1: 128.32.1.1 or 128.32.4.5	128.32.1.0/24	direct, ethernet port 1
	128.32.4.0/24	direct, ethernet port 2
	128.32.2.0/24	128.32.4.4 (R_4)
	128.32.3.0/24	128.32.4.4 (R_4)
R_2: 128.32.1.2 or 128.32.2.6	128.32.1.0/24	direct, ethernet port 1
	128.32.2.0/24	direct, ethernet port 2
	128.32.3.0/24	128.32.2.3 (R_3)
	128.32.4.0/24	128.32.1.1 (R_1)
R_3: 128.32.2.3 or 128.32.3.7	128.32.2.0/24	direct, ethernet port 1
	128.32.3.0/24	direct, ethernet port 2
	128.32.1.0/24	128.32.2.6 (R_2)
	128.32.4.0/24	128.32.3.8 (R_4)

Router or Host	Destination	Next Hop
R_4: 128.32.4.4 or 128.32.3.8	128.32.4.0/24	direct, ethernet port 1
	128.32.3.0/24	direct, ethernet port 2
	128.32.1.0/24	128.32.4.5 (R_1)
	128.32.2.0/24	128.32.3.7 (R_3)
Z: 128.32.2.17	128.32.2.0/24	direct, ethernet port 1
	default	128.32.2.6 (R_2)

A) (5 points) Suppose host A sends a datagram to host C.

i) What route does the packet take? It's best if you list both the nodes transited and the network numbers. I'll get you started with this question:
Node A (128.32.1.1)
Network 128.32.1.0
(you complete this...)

ii) What communications are sent to deliver the datagram? Please indicate where (i.e. over which network) and what (i.e. the link-layer addresses, if any) and the meaning of the packet. I'll get you started with this question:
Net 128.32.1.0: 08:00:20:21:77:b2 --> ff:ff:ff:ff:ff:ff

Table 2: Routing tables for selected nodes.

ARP - WhoKnows "128.32.1.12"?
Net 128.32.1.0: 00:60:8c:36:b2:7f --> 08:00:20:21:77:b2
ARP - Reply 128.32.1.12 is 00:60:8c:36:b2:7f
(you complete this...)

B) (5 points) Suppose host A sends a datagram to host Z.

i) What route does the packet take? (Please answer in the same fashion described above.)

ii) What communications are sent? (Please answer in the same fashion described above.)

C) (5 points) Suppose host Z sends a datagram to host A.

i) What route does the packet take? (Please answer in the same fashion described above.)

D) (5 points) Suppose host A sends a datagram to IP address "128.32.123.45".

i) What happens? What route is used?

E) (5 points) Suppose we replaced R2 with an Ethernet switch.

i) What must change (i.e. what reconfigurations would we have to do)?

ii) What route would a packet from host A to Z now take?

