Title
Wireless Seismic Data Collection

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Publication Date
2003
**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
    - A central node can relate two broadcast domains to each other

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