Wireless Seismic Data Collection

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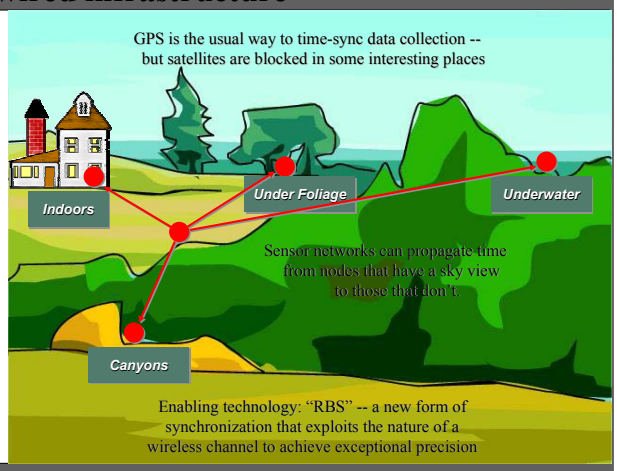
Introduction: Seismology is limited by the need for wired infrastructure

Discoveries are driven by data collection

- **Much of our knowledge of the Earth's internal structure comes from measurement of earthquakes**
  - Comparison of observations from many locations yields insight into details of the Earth's structure in between

Data collection currently requires infrastructure

- **Correlation across sensors usually requires time synchronization**
  - GPS (Global Positioning System) Satellites provide precise time world-wide
  - Unfortunately, GPS is not visible from many seismically interesting areas: inside buildings or tunnels, under foliage, in canyons, underwater…
- **Remote data retrieval makes the system practical**
  - Instant feedback after a significant event
  - Also allows health monitoring – faster turnaround on tuning, maintenance, etc.
  - Typically accomplished by connecting nodes to the Internet



Problem Description: Ease deployment by going wireless but maintain "good as wired" service

Wireless, autonomous nodes … Use inexpensive, off-the-shelf hardware (e.g., 802.11b) to provide a wireless link to every node

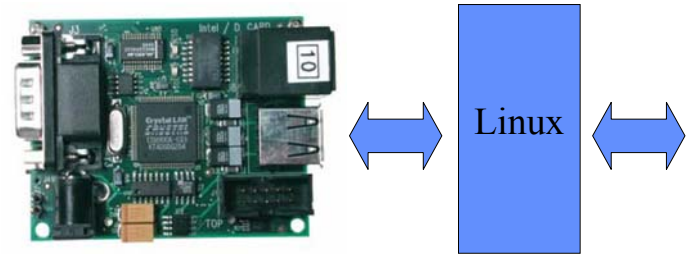
Multi-hop data and control routing … Allow collected data and outgoing control messages to be distributed hop-by-hop through the network to the nearest access point, rather than requiring Internet to every node

High-precision multi-hop time sync … Nodes that have a view of GPS satellites propagate high-precision global time to nodes that need it

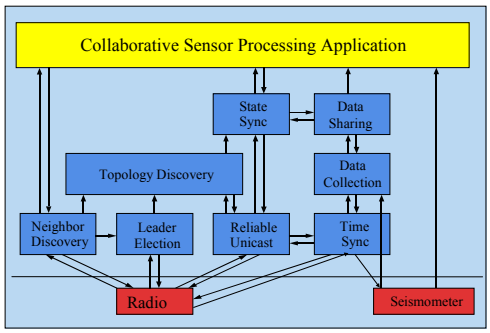
Proposed Solution: A prototype wireless seismic testbed using commodity hardware

Small, low-power Linux platform: The Intel/Crossbow X-Scale "Stargate"

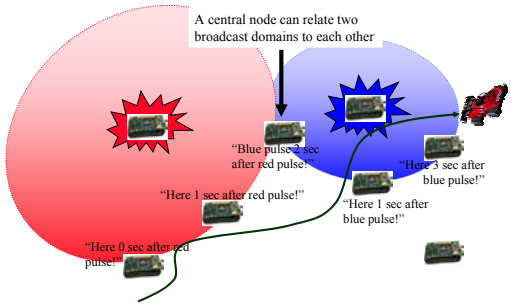
400 MIPS, 32 MB Flash and RAM, PCMCIA, Compact Flash



EmStar: A Framework for Flexible Wireless Sensor Network Software



Reference-Broadcast Synchronization: Leverages Wireless Broadcasts for Precision



Automatic Construction of Trees for Multi-Hop, High-Precision Time Sync