# Problem Set 4, Part b

**Due:** Wednesday, April 19, 2006
Problem sets will be collected in class. Please hand in each problem on a separate page, with your name on it.

## Reading

*Location-based routing*
- Ko, Vaidya: Location-aided routing (LAR)
- Ko, Vaidya: Location-based multicast algorithms *(optional)*
- Kranakis, Singh, Urrutia: Compass routing *(optional)*
- Bose et al.: Routing with guaranteed delivery
- Karp, Kung: GPSR: Greedy perimeter routing
- Barriere, Fraignaud, Narayanan: Robust position-based routing
- Kuhn et al.: Geometric ad hoc routing

### Reading for next week

*Global infrastructures*
- Elkin: Distributed approximations—a survey
- Kuhn, Wattenhofer: Distributed dominating set approximation
- Kuhn, Moscibroda, Wattenhofer: What cannot be computed locally!

## Problems

1. Ko and Vaidya, in their paper on Location-Aided Routing (LAR), do not state or prove any formal results about guarantees their algorithms make. Pick one of their algorithms, and formulate some interesting guarantees the algorithm satisfies. This may involve defining some metrics to use in measuring success. The statements should be of a "conditional" nature, delineating particular circumstances under which the algorithm makes particular guarantees. Then, describe how you might prove the guarantees.

2. Consider the Compass Routing II procedure in the Kranakis et al. paper, later called "Face Routing".
   (a) Draw some interesting graphs with distinguished source and destination nodes $s$ and $t$ and trace the routes from $s$ to $t$ that Compass Routing II would take on these graphs.
   (b) For each of your examples, compare the hop count of the path taken by Compass Routing II to the shortest distance between $s$ and $t$ in the graph.
   (c) For each of your examples, compare the total Euclidean distance on all the edges of the path taken by Compass Routing II, to (a) the shortest Euclidean distance between $s$ and $t$ on any path in the graph, and (b) the actual Euclidean distance from $s$ to $t$.

3. Consider an underlying network graph $G$ that changes over time, as a result of nodes joining, leaving, and moving. Assume the graph $G$ at any point in time is determined by the simple unit disk model.
   (a) Discuss how one might maintain a planar subgraph of $G$, for example, a Gabriel Graph, in the presence of these changes.
   (b) Describe how message forwarding might be carried out using your adaptive planar graph, using GPSR-like strategies.

(c) What properties does your message-forwarding algorithm gurantee?

4. In the Barriere et al. paper, the authors describe a "three-phase" algorithm, but then say that the phases are really interleaved.

   (a) What issues arise as a result of this interleaving?

   (b) Why are these issues not serious problems?