Project #2 for ECE478/578

Preliminaries

- You must form a group of (strictly) two people. If you do not have a partner please contact the instructor.
- **Due date:** Friday. April 19th, 2012, 11:59pm.
- You must submit your code and a project report.

Project Description

You are to implement and study different routing algorithms in wireless networks. Consider a network of 12 routers equipped with wireless transceivers and omni-directional antennas. Each router has a maximum communication range of r_{max} = 20m, unless otherwise stated.

The (X, Y) coordinates of the 12 nodes are as follows:

X	Y
33.69	49.97
48.08	2.94
18.01	27.42
13.08	29.86
2.46	28.55
35.04	48.11
37.52	36.99
21.59	31.71
40.15	4.19
47.27	45.79
30.0	12.67
43.67	25.67

Assign cost $c(u,v) = d(u,v)^2$ to each link in the network, where $d(u,v)$ is the Euclidean distance between routers u and v. If $d(u,v) < 1$, then set $c(u,v) = 1$. The link cost is now proportional to the power required for a line-of-sight transmission from router u to router v. Here we assume that power control is available at each router. A router can adjust its power depending on the destination.

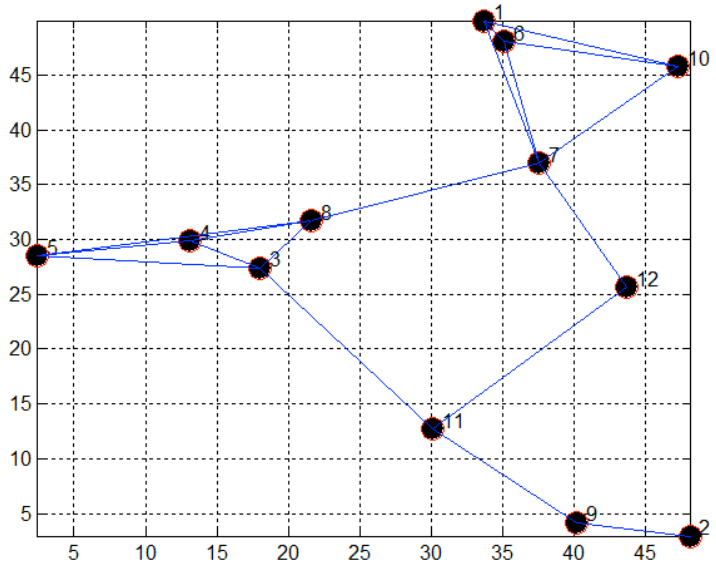

Figure: Connectivity graph for the network of routers.

1. **Minimum-Cost Routing**

Write a program that receives as input the coordinates of the nodes of the network, the maximum communication range r_{max} and the source node and outputs the minimum-cost routing tree using link-state routing. Draw the routing tree for nodes 7 and 11, and print the corresponding forwarding tables. E.g.,

Dest	Cost	Next Hop
1	49.97	7
2	2.94	11
3	27.42	11
4	29.86	11
5	28.55	11
6	48.11	7
7	36.99	7
8	31.71	7
9	4.19	11
10	45.79	7
11	12.67	11

2. Broadcast Routing

Write a program that outputs a broadcast routing tree assuming that router 1 is the broadcast source, using

a. the minimum spanning tree algorithm.
b. the broadcast incremental power (BIP) algorithm [1].

For each algorithm, your program should output the total energy needed to broadcast one message to all routers in the network and the total number of transmissions. Assume that routers perform power control and hence, tune their transmission power according to the destination. Make sure to account for the broadcast advantage in calculating the total energy and number of transmitted messages. Any node within the transmission range of a broadcasting router is able to receive a broadcast transmission. Draw the minimum spanning tree and the BIP routing tree. Comment on their differences if any. For the purpose of calculating the required energy, assume that when a router u transmits to a router v the energy needed is E(u,v) = P(u,v) (i.e., each transmission lasts for one unit of time).

Repeat your experiments by assuming that the range of the routers is unlimited. Comment on any changes on the routing topology of the minimum spanning tree and the BIP tree.

Repeat your experiments when the source of the broadcast message is node 8 and compare with the values obtained for node 1.

Project Report

Include with your report

1. A brief introduction describing the project. In this section *include the responsibilities of each team member* with references to which parts/steps it completed.
2. The topology graphs and the forwarding tables. Any remarks on how the routing algorithms behave.
3. A brief summary of the results from the project and remarks on the difficulties you faced during the implementation.
4. Your code (you will not be graded on your code efficiency) (**ONLY ELECTRONIC SUBMISSION IS NEEDED**)
5. Submit your files through D2L Dropbox.

References

[1] J. Wieselthier, G. Nguyen, and A. Ephremides, "On the construction of energy-efficient broadcast and multicast trees in wireless networks," Proceedings of INFOCOM 2000, pp. 585—594.