What is a Sensor Network?

- A sensor network is a collection of sensor nodes equipped with sensing, communication (short range radio) and processing capabilities.

What is it good for?

DARPA Vision

- Multiple target tracking
- Dense deployment of sensor nodes on the ground
- Flexible sensor tasking
- Multi-modal sensor nodes
  - Seismic sensor, motion detector, microphone

A First DARPA Demo

A Second DARPA Demo

Great Duck Island
Zebranet
- Modelling long-range animal migrations
  - Sparse connections
- Observing inter-species predator-prey interactions
- Analyzing the impact of human development on animal behavior

Wireless Monitoring and Control
- Supply chain management
- Health care
- Structure Monitoring
- Entertainment
- Production Automation
- Surveillance

System Constraints
- Lifetime
  - From a few days to a few years, with or without maintenance
- Cost
  - From a few cents to thousands of euros
- Sensed Data
  - Low rate (e.g., temp sensors) vs. High rate (e.g., imagers)
  - Different accuracy and precision requirements
- Environment
  - From protected (e.g., in a building) to very hostile (outdoors)
- Network topology
  - From star to mesh topologies
- Different densities and scale
- User interaction
  - Fixed vs. Flexible tasking
  - Monitoring vs. control

System Taxonomy
- Scale
  - Sampling: Function of phenomena and application
  - Extent: Space covered and lifetime
  - Density: Density of sensor nodes vs. input stimuli
- Variability
  - Structure: Ad hoc vs. Engineered system
  - Task: Single vs. Multiple modes of operation
  - Space: Mobility of system and phenomena
- Autonomy
  - Modality: Multiple modalities combined
  - Complexity: data vs. Event delivery

Sensor Network Regime
- Based on Darpa Vision (formulated by Culler et al)
  - Limited energy
  - Limited hardware capabilities
  - Concurrent flows of data (from sensors and network)
    - Passive vigilance vs. Bursts of concurrency-intensive operations
    - Need for robustness
- Different classes of applications require definition of appropriate regime
Related Areas

- Pervasive Computing
  - Marc Weiser’s vision
  - Large domain
- Personal Area Networks
  - Person-centric spaces and networks
  - Cable replacement
- RFID
  - Essentially for supply chain management
  - Adding sensing capabilities to RFID is promising
- Ad-hoc networks
  - Infrastructure-less networking

Reality Check

- Thousands of self-configuring sensor nodes
  - Still Sci-Fi
  - Vernor Vinge recommended reading (A depthness in the sky)
- Programming, Debugging, Deployment challenges
- 800 nodes max
- 50 nodes state-of-the-art

Summary

- Sensor networks are application specific
- Key application characteristics
  - Lifetime, cost, data rate, environment, network topology, user interaction
  - Impacts sensor network design
- Appropriate regime for a given class of application