Midterm Exam
CS-460 Section 2
Dr JJ Ekstrom

Name_____ SS# _____

This is a closed book, one page of notes exam. There is a three-hour time limit. You may use a calculator if you need one. If you feel that a question is ambiguous, state your assumptions and answer the question using those assumptions.

1) (5 Points) Suppose a DS3 point-to-point link is being set up between the Earth and a new lunar colony. The distance from the moon to the Earth is approximately 242,000 miles, and data travels over the link at the speed of light---186,000 miles per second.

a) Calculate the minimum RTT for the link, rounded to the nearest 100ms.

242000miles*2/186000miles/sec=2.6sec

b) Using the RTT as the delay, calculate the delay×bandwidth product for the link.

$2.6sec*45*10^6 b/sec=117Mbits=13.9MBytes$

c) A camera on the lunar base takes pictures of the Earth and saves them in digital format to disk. Suppose Mission Control on Earth wishes to download the most current image, which is 25 MB. What is the minimum amount of time that can elapse between the time that the request for the data goes out and the transfer is finished?

$2.6sec+(25*2^{20}*8)/45Mbps=2.6+4.7=7.26sec$

d) Suppose each image is transferred as a sequence of packets using the sliding window algorithm. Assuming each packet carries 1KB of data, how many bits do you need for the sequence number?
$117Mbits/(1024*8bits/packet)=14.3*10^3$ packets
sequence number space is double this $=28.6*10^3$ packets
$2^{15}=32.8*10^3$ so we need 15 bits

2) (5 Points) What is the hex value of the NRZI encoding for the bit sequence "0010100011101110" assuming that the output starts at a "1" value? 0x_cf4b_____

1100 1111 0100 1011

3) (5 Points) We mentioned that most protocol stacks use the Process-per-message model in the operating system. What are the advantages and disadvantages of this model? What are the advantages and disadvantages of Process-per-protocol?

Process-per-message
Advantages
Procedure call between layers

Disadvantages
Harder to debug, needs semaphores

Process-per-message
Advantages
No semaphores needed

Disadvantages
Context switch between layers makes it slow, need queue for messages

4) (5 Points) HDLC is being used as a framing protocol. Suppose the sequence of bits given below arrived over a link. Show the resulting bit-sequence in binary and HEX after any stuffed bits have been removed.
Why is bit stuffing performed? To create a unique sentenel

Received Data = 01111110110111110100111110111110111011111000011111101
Decoded Data = 1101 1111 1001 1111 1111 1111 0111 1100_= 0xdf9f ff7c_____

5) (5 Points) What is the packetization delay (The time to convert analog signals to digital and fill up a cell) for an ATM connection assuming that the endpoints are using normal voice grade phone line speeds? What would the delay be if the payload of an ATM cell were 1024 bytes? Why would this cause problems if ATM is used for voice networks?

48 Bytes/(8Kbytes/sec)=6ms
1024 Bytes/(8Kbytes/sec)=125ms
Problems include noticeable delay on phone calls, echo cancellation needed on hardware

6) (5 Points) Select the best acronym to answer the following questions: FTP, RFC, HTTP, URL, LAN, MAN, WAN, STDM, FDM, RTT, FDDI, IP, TCP, UDP, ISDN, ATM, CSMA/CD.

a) If the delay is 1.3 seconds, this value is 2.6 seconds _RTT_____
b) This protocol provides two 64Kbps B channels and one 16Kbps D channel as a standard connection __ISDN___
c) This kind of multiplexing sends data streams on different frequencies through a shared medium __FDM___
d) This protocol provides host-to-host connectivity over the internet __IP_____
e) When there is no carrier detected on the line this access technique sends data and looks for collisions __CSMA/CD_

7) (5 Points) What are the 7 layers in the OSI model? Give an example implementation of each layer. (For example, your answer might be Protocol Layer = Internet, Example = Netscape)

Protocol Layer	**Specific Example**
Application	Email/ftp
Presentation	Integer size, endian
Session	Synchronization video/audio, TCP
Transport	TCP
Network	IP
Data Link	Ethernet, hdlc
Physical	Ethernet wire

8) (5 Points) Messages in most networking kernels are represented by a complex DAG. Let's assume that we decide that this is too difficult to code and use a strict object oriented approach. In this approach we copy the data into a new memory location between each protocol layer. If we are using the 4 layer TCP/IP model, then we will have 4 copies as the message is transmitted and 4 copies as the message is received. If we are using a 1000MHz processor that can transfer 32 bits to memory or read 32 bits (but not both) from memory each 200Mhz memory clock cycle, what is the maximum bandwidth we can achieve using this approach? Assume that you are transferring 1Kbyte packets.

1024bytes per packet /4bytes per transfer=256 transfers/packet *2 (read and write) =512 transfers/packet,
512 transfers per packet/(200Mtransfers/sec)=2.56us/layer*4layers=10.24us
1KB/10.24us=100MBps=800Mbps

200Mcycles/sec*32bits/cycle=6.4Gbits/sec /2transfers/bit = 3.2Gtransfers/sec /4 layers/transfer = 800Mbps

9) (5 Points) Determine which characteristics apply to routing with datagrams, virtual circuits and source routing (Place an X in the square if the characteristic applies).

