User Interaction: Intro to Location

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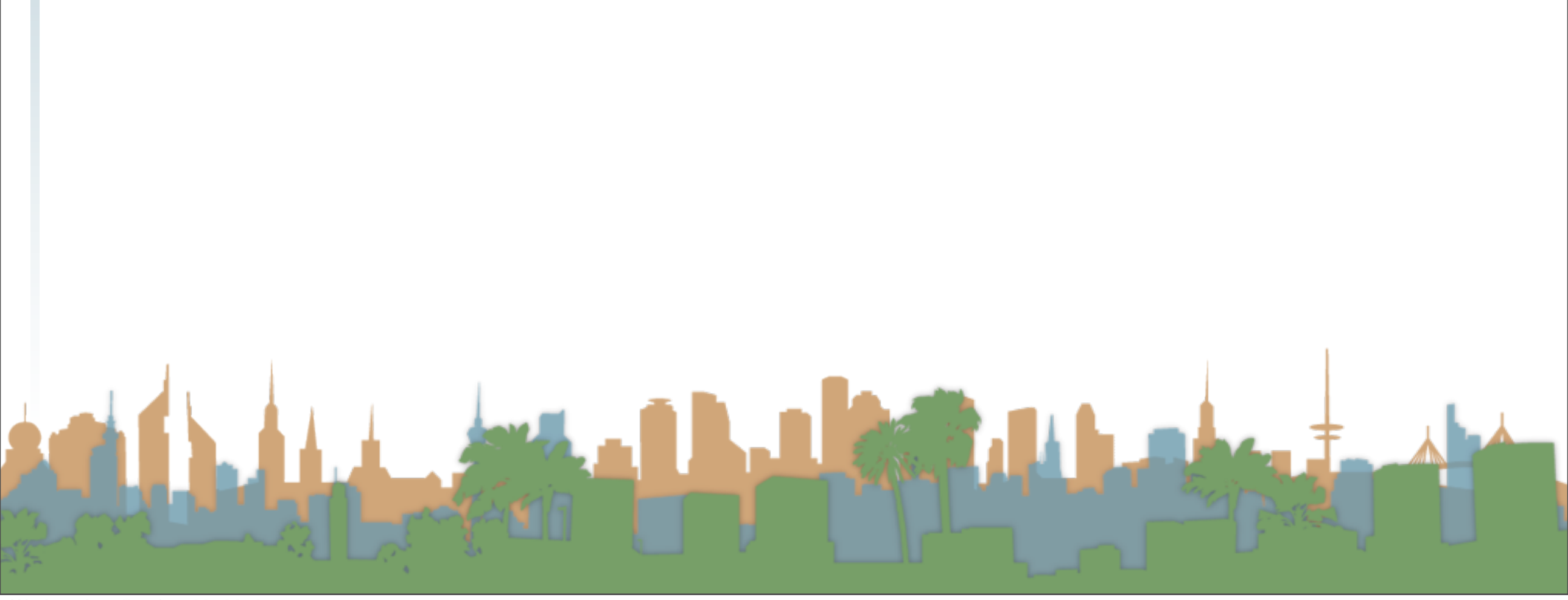
INF 133 Fall 2010

Computing with Location

- Navigation Tools
- Latitude and Longitude, Datum
- GPS: satellites, scalability
  - 3D Foghorn principle
  - WAAS, DGPS
  - Galileo, GLONASS, Beidou, Japanese Quasi-Zenith
- Model-based localization vs. fingerprinting
  - Localization beyond GPS

Global Location GPS



Global Location GPS

- GPS accuracy
  - 13 m 95% of the time horizontal
  - 22 m 95% of the time vertical system
  - 40 ns 95% of the time
  - How do you design for this?

