On the use of nodes with controllable mobility for conserving power in MANETs

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Abstract

- Traditionally, the mobility of nodes in a mobile ac hoc network (MANET) is presumed to be beyond the control of any network protocol.
- We explore the idea of using relay nodes with controllable mobility as intermediate hops for reducing the power consumption in MANETs.
- We formulate the relay positioning problem and propose four variations of a simple algorithm to compute the optimal position and the movement of the relay nodes.

Mobility Controllable Relay Nodes

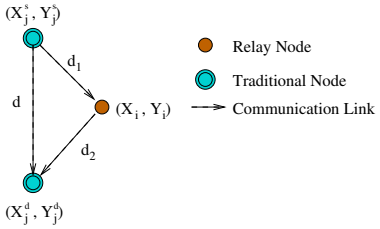
We introduce special nodes called Relay Nodes which have the following properties:

- Mobility of the relay nodes is controllable
- Relay nodes adopt a mobility pattern similar to the traditional nodes
- Relay nodes serve as intermediate hops, enabling the traditional nodes to transmit at reduced power
- Due to the simplicity of the task involved, such relay nodes cost much less
- Loss of a relay node does not affect the network's mission

Problem Formulation

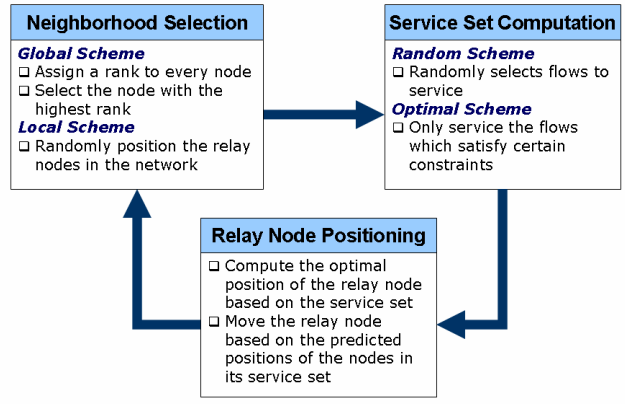
Simple Scenario:

- Two mobile nodes S and R
- S sends a single data flow to R
- Total power consumed for transmission is proportional to the distance between S and R



Suppose, we decide to use an intermediate node to relay data from S to R

- How should the relay node move to minimize the overall transmission cost ?
- How should the relay node move such that it also stays with the transmission range of S and R



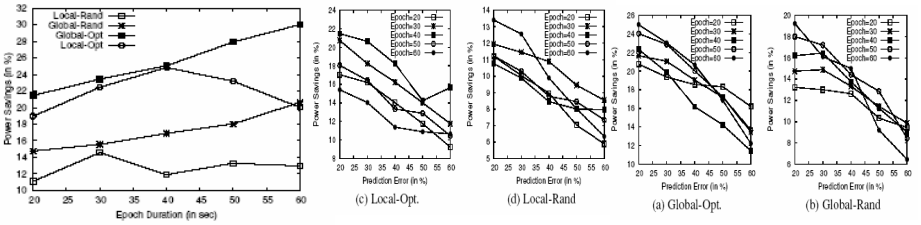
General Scenario:

- Given a network with many traditional nodes
- There are more than one flows between a given pair of nodes

Given a fixed set of relay nodes:

- How do we decide on the set of traditional nodes to service?
- How do we decide which flows to service between the selected nodes?
- How should the relay nodes be positioned and moved in order to minimize the overall power consumption required for transmission?

Preliminary Results



Sensitivity to Epoch Duration:

- The Global neighborhood selection scheme results in better performance
- Local-Opt scheme performs better than the Global-Rand scheme
- Performance of the local neighborhood selection schemes rapidly degrades

Sensitivity to Prediction Error:

- Total power savings in all the schemes decreases with an increase in the prediction error.
- Global neighborhood selection performs better than the local scheme
- Optimal flow selection scheme performs better than the random scheme

Conclusions & Future Work

- We explored the possibility of deploying relay nodes with controllable mobility as intermediate hops for conserving powers in MANETs
- Preliminary results indicate that deploying relay nodes as intermediate hops does result in considerable power savings
- Evaluate the issues that need to be addressed in deploying such mobility controllable relay nodes in a real network
  - Interaction with routing protocols
  - Effect of various of prediction algorithms
  - Costs associated with the mobility of relay nodes
  - Effects of different propagation models