Geographic Aspects of Location Tracking with RFID and GPS

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Foci of this Presentation
- Compare and contrast RFID and GPS
- Legal issues
  - Reliability and liability
  - Lobbying and legislation
- Privacy issues
  - Informed consent
  - Retention period
  - Control of one’s locational history
  - Unintended consequences

Radio Frequency Identification
- Advantages
  - Inexpensive tags, especially for merchandise
- Disadvantages
  - Limited range
  - Position tied to location of the antenna/reader
- Technical issues
  - Increase the range?
  - Support triangulation?
  - Can movement be channeled through a minimal number of gates?

Geographic Issues for RFID
- Range (effective distance)
  - Positively correlated with cost (and size)
  - Greater the range, the less dense the network of interrogator stations
- Tag memory (read/write? store data?)
  - Positively correlated with cost
  - Tags with ample read/write memory could keep track of where they’ve been
  - Locational history is possible with read/write tags and an adequate interrogation network

Interrogator Network
- Choke points in the circulation network
  - A geographic problem: what’s the network like and where are the choke points?
  - An optimization issue: trade-offs between cost and coverage
- Network and optimal chokes depend on:
  - Gates (doorways) or movement channels
  - Pause points in subject’s movement
  - Predictable routes based on predictable origins and predictable destinations
  - Plan for less predictable movement?

Global Positioning System
- Military origin
  - Real-time weapons-system guidance
  - A “you-are-here” for electronic battlefield maps
- Constellation of 24 satellites
  - Satellites transmit an ID-and-time signal
  - Estimates location and elevation
  - Time signal blurred under “Selective Availability”
  - Location Based Services (LBS) industry
  - European commercial system: Galileo
Global Positioning System

- **Disadvantages**
  - Cost and size of receiver
  - Real-time tracking depends on wireless network
  - Poor indoor reception because of signal attenuation and multipath-corrupted signals in buildings and "urban canyons"

- **Advantages**
  - Positional accuracy
  - The slower the movement, the greater the locational accuracy (useful for geodetic surveying)
  - Record or transmit a locational history

GPS - RFID Hybrids

- **GPS for**
  - Outdoor movement
  - Short-term storage of recent locational history

- **RFID for indoor tracking**
  - Greater control of subject’s movement indoors
  - Does the location warrant interior detail?
  - Network density (interrogator stations, range, etc.) can be adjusted to need for surveillance

- **RFID as a supplement to GPS tracking**

"Pseudolites"

- **Pseudo-satellites**
  - Aircraft at a lower altitude
  - Stronger signal

- **Military solution to**
  - Jamming
  - Need for greater accuracy and reliability in a war zone

- **Compatible with regional denial of GPS signals—ad hoc "Selective Availability"**

Links to Other Systems

- **Video surveillance**
  - RFID as a trigger

- **Traffic surveillance systems**
  - RFID to increase the panoptic potential of traffic-count and signal-control systems

- **Real-time Web monitoring**

- **GIS-based 'no-go' areas**

Legal Issues

- **Reliability of highly complex systems**
- **Consequences of failure**
  - Litigation
  - Disclaimers

- **Lobbying and legislation to . . .**
  - Reduce the failure rate (standards, better data)
  - Externalize costs of system improvement

- **The Wireless E-911 experience:**
  - Repeatedly deferred deadlines

Privacy Issues

- **Tracking of vehicles and merchandise**
  - Personal privacy?

- **Limits to surveillance of employees?**

- **Whose information is it?**
  - Retention period
  - Sale of locational histories (anonymized or not)
  - Why reliable anonymization is problematic

- **'Opt in' or 'opt out'?**
  - "Do not track" button?
  - Can the USA PATRIOT Act override it?