ITU
Faculty of Computer and Informatics
Prof. Dr. F. Sema OKTUĞ
Ress. Asst. G. Selda UYANIK

28.11.2013

BLG 433E: COMPUTER COMMUNICATIONS

PROJECT – II

In this project, you will simulate *Dijsktra's Shortest Path Algorithm* based routing in an ad hoc wireless network considering power cost.

➢ Ad Hoc Wireless Network Parameters:

- There are **N = 10** routers. Each router is equipped with wireless transceivers and omni-directional antennas.
- Routers are distributed over a 2-D terrain and X/Y coordinates of a router are selected from intervals: {0, x_{max} = 50 meters} & {0, y_{max} = 50 meters}.

Implementation detail: You are supposed to read the Euclidean 2-D Plane coordinates of N nodes from *inputFile* (.txt file). Each line (N lines in total), corresponds to X and Y coordinates (in meters, can be floating numbers) separated by tab character. You will create your own test file and submit along with your other project files.

- Each router has transmit/receive antenna pairs having gains: **$G_t = G_r = 10$**
- Working frequency is 2.4 GHz, and therefore wavelength is: **$\lambda = 0.125$ m**

($\frac{c}{f} = \frac{3*10^8\ m/\sec}{2.4*10^9\ Hz} = 0.125m$)

- Each router has *power adaptation capability*, that is: increases/decreases its transmission power for reaching out distant/nearby nodes. This capability will be used in link cost calculation.

- Each router has a *maximum power limit* of **P_{max}= 3.2 mW**.

- Each router can decode the signal accurately if the received power is over a *threshold power* of **P_{th}= 0.1 µW** (Rx sensitivity)

➢ Connectivity and Cost Calculation:

- The cost of a wireless link between two routers is designed to reflect the power consumption required for the transmitter node for line of sight communication between them. (power adaptation)

- The nodes are assumed to be identical: you may calculate cost once and use same cost for both directions.

- Friis Free Space Propagation model will be used:

$$P_r = P_t G_t G_r \frac{\lambda^2}{(4\pi d)^2}$$

where

- G_t / G_r : The transmit / receive antenna gains (dimensionless)
- λ : Wavelength (m)
- d : Euclidean distance between transmitter & receiver (m)
- P_t : Transmitted power (W)
- P_r : Received power (W)

- With the distance (d) information, transmitter calculates required transmit power (**P_t^***) for its transmission in order to ensure the intended receiver will be able to decode its signal. (P_r=P_{th}). Transmitter then adjusts its power accordingly, also considering power limit (**P_{max}**).

  Link cost is determined based on this power calculation as follows:

  (P_t^* is calculated for transmitter$_i$ sending to receiver $_j$)

$$\text{cost}_{i,j} = \begin{cases} P_t^* & : P_t^* < P_{\max} \\ \infty & : P_t^* \geq P_{\max} \end{cases}$$

➢ **Program:** Write a C++ program to implement the described behaviors below:

- 10 Nodes' positions will be read from input file: *inputFile* (.txt file) whose name is given as command line parameter.
- Network topology will be constructed: Cost of each wireless link will be determined.
- This information will be sent to all network nodes
- Each node will then calculate shortest path from itself to all other network nodes and produces its routing table
- You should maintain record of topology, shortest paths calculated by each node and their routing tables.

➢ **Report:**

- Give *brief* but *sufficient* information of structures & parameters you use in your program.
- Please do NOT place code/slide/textbook/algorithm screenshot/s
- Please provide a sample run in your report and submit the sample *inputFile* that you use for testing your program. (even if your programs will also be tested by another sample topology)
- Sketch your topology including node deployment and link costs (you may use bidirectional links). Also, demonstrate the routing tables for each node.
- Answer: What is the **d_{max}** value in described system with given parameters: the maximum distance between any two wireless nodes in order for them to be able to communicate directly?

Due to: **12 December 2013, Thursday, 23:00**

Submission NOTES:

- Submissions are through Ninova system and has a **strict deadline**, no assignments submitted after deadline is accepted.
- Source codes and the report file you prepared should be uploaded as one compressed file named after your student number as "*student_number*.zip"
- You should implement your program in C++ programming language.
- Be sure that your program works and produces reasonable and expected results.
- This is *not* a group assignment and getting involved in any kind of cheating induces negative grades.