CS-541 Wireless Sensor Networks

Homework #2

Due date 30/4/2018, 18.00

- WSN deployment: Assume an IEEE802.15.4-compliant WSN (operational frequency = 2.4GHz/ DSSS) comprised of 50 nodes randomly deployed in a 100x100 region.
- Propagation mechanism: lognormal shadowing model with: Reference distance = 1m, {Gtx, Grx, L} = 1, standard deviation of normal variable X sigma (sigma = {2, 4}), and path loss exponent n = {2, 2.5, 3}.
- The level of transmission power Ptx equals to -10 dBm.

Transmission Range & Connectivity

The log-normal shadowing model can be used to calculate the maximum transmission range d_i for each node *i* such that $Prx(d_i) \geq S$, where is the receiver's sensitivity (S = -94dBm) and *Prx* is the received power in dBm.

Using the transmission range d_i calculated above for each node and the Euclidean distance c_{ij} between any two nodes i, j, calculate the connectivity matrix of the network defined as $A = [a_{ij}]$, where:

$$a_{ij} = \begin{cases} 1\ if\ c_{ij} \leq \min(d_i, d_j) \\ 0, \quad otherwise \end{cases}$$

- For all different cases of sigma, and path loss exponent calculate the transmission range of each node.

- Run the same experiment 10 times (random deployments) and plot the CDF of the transmission range with respect to the path loss exponent and sigma. Comment on the results.

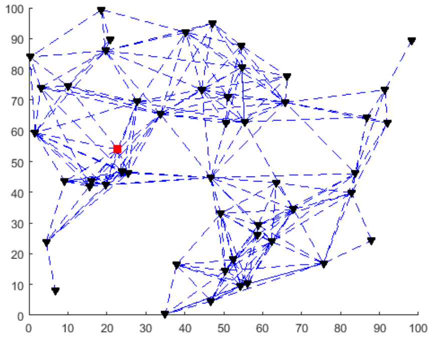
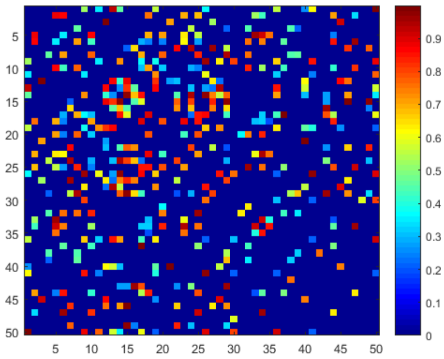
Routing.

Consider the case of a connected network for Ptx = -10dBm, n = 3, s= 4, modelled as an undirected graph G=(V,E), where V is the set of the nodes, and E is the set of edges connected edges:

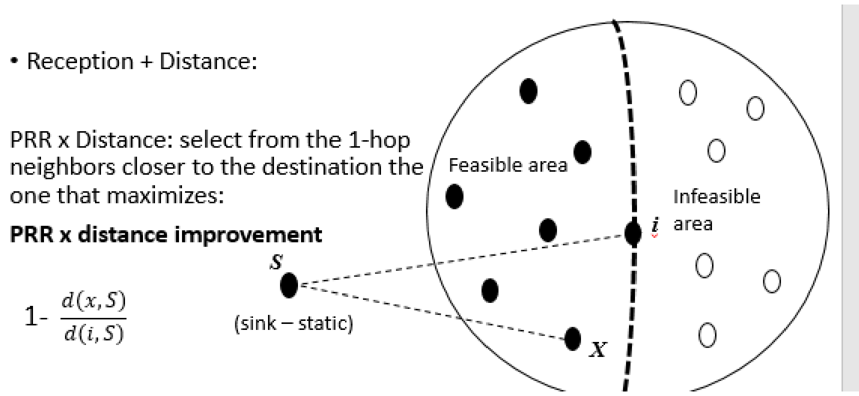
$$E = \{(i,j) \mid where\ i,j\ are\ nodes\ with\ a_{ij} = 1\}$$

Each edge (i,j) edge is additionally characterized by the link reception metric $prr_{ij} \in$ [0,1].

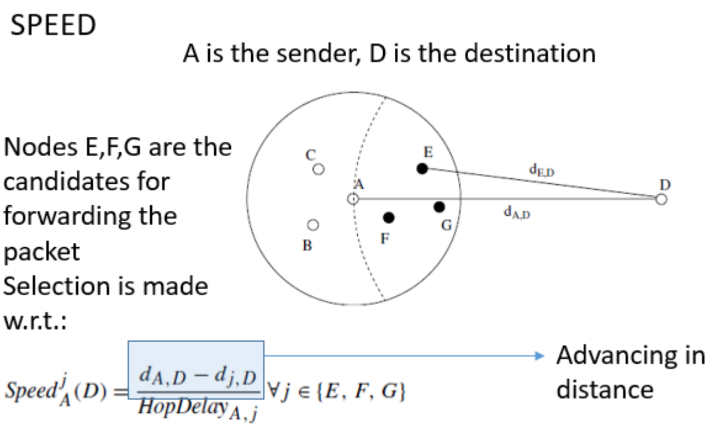
0 corresponds to no connectivity/extremely poor reception and 1 corresponds to excellent link reception. In addition, $prr_{ii} = 1$, and $prr_{ij} = prr_{ji}$.

- Considering a uniform random distribution within the range [0.1,1] for the link reception metric, calculate the routing path $R_i \subseteq E$ from each sensor node *i* (with id> 1) towards the sink node (with id =1) **based on the Disjoint GEDIR** (i.e. greedy forwarding with storing the routing path and discarding visited nodes) routing technique, and the following routing criteria:
  - The optimal (maximum) *prr x distance improvement* metric. For *prr* consider the link reception metric prr_{ij}.



  - The optimal (maximum) *SPEED* metric, considering as Hop Delay **the total delay** for transmitting a PHY packet of 50bytes from one hop to the next.



- Compare and evaluate the performance of the two routing criteria w.r.t : (a) total latency and total energy per node for reaching the sink node (energy needed for transmitting a single packet: 0.05Joule) with respect to the distance from the sink node, (b) the length of the routing paths formulated, (c) existence (or not) of any disjoint routing paths.

Deliverables

1. Report 2-3 pages (incl. diagrams & results)
2. Code (matlab or similar) with comments