F) (10 points) Suppose we captured the following Ethernet frame using tcpdump. (tcpdump doesn't actually capture/print Ethernet frames like this--I've fabricated this packet. To make this more readable, I've maintained the word alignment that we're used to reading.)

```
14:36:43.684769 xxxx.berkeley.edu.xxx > xxxx.berkeley.edu.xxx ...
    aaaa aaaa aaaa aaab 0800 2023 79ee 0060    ................
    8c52 d000 0067 0101 01                     .........
    4500 004e f0d7 0000 3b11 ae7b 8020 0310    E..N....;..{. ..
    8020 020d 0706 0035 003a 0000 0008 0100    . .....5.:......
    0001 0000 0000 0000 0141 0842 6572 6b65    .........A.Berke
    6c65 7903 4544 5504 4545 4353 0842 6572    ley.EDU.EECS.Ber
    6b65 6c65 7903 4544 5500 0001 0001         keley.EDU.....
      00 xxxx xxxx                              .........
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i) What are the source and destination network layer addresses?

ii) What are the source and destination data link layer addresses?

iii) What transport protocol is this? (e.g. TCP or UDP)

iv) What application is this? (See the list of "well-known ports".)

4) Ethernet & Token Ring (20 possible points)

In this problem, I ask you to describe/contrast Ethernet and Token Ring networks.

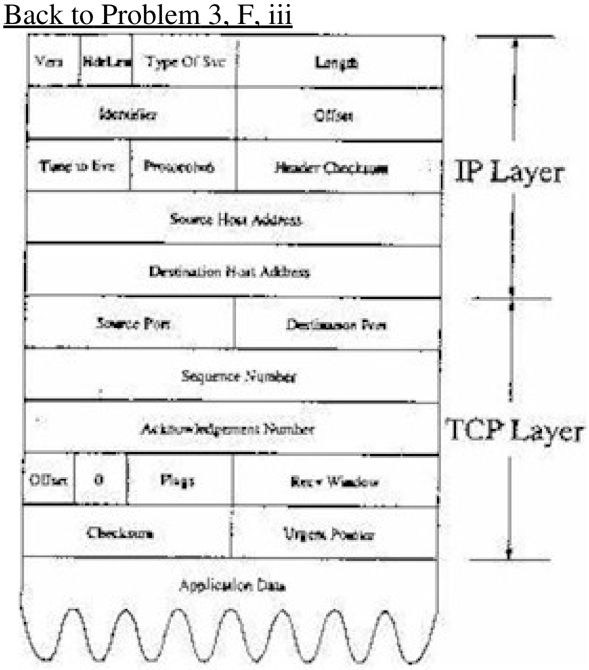
A) (8 points) How do the Media Access Control (MAC) protocols differ? (e.g. compare CSMA-CD and Token Passing on a ring.) I'm not looking for a detailed description of the protocols. Rather, I'd like you to compare the performance characteristics.

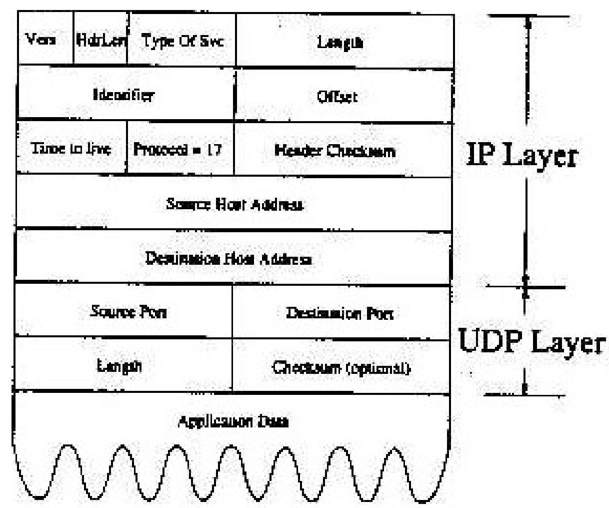
B) (6 points) How is clock recovery different (think about how the topologies differ)?

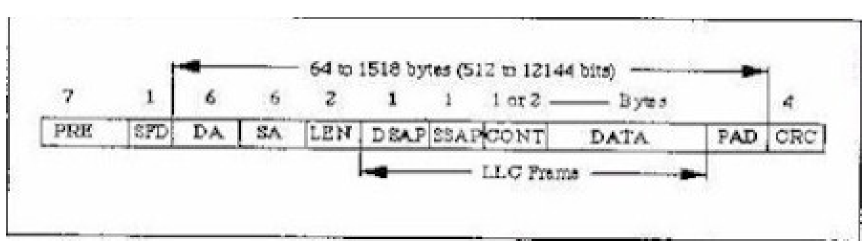
C) (6 points) Why do Token Ring frames go all the way around the ring (i.e. back to the sender) instead of being stripped (removed from the ring) at the destination node?

Reference Material

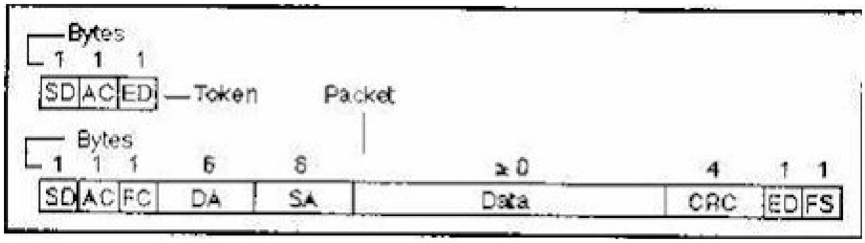
Back to Problem 3, F, iii







Ethernet Frame Structure



Token Ring Frame Structure

Back to Problem 3, F, iv

ftp-data	20/tcp	
ftp	21/tcp	
telnet	23/tcp	
smtp	25/tcp	# mail
domain	53/udp	# DNS nameserver
finger	79/tcp	
nntp	119/tcp	# Network News Transfer
login	513/tcp	# for rlogin

Some "well-known" ports

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