Title
Controlled Mobility for Increased Lifetime in Wireless Sensor Networks

Permalink
https://escholarship.org/uc/item/8686v73p

Authors
Arun Somasundara
Aman Kansal
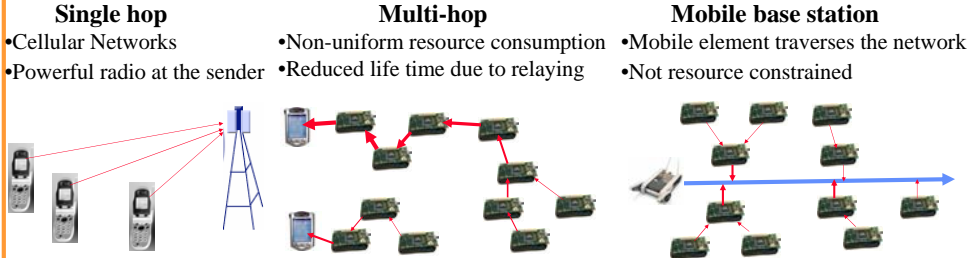David Jea
et al.

Publication Date
2004

Controlled Mobility for Increased Lifetime in Wireless Sensor Networks

Arun Somasundara, Aman Kansal, David Jea, Mani Srivastava
Networked & Embedded Systems Lab (NESL) - http://nesl.ee.ucla.edu

Introduction: Controlled Mobility

Ways of Data Collection

Single hop
- Cellular Networks
- Powerful radio at the sender

Multi-hop
- Non-uniform resource consumption
- Reduced life time due to relaying

Mobile base station
- Mobile element traverses the network
- Not resource constrained

Types of Mobility

- **Random**
  - No delay guarantees
  - DataMule, Zebranet, Whalenet
- **Predictable**
  - BusNet
- **Controlled**
  - Control in Space
  - Control in Time (moves on a trail)

Problem Description: Design network algorithms and control the motion of mobile
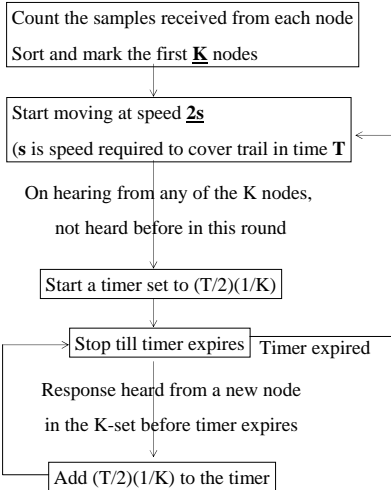
Design Choices

- Multiple small multihop networks
- Initial training phase:
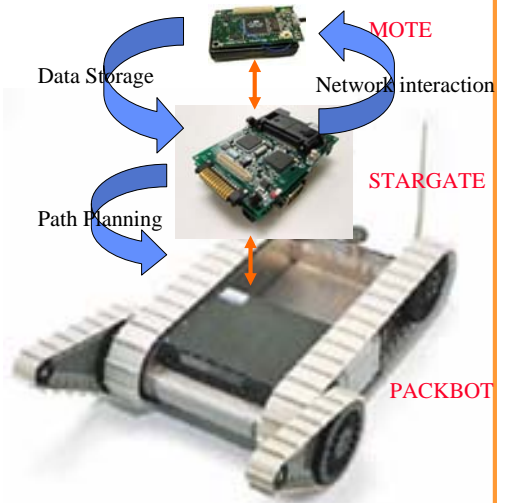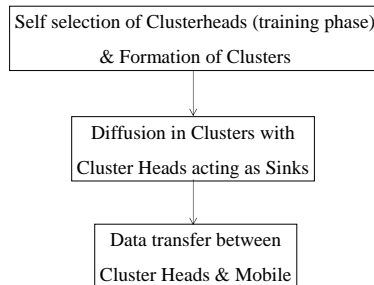 - On-path nodes
- Trees rooted at these.

Mobile \ Network	Without Precaching	With Precaching
Mobile stops on hearing from a node	Unpredictable Delays	Unpredictable Delays More memory at on-path nodes
Mobile moves with fixed RTT	Less data from >1-hop nodes	More memory at on-path nodes

Proposed Solution: Mobile moves with fixed RTT (T), On-path nodes do precaching

Algorithm on the mobile

Count the samples received from each node
Sort and mark the first **K** nodes

Start moving at speed **2s**
(**s** is speed required to cover trail in time **T**)

On hearing from any of the K nodes,
not heard before in this round

Start a timer set to $(T/2)(1/K)$

Stop till timer expires — Timer expired

Response heard from a new node
in the K-set before timer expires

Add $(T/2)(1/K)$ to the timer

Network Algorithm

Self selection of Clusterheads (training phase)
& Formation of Clusters

Diffusion in Clusters with
Cluster Heads acting as Sinks

Data transfer between
Cluster Heads & Mobile

Data Storage
Network interaction
MOTE
STARGATE
Path Planning
PACKBOT

Theoretical Analysis

START
r
d
2r
Path

MODEL & ASSUMPTIONS

- Network of **N** nodes deployed in a circular area of radius **d**
- Radio range of nodes **r**
- The mobile moves along the *dotted* path
  - It is within 1 hop of all the nodes sometime
- Mobile is in range of **k** nodes at all times
  - $k = (N) * (\pi r^2) / (\pi d^2)$
- Channel bandwidth is **W**

RESULTS

- Distance moved by mobile
  - assuming **d** is an even multiple of **r**
  - $L = (2\pi d^2)/4r + (d-2r)$
- **Capacity = (W/N) * $2\pi d^2/(2\pi d^2 + 4rd - 8r^2)$**