	Connectionless	User can select route	Fixed size header	Specified QoS for transmission	No RTT delay for connection setup
Datagrams	X		X		X
Virtual Circuits			X	X	
Source Routing	X	X			X

10) (5 Points) How would you decrease the size of a collision domain?
Add a bridge or switch

How would you decrease the size of a broadcast domain?
Add a router

11) (5 Points) Given a generator polynomial of x3+x2+1, determine the CRC value for the message 10111010.

```
        11000011
1101 | 10111010 000
       1101
        1101
        1101
           10 000
           11 01
            1 010
            1 101
              111
```

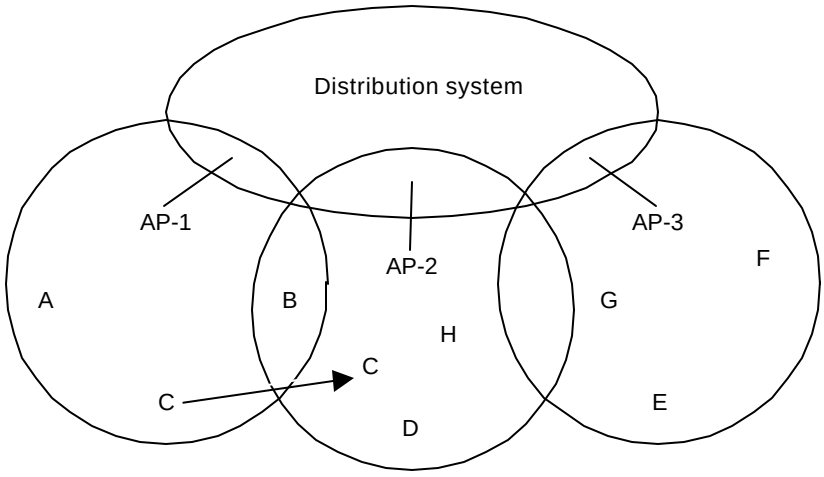
CRC=7

12) (5 Points) Given a OC-3c link with 200ms RTT and a frame size of 4Kbyte, what would be the maximum throughput achievable using Stop-and-wait?

5RTT/sec * 1frame/RTT * 4Kbyte/frame = 20Kbytes/sec = 163.8Kbps

13) (5 Points) Given the following 802.11 configuration., describe (in detail) the protocol involved in selecting an Access Point as mobile node "C" moves between the two positions in the following figure. Identify the sequence of messages and the type of messages that are sent.

C sends a probe frame which results in probe responses from AP-2 and AP-1. Eventually, the signal fromAP-2 is stronger than AP-1 and C switches over to AP-2. AP-2 can also send a Beacon frame. Eventually C sends an Association request to AP-2.



14) (5 Points) Assume the following routing table:

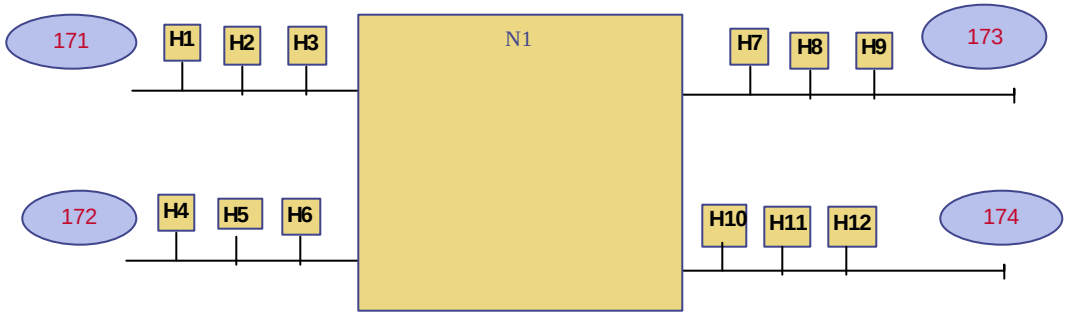
Subnet Number	Subnet Mask	Next Hop
128.96.39.0	255.255.255.128	Interface 0
128.96.39.128	255.255.255.128	Interface 1
128.97.0.0	255.255.0.0	R2
193.96.39.0	255.255.255.128	R3
<default>	---	R4

What "Next Hop" would the router use for the following packets?

a) 128.96.39.132 I1 _____
b) 129.97.39.10 R4 _____
c) 193.96.39.34 R3 _____
d) 193.96.39.156 R4 _____
e) 128.97.40.32 R2 _____

15) (5 Points) For each of the following questions, determine if N1 is a Switch/bridge, Hub, or Router (with no virtual networks). In each case the packet may be seen by other hosts in addition to the ones specified and more than one answer is possible.

```
H2 IP=192.134.171.2
H2 ETH= ab:89:09:67:45:12
H8 IP=192.134.173.8
H8 ETH= ab:89:09:67:45:ad
```



