# Geographic Aspects of Location Tracking with RFID and GPS

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## Foci of this Presentation

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- ∠ Legal issues
  - Reliability and liability
  - Lobbying and legislation

### ∠ Privacy issues

- Informed consent
- Retention period
- Control of one's locational history
- Unintended consequences

# Radio Frequency I dentification

### ∠ 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

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- 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

### $\ensuremath{\boldsymbol{\varkappa}}$ 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

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- 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

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- 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

## "Pseudolites"

- ∠ Pseudo-satellites
  - Aircraft at a lower altitudeStronger signal
- - 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

## Legal I ssues

- 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 I ssues

- 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
- - "Do not track" button?
  - Can the USA PATRI OT Act override it?