Problem Set 3, Part b

Due: Wednesday, April 5, 2006
Problem sets will be collected in class. Please hand in each problem on a separate page, with your name on it.

Reading

Broadcast Kowalski, Pelc: Deterministic broadcasting paper. Read the algorithm for radius-2 networks (but not the one for $o(\log \log n)$ networks. Try to understand the main ideas of the lower bound.
Kushilevitz, Mansour: Lower bound for broadcast in radio networks

Point-to-point routing Johnson, Maltz: Dynamic Source Routing (DSR)
Perkins, Royer: Ad hoc on-demend distance-vector routing (AODV)
Hu, Johnson: Caching strategies for on-demand routing protocols
Chen, Murphy: Enabling disconnected transitive communication

Reading for next week

Point-to-point routing Gafni, Bertsekas: Link reversal routing algorithm
Park, Corso: TORA routing algorithm
Busch *et al*: Analysis of link reversal routing

Problems

1. The algorithms in the Kowalski-Pelc paper (like the ones in the Bar-Yehuda papers) are based on strong assumptions about message delivery and message collision behavior.

   (a) Describe some ways in which the assumptions about the underlying communication behavior might be weakened, in order to capture realistic network behavior.

   (b) What happens to the Kowalski-Pelc algorithms, specifically, to their $ECHO$, $Binary-Selection-Broadcast$, and algorithm $\mathcal{A}_2$, when they are executed in networks satisfying your weaker assumptions? Do they yield any interesting guarantees?

   (c) If the algorithms don't work well in networks with weaker assumptions, what are some ideas for modifying their algorithms so they work better?

2. The Kushilevitz-Mansour paper states the assumption that processors are inactive until they successfully receive a message for the first time. This means the processors in layer i only start contending once layer $i-1$ succeeds.

   (a) Suggest some ways this assumption may be enforced.

   (b) How does the proof of the main theorem break without this assumption?

3 The Dynamic Source Routing algorithm, described in the Johnson, Maltz and Hu, Johnson papers, can be implemented so that each host maintains a cache of individual links rather than of entire paths. Suppose that the link cache is large enough to hold information about every link in the entire ad hoc network.

(a) Describe a convenient data structure that can be used to store the links. Discuss the operations that must be performed on this data structure during the execution of DSR, and discuss (or analyze) their costs using your data structure. You should design your data structure to yield costs that are as low as you can manage.

(b) Should links ever be removed from the cache structure? Discuss why or why not.

(c) If you think links should be removed, then describe a good policy, based on timeouts or another mechanism, for removing links from your link cache structure. Discuss why you think your policy is good. Compare it to various policies discussed in the Johnson, Maltz and Hu, Johnson papers.