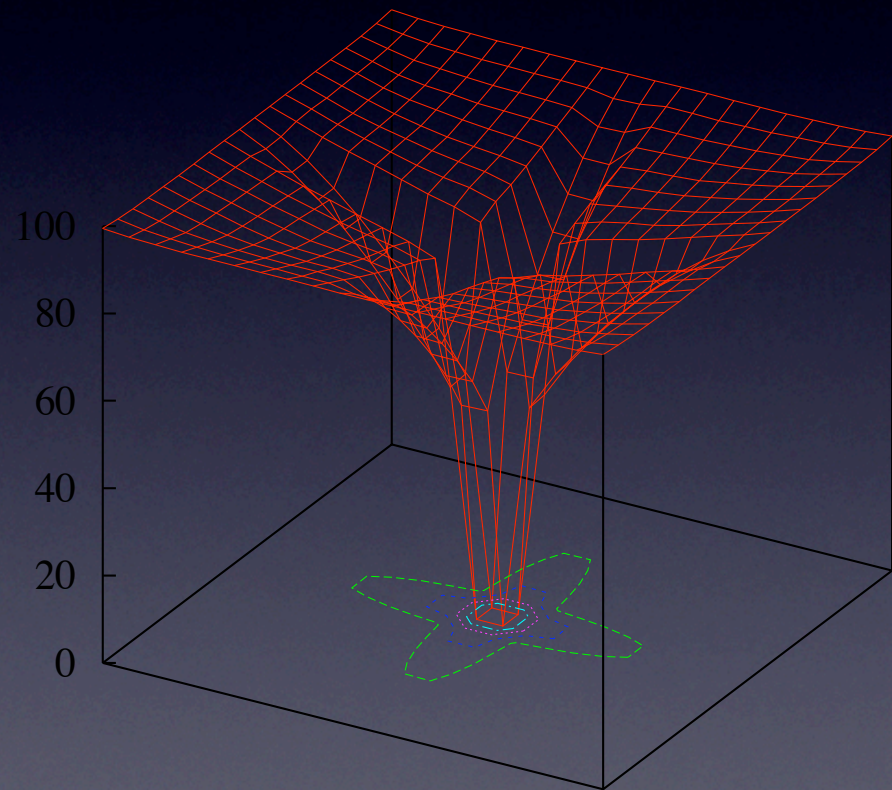


Exploiting Mobility for Enhancing Multi-hop Wireless Networks Performance: The Case for WSNs

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Many Reasons for Mobility

- Here's one:



Network with 400 nodes
sink at the center

Let's Move the All-powerful Sink

- Where to?
 - Sink sites vs. continuous positioning
- For how long?
 - Once at a site, how should it stay there?
- Which performance metrics to optimize?
 - Network lifetime? Packet latency?

A Test-Case: Lifetime for WSNs

- Optimal solution: Using ILP technology
 - Centralized, but with some perks
- Distributed heuristics
 - Localized design, as appropriate

ILP, Possible

- A well-established “work horse” technology
 - ILP models provide provable bounds
 - Enables rigorous benchmarking of heuristics (for larger cases)
 - Interesting algorithmic challenges anyway

“Simple” MILP Model

$$\text{Max } \sum_{k \in S} t_k$$

$$\text{subject to: } \sum_{k \in S} c_{ik} t_k + \sum_{k \in S} f_{ik} y_k \leq e_0 \quad (i \in N)$$

$$t_{\min} y_k \leq t_k \leq M y_k \quad (k \in S)$$

$$\sum_{k \in S} x_{0k} = 1$$

$$\sum_{k \in S} x_{k,q+1} = 1$$

$$\sum_{\substack{j \in S \cup \{0\} \\ (j,k) \in OUA}} x_{jk} = \sum_{\substack{j \in S \cup \{q+1\} \\ (k,j) \in AUD}} x_{kj} \quad (k \in S)$$

$$\sum_{\substack{j \in S \cup \{0\} \\ (j,k) \in OUA}} x_{jk} = y_k \quad (k \in S)$$

