CSE 123 Midterm Exam

Fall 2011

Name: _____ Student ID: _____

Be sure to read questions carefully and answer all parts. Use complete sentences and explain your answers. You should be able to answer the questions in a few sentences or less. There is no need to write an essay. Remember to flip the pages over (there are questions on the back of most pages.) Good luck!

Question 1	**/ 12**
Question 2	**/ 12**
Question 3	**/ 12**
Question 4	**/ 12**
Question 5	**/ 20**
TOTAL	**/ 68**

1. True/False (2pts each)

a) The Transport Layer is responsible for Media Access Control.

False

b) Ethernet is a contention-based protocol.

True

c) Distance vector protocols can create temporary loops but link-state protocols cannot.

False

d) Bit stuffing ensures that a sentinel value will never occur in the transmitted payload.

True

e) FDMA uses collision detection.

False

f) The Ethernet protocol has a hierarchical address space in which part of the address identifies the network and part identifies the host.

False

2. Layering and Coding

a) List the layers in the Internet layering model, describe briefly (i.e., in a few words) what the layer is for, and list an example of a protocol operating at this layer. (6 points)

[in general, they have to get the layer right, but they don't have to describe everything the layer is for… so I'm fine giving full credit for transport: reliability: TCP]

Physical layer: encoding of bits and transmission: (I'll accept a variety for the example, since we frequently conflate datalink and physical layers… so laser, copper wire, coax, Ethernet, fddi, wifi/802.11, etc are all fine here)

Data link layer: framing, error detection, media access: Ethernet, Wifi/802.11, FDDI, ATM

Network layer: addressing, routing : IP

Transport: reliability, endpoint addressing, flow control, congestion control, ordering: TCP, UDP

Application: whatever the application needs: HTTP, SMTP, etc (happy to accept just about anything here… i.e., Web is a fine substitute for HTTP)

b) After graduating from UCSD you go to work for a networking company that builds a high-speed point-to-point laser modem. Your boss arrives at your desk one morning and tells you that for the next version of the product it is your responsibility to double the bit rate the modem can deliver. You know that your lab has the ability to double the bandwidth (B) or double the signal to noise ratio (S/N) (assume the S/N for your existing product is ~10). Which offers the best chance of meeting your bosses goal and why? (6pts)

Doubling the bandwidth is a surefire way to double the capacity. Shannon's law says that $C=B*\log_2(1 + S/N)$. So doubling the bandwidth (B) is sufficient to double the capacity of the channel. However, doubling S/N is going to have a smaller impact (note that $2\log_2(x) = \log_2(x^2)$) so you need to effectively square S/N to double capacity)

3. Framing and Errors

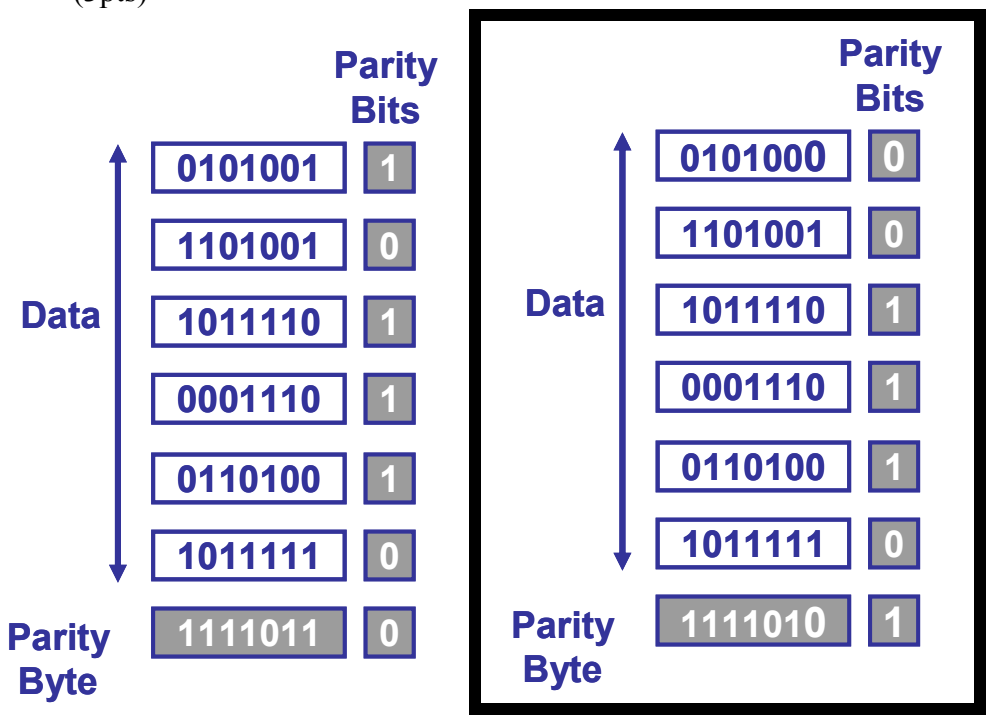
a) Doing some Christmas Shopping at UTC you overhear a Qualcomm engineer telling his friend about a new combined bit/byte-level framing protocol he's invented on his own time, which he calls "HybridFraming". Here's how it works: The bit-pattern "01010101" is used as a sentinel to identify frame boundaries (i.e., the sentinel is inserted at the beginning and end of each frame, with the payload data sandwiched between). If the sentinel pattern occurs in the payload data, then a "1" is stuffed right after the sequence "010101" (i.e., so 01010101 would produce 010101101). He says that since you only stuff 1 bit that this protocol is more efficient than traditional approaches. Provide a concrete example demonstrating why this protocol is unlikely to work how he thinks. (6pts)