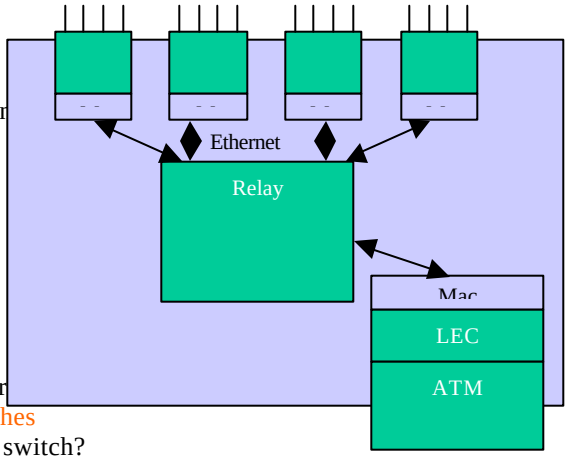
a) Host H2 sends ten packets to ethernet address ab:89:09:67:45:ad and they are all seen by Hosts H11, H5 and H12. What is Network element N1? Hub, a router would only send to destination, a switch would learn after the first packet and only send to the destination
b) Host H2 sends a packet to ethernet address ff:ff:ff:ff:ff:ff and it is seen by Host H11. Network element N1 is not a Router, a router would separate the broadcast domains.
c) Host H2 sends a packet to ethernet address ab:89:09:67:45:ad and it is not seen by H11 or H5. Network element N1 is not a Hub, a hub would send the packet on all interfaces
d) Host H2 wants to send a packet to IP address 192.134.173.8 so it sends an ARP request for IP address 192.134.171.1. Using the information in the response, host H2 uses the ethernet address 12:42:65:ef:89:ad as the destination ethernet address when sending the packet to host 192.134.173.8. Network Element N1 is a Router, since the MAC address is different from the destination address.
e) Host H2 sends a packet to ethernet address ab:89:09:67:45:ad and it reaches H8. N1 is a Hub or switch, otherwise the MAC address would have to be the address of the router.

16) (5 Points) Describe the process by which a LEC configures itself when joining an ATM emulated LAN.

Contact LECS to find address of LES
Give LECS the LEC ATM address
Connect to LES to register MAC and ATM address
Get Address of the BUS from the LES
Connect to BUS

Describe the steps that occur and the servers that are contacted when a packet is sent to a new IP address in an ATM ELAN.
The packet is sent to the BUS. The LEC contacts the LES to get the ATM address for the new IP address. When the LES responds, the LEC creates a virtual circuit to the new IP address.

17) (10 Points) You want to produce a switch with 16 10/100Mbps Ethern uplinks. Show a block diagram of the switch architecture.



What needs to be added to support a Packet over Sonnet uplink to another
POS card with a MAC interface, then a Sonnet connection between switches
What needs to be added to support an ATM AAL5 connection to another switch?
ATM card with a MAC interface, then a PVC connection between switches
Assume that an ATM uplink module is created with a LANE Client implementation on-board the module card. What are the advantages and disadvantages of each of these three uplink technologies (POS, ATM AAL5, LANE)?

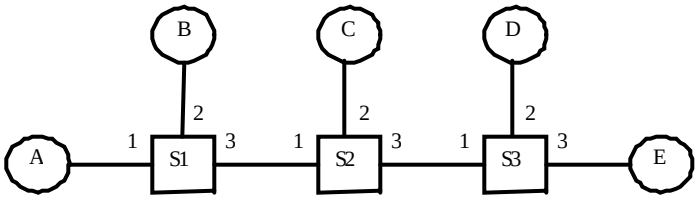
Technology	Advantages	Disadvantages
POS	Simple edge and core switch	More expensive, time division multiplexing, no PNP
ATM AAL5	Simple edge switch	Complex core switch, no native ATM, no PNP
LANE	Native ATM machines, PNP	More complex edge switches

What is the difference between the RELAY interface to Ethernet ports and ATM ELAN ports?
No difference, they both have MAC interfaces

18) (5 Points) Consider the virtual circuit switches in the following figure. The table lists, for each switch, what <port, VCI> pairs are connected to what other <port,VCI>. List all endpoint-to-endpoint connections (for example, if A is connected to D, {A-D}).

Switch S1				Switch S2				Switch S3			
Input		Output		Input		Output		Input		Output	
Port	VCI	Port	VCI	Port	VCI	Port	VCI	Port	VCI	Port	VCI
1	2	3	1	1	1	3	3	1	3	2	1
1	1	2	3	1	2	3	2	1	2	3	1
2	1	3	2	1	3	2	2	1	1	2	3

Connections
__A-D___ _____
__A-B___ _____
__B-E____ _____



19) (5 Points) A 1246 byte Ethernet packet is received by a router that has a PPP link to the next hop for the packet. The MTU for the PPP link is 255 bytes. Show the offset, flag and length fields for each of the fragmented packets (Note! You may need fewer fragments than the number of spaces given in the table). Max fragment size=

Fragment Number	Flag (M bit 0 or 1)	Offset	Length
1	1	0	248
2	1	248	248
3	1	496	248
4	1	744	248
5	0	992	254
6			