$$u_j - u_k + q x_{jk} \leq q - 1 \quad ((j,k) \in A)$$

$$t_k, u_k \geq 0 \quad (k \in S)$$

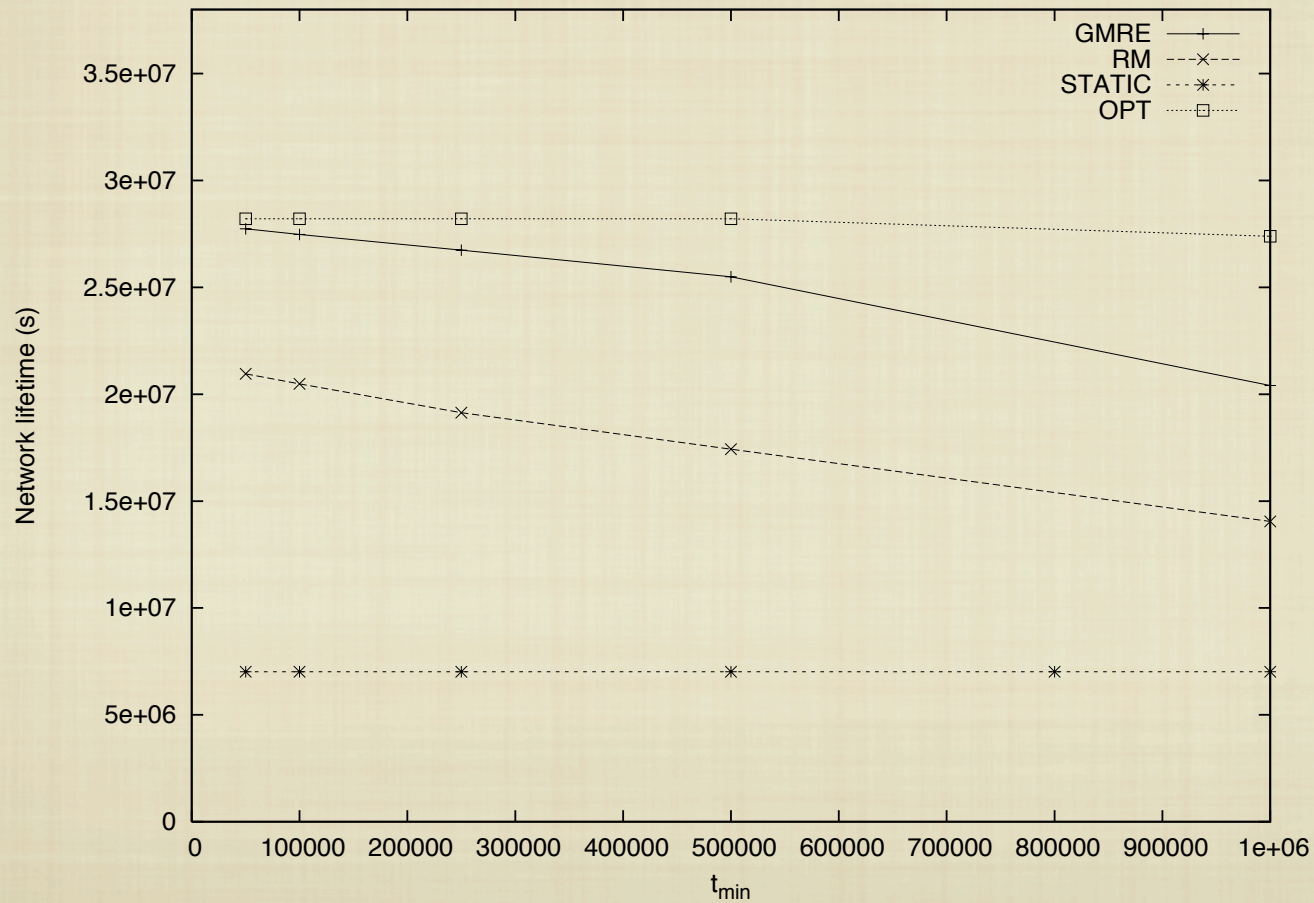
$$y_k \in \{0, 1\} \quad (k \in S)$$

$$x_{jk} \in \{0, 1\} \quad ((j,k) \in X)$$

Our MILP Model ...

- Solves realistic cases
 - 400 nodes, 64 sink sites
- Gives us insights on how to design distributed and localized protocols
- Allows us to benchmark non-trivial heuristic solutions
- Basagni et al. “Controlled Sink Mobility for Prolonged WSNs Lifetime” ACM Winet 2007

Our Example Again



Network lifetime

So ...

- Embrace the design of new solutions for mobility exploitation in multi-hop networks
 - Multiple sinks? Routing optimization? DTN problems?
- Using ILP technology for provable bounds and benchmarking
 - Lot of problems here
 - Interdisciplinary: OR, industrial eng., CS
- Devising and testing new distributed solutions