Massachusetts Institute of Technology   Handout 6
6.885: Distributed Algorithms for Mobile Wireless Ad Hoc Networks
Prof. Nancy Lynch   February 22, 2006

Problem Set 1, Part b

Due: Wednesday, March 1, 2006
Problem sets will be collected in class. Please hand in each problem on a separate page, with your name on it.

Reading

MAC layer	Komlos and Greenberg
	Brenner's notes on 802.11
	MACAW paper
Background	Schiller, Chapter 3
	Vaidya's notes on MAC layer
Localization	Priyantha et al. Cricket paper
	Savvides et al. Dynamic fine-grained localization paper
	Priyantha et al. mobile-assisted localization paper

Reading for next week

Localization	Moore et al. Robust distributed network localization
	Aspnes, Eren et al. Theory of network localization
Time synchronization	Elson, Girod, Estrin RBS paper
	Karp, Elson, et al. Global synchronization in sensornets

Problems

1. One of the changes made in the MACAW protocol, compared with the prior MACA protocol, was to include an additional Ack packet in the normal data exchange for unicast messages.

   (a) What are some benefits of the additional Ack packets?

   (b) What impact (if any) does the addition of Ack packets have on the ability of the protocol to cope with the hidden terminal and exposed terminal problems?

2. Theoretical papers on ad hoc wireless network algorithms often make strong, simplifying assumptions about the behavior that is guaranteed by the MAC Layer. For example, they may assume that the MAC Layer yields reliable broadcast communication, within some time bound t, to all nodes within Euclidean distance d.

   (a) Given everything we have learned about the behavior of the physical and MAC layers, do you think that this assumption is a reasonable basis for designing and analyzing algorithms above the MAC layer? Why or why not?

   (b) Can you devise (sketch) a better abstract description of MAC layer guarantees? Such a description should be simple, accurate, and likely to be usable in designing interesting algorithms.

3. Consider the Cricket method for producing distance estimates, based on measuring the time difference between arrivals of simultaneously-sent radio and ultrasound signals. It is claimed, and demonstrated in experiments, that using the mode to determine the distance generally gives more accurate distance measurements than using the mean.

    (a)   Explain informally why this might be so.

    (b)   Describe a specific example system and execution that produces a less accurate estimate using the mean than the mode.

4.   The mobile-assisted localization paper describes an algorithm for determining the distances between 2, 3, and 4 points in 3-space, and uses this to determine coordinates for all nodes. Now suppose that we only need these algorithms to work in 2-space.

    (a)   State versions of propositions 2 and 4, as needed for use in 2D.

    (b)   Describe how a 2D version of MAL would work, using your propositions.

    (c)   Describe what a 2D version of AFL would do, based on your new version of MAL.