

Technology Issues in Wireless Sensor Networks

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Available Sensor Technology

- Today sensors are available to detect:
 - Chemicals, radiation levels, light, seismic activity, motion
 - Audio, video
- Challenges ahead:
 - Miniaturization
 - Untethered communication
 - Battery lifetime
 - Self organization

Emerging Technology

- MEMS

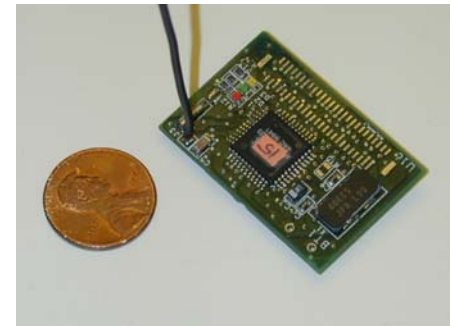
- Micro Electro-Mechanical Sensors
- Potential for tremendous storage capabilities

- Motes

- 8 bit 4 Mhz Atmel microprocessor, 512 bytes SRAM, 8 K Flash ROM

- Cell computer

- Full featured PC



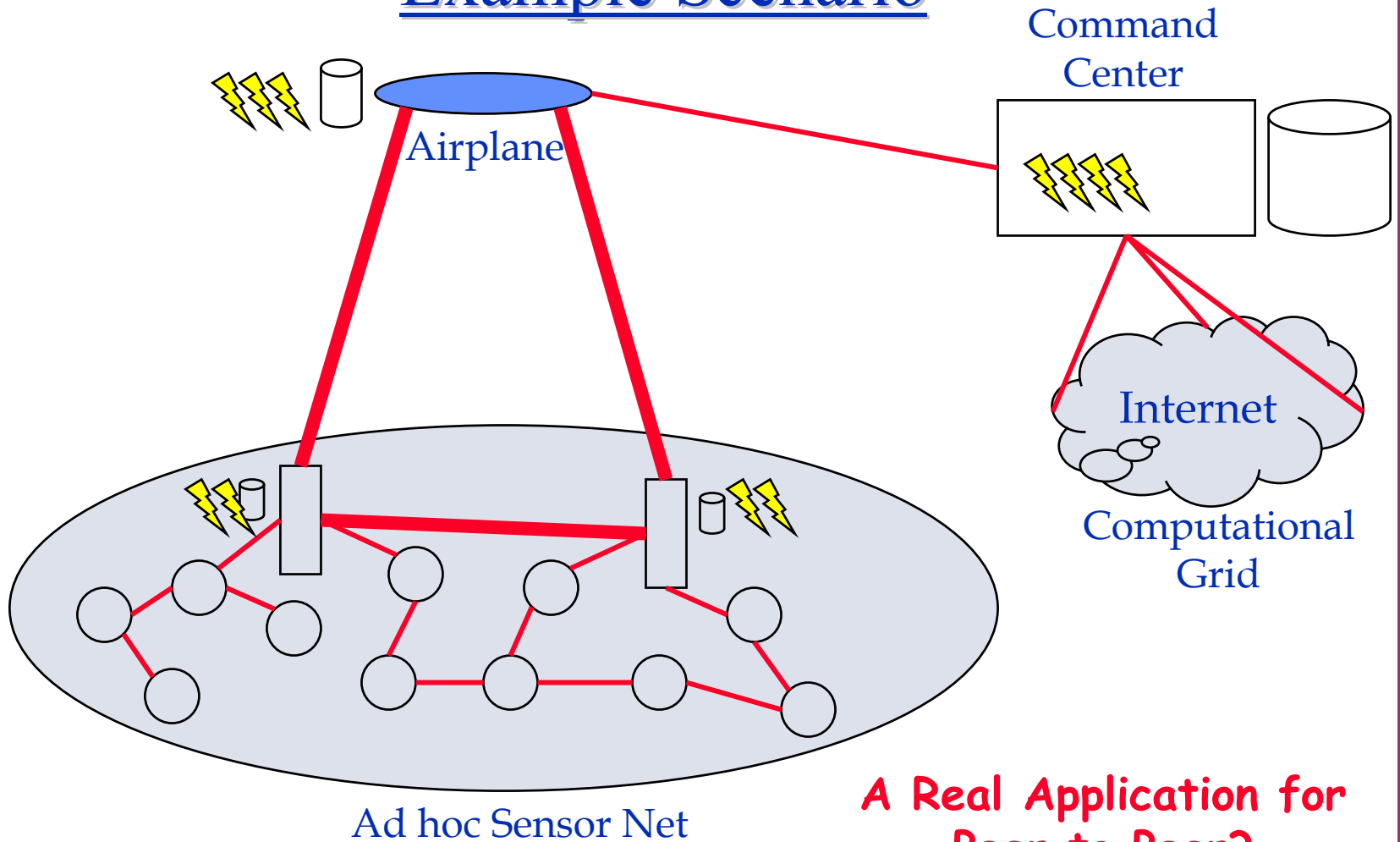
Target Scenarios

- Disaster recovery
 - Aid in search and rescue
- Agriculture
- Industrial tracking
 - Sensors prevalent in automobiles
- Military scenarios
 - Aircraft dropping sensors over a geographic range and circling the area, acting as a base station
- Surveillance?

Example Scenario

- Plane drops thousands of sensors over target area
 - Heterogeneous capabilities: computation, communication bandwidth/range, battery power
 - Plane circles area acting as base station
 - For subset of nodes with relatively long range (low bw?)
 - Sensors self-organize into hierarchical ad hoc network
 - Communicate findings to plane (with local computation)
 - Plane distills data stream, computes and transmits to command center
 - Feedback from command center, through plane, to sensor net

Example Scenario



**A Real Application for
Peer to Peer?**

Counter-Terrorism

- Detect anthrax spores, gas leaks
 - Track building stability
 - Track mail delivery
 - Embedded barcode symbols per stamp?
 - Denial of service detection and prevention
- Sensors must transmit findings to central location
- Widespread deployment for fine-grained accuracy

Challenges

- Automatic tracking of characteristics in a geographic region
- Minimize human intervention and management
 - Maximize accuracy
- Hostile environments
- System lifetime
 - Computation/communication becoming cheaper
 - Energy as critical resource

Personal Security

- Sensors able to track broad range of information
- Integrated wireless communication and cheap central storage
- Broad range of information available for data mining
- What are the implications for privacy?
- Technology to control “proper usage” of data?
 - Analogies to medical records
 - How to enable owner of data to control distribution?
 - How to distribute proper authority when necessary?

Conclusions

- Sensor technology continuing to improve
- Key is to integrate computation, communication, and sensing on single miniature platform
 - Power management
 - Redundancy to maximize fault tolerance
- Dynamically react to changing network conditions
 - Minimize human interaction to maintain system
 - Empower people to make proper high level decisions