

CNT5106C Computer Networks, Fall 2009
Instructor: Prof. Ahmed Helmy
Homework #3 & 4 (this is worth the grade of 2 homeworks)
On the Data link layer, MAC protocols and Wireless Networking
[Date Assigned: Nov 18th, 2009. Due Date: Dec 2nd, 2009 to the TAs]
Total Points: 176, Out of which 30 are extra points

Q1. (17 points: 9 + 3 + 5)

- I.** Derive the utilization formula for: (a) Ethernet, (b) Token ring (release after reception), and (c) FDDI [which uses Token ring (release after transmission)].
- II.** Compare them.
- III.** Comment on what happens when the number of stations on the LAN is increased in each case.

Q2. (12 points: 3 + 6 + 3) MAC layer utilization

For an Ethernet LAN (shared bus) the data rate was increased from 10Mbps to 100Mbps.

- I.** How will the utilization (U) of this network change? [Calculate U for each case]
- II.** Suggest two ways in which we can return the utilization to what it was before (By increasing or decreasing another parameter and by how much? Show your reasoning.)
- III.** One person argued that increasing the number of stations attached to the LAN would reduce the idle time on the LAN and hence increase the utilization. Do you agree?

Q3. (10 points: 6 + 4)

- I.** What is the mechanism used to increase the efficiency of CSMA/CD for switched Gigabit Ethernet? Describe its operation and how it increases efficiency.
- II.** Discuss whether CSMA/CD is still needed for switched Ethernet and why? If not, why is it still being used?

Q4. (6 points) Can CSMA/CD be used in wireless networking? Why?

Q5. (6 points) What is the “hidden terminal” problem? and how does 802.11 address such a problem?

Q6. (8 points) “802.11 is fair always since it randomizes the timers before a station attempts to access the medium, so that the previous winners do not dominate the channel in the future”, discuss this statement, whether it is true or not and when, illustrating your point with ample examples.

Q7. (8 points: 4 x 2)

- I.** What is ‘rate adaptation’ in wireless MAC protocols? Why is it used, and how does it help the performance of wireless networks?
- II.** Discuss possible effects on upper layer protocols (such as TCP and real time applications)?

Q8. (15 points) Mention five advantages to using CDMA (or DSSS).

Q9. (24 points: 3 + 9 + 6 + 6) TCP over ATM:

- I.** What is the main observation (or problem) you can identify regarding transfer of TCP segments and IP datagrams over ATM networks?
- II.** Suggest and compare three different schemes that attempt to alleviate the above problem. Mention the advantages and disadvantages of each.
- III.** What are the features in ATM AAL5 that allow efficient transfer of TCP over ATM? Mention 2 main features and explain how they can be used to increase the efficiency (define what you mean by efficiency).
- IV.** What would happen if those two features were not supported?

Q10. (16 points: 4 + 6 + 6)

- I.** What are the main problems that Mobile IP is attempting to solve and how does it solve it?
- II.** What are the problems with Mobile IP?
- III.** Suggest two different ways to overcome the shortcomings of Mobile IP by discussing other mobility management solutions

Q11. (12 points) In a wireless ad hoc network, where all the devices are mobile and all hosts are acting as relays (or routers), do you think the unicast routing approach in the Internet is suitable? Why? If not, suggest and discuss an approach that may work in a better way. [Assume that the ad hoc network is always connected and that disconnections are rare].

Q12. (12 points) In delay tolerant networks, DTNs, the network has mobile devices (as in ad hoc networks) but they get frequent disconnections where the network is partitioned, and there may be times where there are no complete routes from any point to any other point. Suggest another paradigm of routing that would be suitable for such an environment. Discuss briefly how to enhance the efficiency of your mechanism.

Q13. (20 points: somewhat open ended, extra)

How would you use the traces collected in the experiments in class (Bluetooth encounter traces and Wi-Fi scan traces) to design a routing protocol for ad hoc or DTN networks? [Keep in mind that DTNs rely on cooperation between nodes, and not all nodes maybe willing to cooperate, perhaps for the lack of ‘trust’ or otherwise. So not every encounter may count.]

Q14. (10 points: 3 + 3 + 4)

- I.** What is the spectral congestion problem in mobile networks?
- II.** How did cellular networks overcome such a problem?
- III.** What are the main problems created by the solution in *II.* above? [mention two main problems at least]