

An Analysis of a Large Scale Habitat Monitoring Application

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Overview

- ◆ What was done
- ◆ Implementation
- ◆ Important Results
- ◆ Analysis
- ◆ Pro v. Con Discussion

Questions to Consider

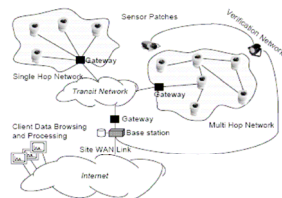
- ◆ What are the technical challenges addressed?
- ◆ What could have been improved?
- ◆ Was a sensor network necessary?
- ◆ In-network v. Out-of-network processing?

Introduction/Background

- ◆ Location: Great Duck Island, Maine
- ◆ Goal: Collect environmental data
- ◆ Time: 4 months, Summer 2003
- ◆ Network: 150 devices

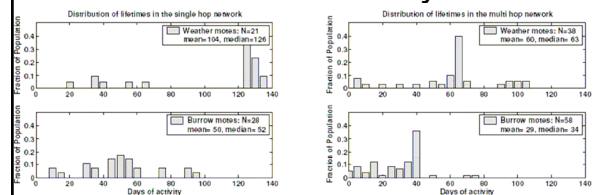
Implementation

- ◆ Sensor Patches
 - Single/Multi
- ◆ Gateway
- ◆ Transit Network
- ◆ Base Station Gateway



Were field tools actually developed or just suggested?

Performance Analysis



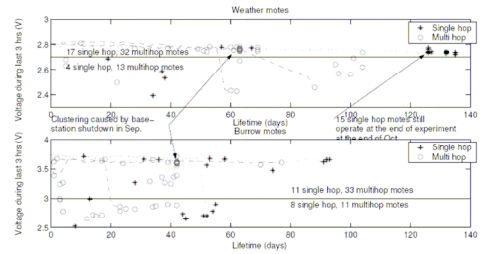
- ◆ Lifetime
 - What can we say about multi v. single hop?

Performance Analysis (cont.)

- ◆ Predictions
 - How are these different from the actual results?
 - Is overhearing a good thing idea?

Subsystem	Energy (mJ)	Single-hop period (s)	Single-hop power (μ W)	Multi-hop period (s)	Multi-hop power (μ W)
Baseline sleep	-	56	-	-	56
Tuner	0.0034	62	62	-	-
Incoming packet detection (low power listening)	0.465	1.085	465	0.540	930
Packet transmission (short preamble)	3.92	300	14	-	-
Packet transmission (long preamble)	39.2	-	-	600	64.4
Climate sensing	36.4	300	120	1200	31
Occupancy sensing	35.3	300	118	1200	29
Weather mote (w/o forwarding & overhearing)					
Average power	717	-	-	-	1142
Expected life (days) (\$60 mAh battery 2.5V)	140	-	-	-	90
Burrow mote (w/o forwarding & overhearing)					
Average power	714	-	-	-	1141
Expected lifetime (days) (1000mAh battery 3.6V)	127	-	-	-	80

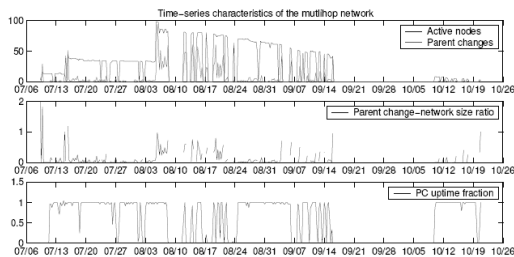
Performance Analysis (cont.)



◆ Battery Life

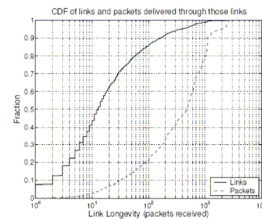
- Important Concept: Failure to transmit below a certain voltage

Performance Analysis (cont.)



- ◆ Network Stability
 - Pitfalls of a multi-hop network?
 - Is redundancy important?

Performance Analysis (cont.)



◆ Link Stability v. Routing

- Most stable support the majority of the packet tx
- Is this a pro or a con of a self organizing routing structure?

Performance Analysis (cont.)

- ◆ Oversampling v Packet Yield
 - Used to mask the fact that some packets will not ever be reported
 - Is this an effective use of power?
 - Does this approach even work?
 - ◆ Effective for single-hop nets
 - Stability throughout network lifetime
 - ◆ Ineffective for multi-hop
 - Large variability in packet yield

Future work

- ◆ Node reclamation
 - As networks get larger, task becomes unmanageable
 - Node maps do not account for 3 dimensions
 - Other considerations?
 - Is there a better way to find them?

Future Work (cont.)

- ◆ Field Tools
 - PDA-device to monitor nodes in the field
 - Re-task, etc
- ◆ Client Tools
 - Visualize networks
 - Re-program

Faults in Implementation

- ◆ Need for sensor network?
- ◆ Redundancy esp. for critical nodes (80-20 rule)
- ◆ TDM, FDM v. sense and send for streaming protocols
- ◆ Data compression
- ◆ Query specific nodes

Discussion

- ◆ What are the technical challenges addressed?
- ◆ What could have been improved?
- ◆ Was a sensor network necessary?
- ◆ In-network v. Out-of-network processing?

Summary

- ◆ Excellent out-of-network analysis of network
- ◆ Proposal of future work
- ◆ Function of network is generally satisfactory