This doesn't work because the resulting bitstream is ambiguous. Suppose the data is 1101. Then the frame plus sentinels is 01010101 1101 01010101. Now after the receiver receives 01010101 11, it does not know if the next eight bits are a new sentinel (01010101 followed by data 01) or if they represent a 01 followed by a sentinel.

b) Consider the CRC generator function $x^8 + x^2 + x^1 + 1$. How many bits will the resulting frame check sequence be? (3pts)

8 bits

c) Two-dimensional parity can catch all 3-bit errors, but *not* all 4-bit errors. In the following diagram change four bits in a way that 2D-parity will not detect the change. (3pts)



4. Media Access and Reliability (3pts each)

a) In a slotted aloha system, suppose there are 5 nodes that each transmit with probability of p. What is the likelihood, in a given slot time, that one of the nodes successfully transmits a packet?

5p(1-p)^4

b) Why does CSMA outperform Aloha? Be specific.

Because a transmitter will not send if it hears that another transmitter is already sending. This dramatically reduces the number of collisions and uses the channel more efficiently.

c) Why do we need the spanning tree protocol in Ethernet LANs?

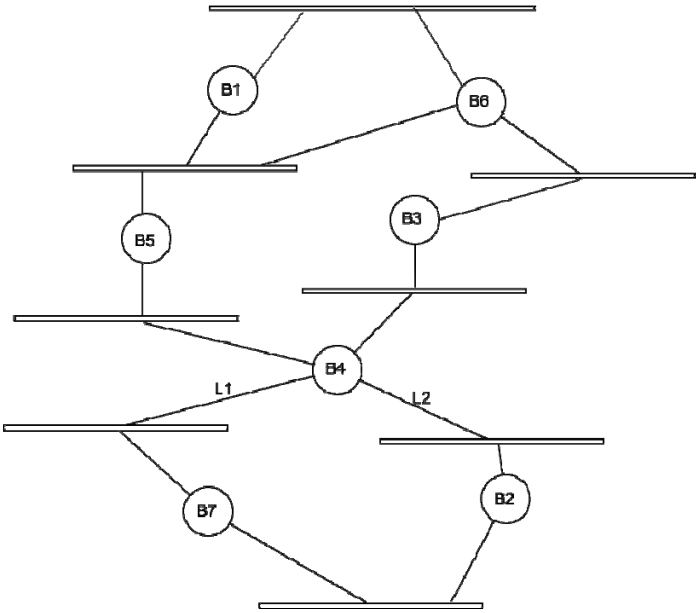
.

The spanning tree is necessary to prevent loops. For example, consider the network formed of two LAN, A and B, which are interconnected with two bridges, X and Y. If a station on A transmits a frame, X and Y will both broadcast it on B. X will receive Y's broadcast and B and broadcast it to A. Y will receives X's broadcast and broadcast it to A. This can continue forever. Moreover, X and Y will hear that the source for the station on A is on both LANs.

d) What should the minimum value of the retransmission timer be in an ARQ protocol?

One RTT. Any less and every packet will be retransmitted before an ACK can possibly be received.

5. Bridging and Spanning Trees



a. List the messages sent and received by Bridge B4 during the spanning tree creation for this network. Each bridge's address is its label (e.g., Bridge B1 has address B4) and each link has cost 1. Assume time occurs in rounds (i.e., each bridge sends out updates at the same time)
(*15 pts).*

RootID	Distance to Root	BridgeID
S: B4	0	B4
R: B5	0	B5
R: B3	0	B3
R: B7	0	B7
R: B2	0	B2
S: B2	1	B4
R: B1	1	B5
R: B3	0	B3
R: B2	1	B7
R: B2	0	B2
S: B1	2	B4
R: B1	1	B5
R: B1	2	B3

b. Suppose links L1 and L2 were cut. What would happen within the spanning tree protocol? (just describe this, no need to show individual messages) *5 pts.*

This would partition the network into two Ethernets (one with B7 and B2) and the other with the remainder of the LANs. When the roots "age out" the former network will elect B2 to be its root (only able to reach the three LANs B2 and B7 connect to directly) while the rest of the network will continue to maintain B1 as its root.