Chapter 5: Data Link Layer and MAC protocols

1. (4 points) If all the links in the Internet were to provide reliable delivery service, would the TCP reliable delivery service be redundant? Why or why not?

2. (5 points) What are some of the possible services that a link-layer protocol can offer to the network layer? Which of these link-layer services have corresponding services in IP? In TCP?

3. (3 points) Suppose nodes A, B, and C attach to the same LAN. If A sends frames to B (addressed to the MAC address of B), will C's network card (adapter) process these frame and will it pass the datagrams in the frames to its network layer? How would your answers change if A sends frames with the MAC broadcast address?

4. (3 points) Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address?

5. (4 points) Consider the information content of a packet is the bit pattern: 1010101010101011 and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme? [Your answer should be such that a minimum length checksum field is used.]

6. Derivation of the efficiency of slotted ALOHA.
   a. (4 points) With N active nodes, the efficiency of slotted ALHOA is $Np(1-p)^{N-1}$. Find the value of $p$ that maximizes this expression.
   b. (3 points) Using the value of $p$ found in (a), find the efficiency of slotted ALHOA by letting $N$ approach infinity. Hint: $(1-1/N)^N$ approaches $1/e$ as $N$ approaches infinity.

7. (6 points) Explain the effect of changing the number of stations, ‘$N$’, on the utilization of CSMA/CD. Comment on the fact that ‘$N$’ does not appear in the expression for the utilization [For CSMA/CD $u=1/(1+5a)$]

8. (5 points) For an Ethernet LAN the data rate was decreased from 100Mbps to 10Mbps. Utilization (U) of this network will be more or less? [show your answer by calculating ‘U’] Suggest two ways in which we can return the utilization to what it was before (Increasing or decreasing another parameter and by how much? Show your reasoning.)

9. (total 13 points)
   (5 points) Derive an expression for the utilization of the token ring release-after-transmission algorithm. Comment on your result.
What happens to the utilization with the increase in number of stations? Why?
(3 points) Compare this result to utilization of token ring (release after reception) and Ethernet.

What happens to the utilization with the change in ‘a’?

A 2km long FDDI ring, with frame size of 10,000 bits in length and multiple machines connected. Can you reason about a lower bound on the utilization of such a network? [Note: FDDI is token ring (with release after transmission) with 100Mbps] [If not enough information is given please indicate so clearly in your answer, pointing out what information is missing.]

Chapter 6: Wireless Communications and Networks

As a mobile node gets farther and farther away from a base station what are two actions that a base station could take to ensure that the loss probability of a transmitted frame does not increase?

Describe the role of the beacon frames in 802.11?

Why are acknowledgements used in 802.11 but not in wired Ethernet?

Suppose the IEEE 802.11 RTS and CTS frames were as long as the standard DATA and ACK frames. Would there be any advantage to using the CTS and RTS frames? Why or why not?

What are the purposes of the HLR and VLR in cellular (e.g., GSM) networks? What elements of mobile IP are similar to the HLR and VLR?

Suppose there are two ISPs providing WiFi access in a particular cafe', with each ISP operating its own AP and having its own IP address block.
   a. Further suppose that by accident, each ISP has configured its AP to operate over channel 11. Will the 802.11 protocol completely break down in this situation? discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.

   b. Now suppose that one AP operates over channel 1 and the other over channel 11. How do your answers change?

Why are cells (and clusters of cells) used in cellular communication systems instead of a powerful antenna covering the whole desired geographical area?

Why don't we use CSMA/CD in wireless networks?

Why does 802.11 use rate adaptation?

What is the hidden terminal problem and how is it resolved?
21. (4 points) In mobile IP, what effect will mobility have on end-to-end delays of datagrams between the source and destination?

22. (10 points: extra) While most conventional communication systems attempt to conserve bandwidth, CDMA uses bandwidth that is much higher than that necessary to transmit a signal. How does CDMA achieve such a high bandwidth and why? [clearly mention the main operation and (5) advantages of using CDMA]