Sensor Networking Overview

Papers:

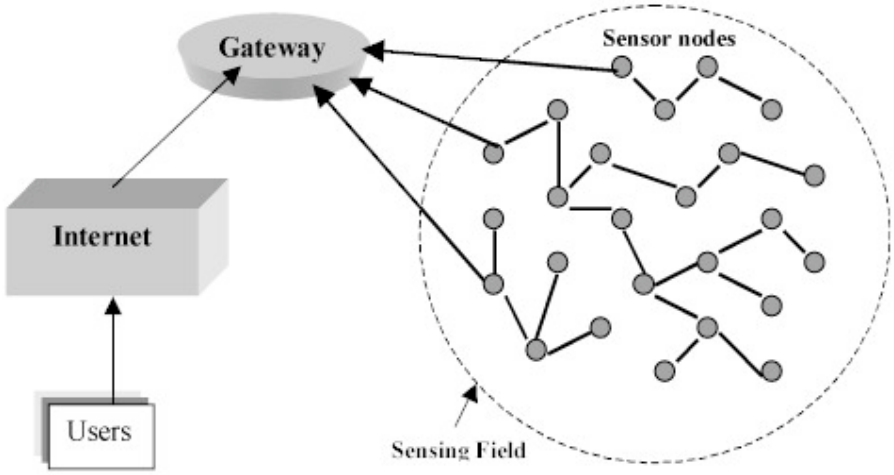
Wireless Sensor Networks for Habitat Monitoring

Fidelity and Yield in a Volcano Monitoring Sensor Network

Background

- Smaller technology has resulted in potential for new kinds of applications.
  - Monitor various habitats without human presence
  - Monitor areas that pose risks to humans

Typical Architecture



http://www.acm.org/crossroads/xrds9-4/gfx/sn1.jpg

General Requirements

- Accessible via the Internet
- Hierarchical network spread over a large geographic area
- Long lived
- No AC power access
- Managed via the Internet (deploy new code, etc)
- Non-disruptive to the habitat

Applying Distirbuted Systems Concepts

- Time synchronization
  - Duty cycling
  - MAC-layer and TDMA
  - Event detection
- Coordination and Election algorithms
  - Topology control
    - Hierarchical structure
    - Every node is a router

Great Duck Island

- Monitor Leach's Storm Petrel
  - Usage of nesting burrows
  - Changes in burrow and surface environmental patterns over 7 month breeding season

Setup

- Mica Motes (32 deployed) - 40kbps, 4MHz, 512KB storage, AA batteries
- Sensor board - temperature, photoresistor, barometric pressure, humidity, passive infrared
- Energy budget - need to run for 9 months = 1.4 hours of processing (only processing, no sensing, etc) per day
- Energy budget must be divided between sensor sampling, data collection, routing, health monitoring, and network retasking

Discussion

- Data sampling
  - sample/sense period is dependent on application and energy budget
  - data may be compressed before sending if energy to compress < energy to transmit
- Communication
  - must be scheduled (requires time synchronization!)
  - each level of the routing tree forwards to the level above at a given time and returns to sleep/low power state
- Health and Status Monitoring
  - use status info to aid with retasking
  - example: adjust duty cycle to alter lifetime

Reventador Volcano

- Gather seismic and acoustic data from volcano
- Explore fidelity and yield in data collection
  - Fidelity - quality and accuracy
  - Yield - quantity

Setup

- TMoteSky-based (16 deployed) - 10KB SRAM, 48KB program ROM, 1MByte flash
- Sensors - single-axis seismometer or three seismometers, microphone
- Energy budget - 2 D-cell batteries, 1-week lifetime, researchers returned to change batteries during 19-day deployment

Challenges

- High-resolution signal collection
  - Sampling rate of 100Hz
- Limited radio bandwidth (100Kbps)
- Timing accuracy
  - Cannot use GPS unit

Discussion

- Network topology and status monitoring
  - nodes transmit status every 10 seconds (position in routing tree, buffer status, timestamp info, battery voltage)
- Data collection
  - nodes continuously collect, but do not continuously transmit data
  - 1MByte flash is a circular buffer
  - if an interesting event is observed, it is reported
  - if enough nodes (30%) report event in a 10 second window, the base station asks all nodes for last 60 seconds of data