Global Location GPS

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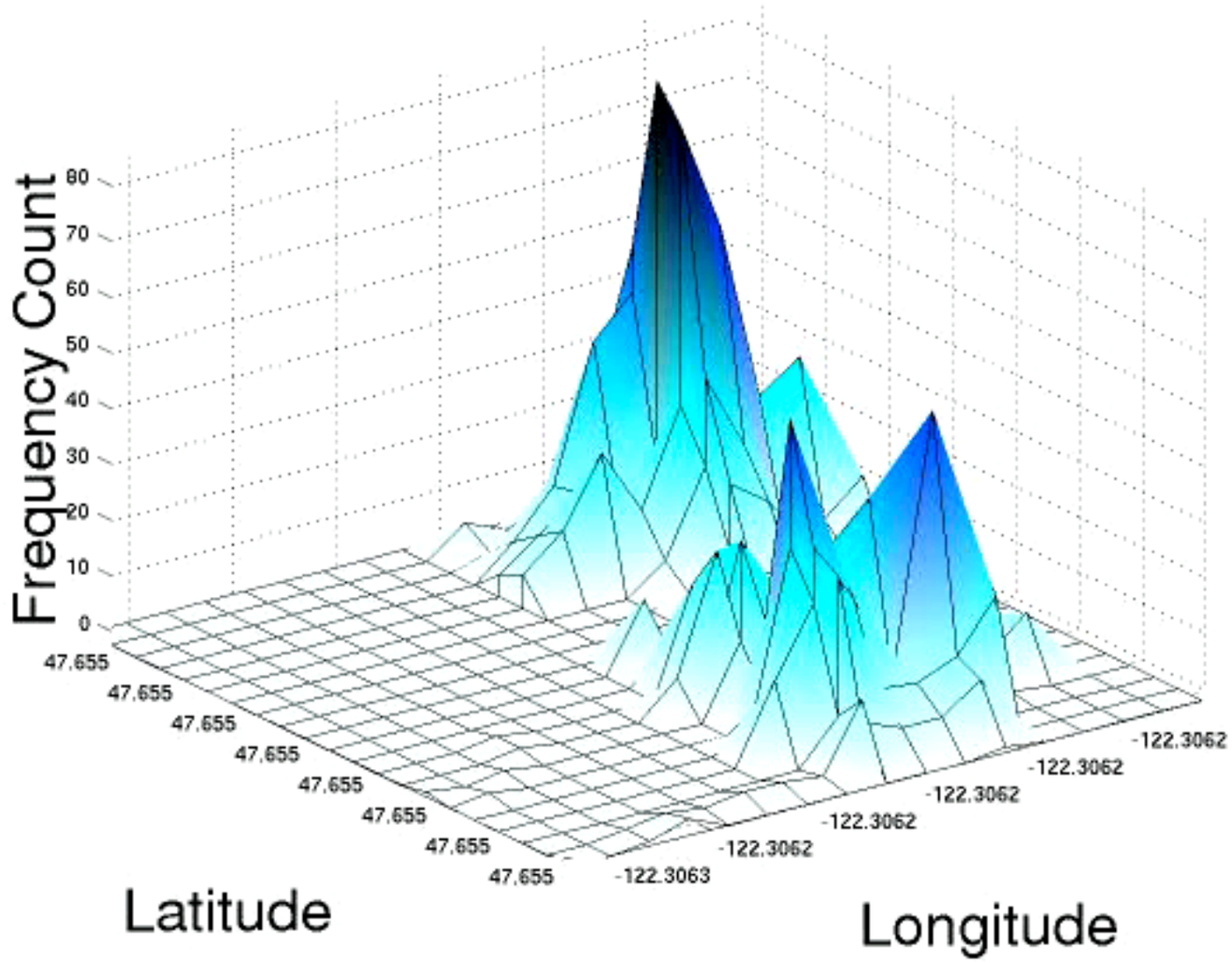
  - 40 ns 95% of the time
  - How do you design for this?
- Urban canyons
  - What are they?
  - Japanese response, European response

Global Location GPS



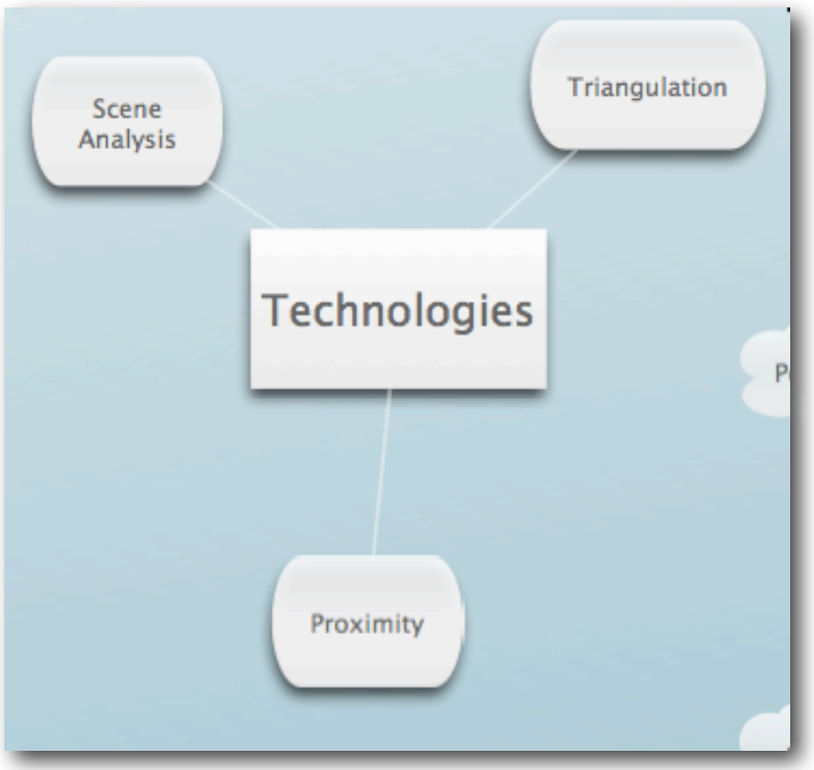
Global Location GPS

Localization beyond GPS

Properties of Location Systems

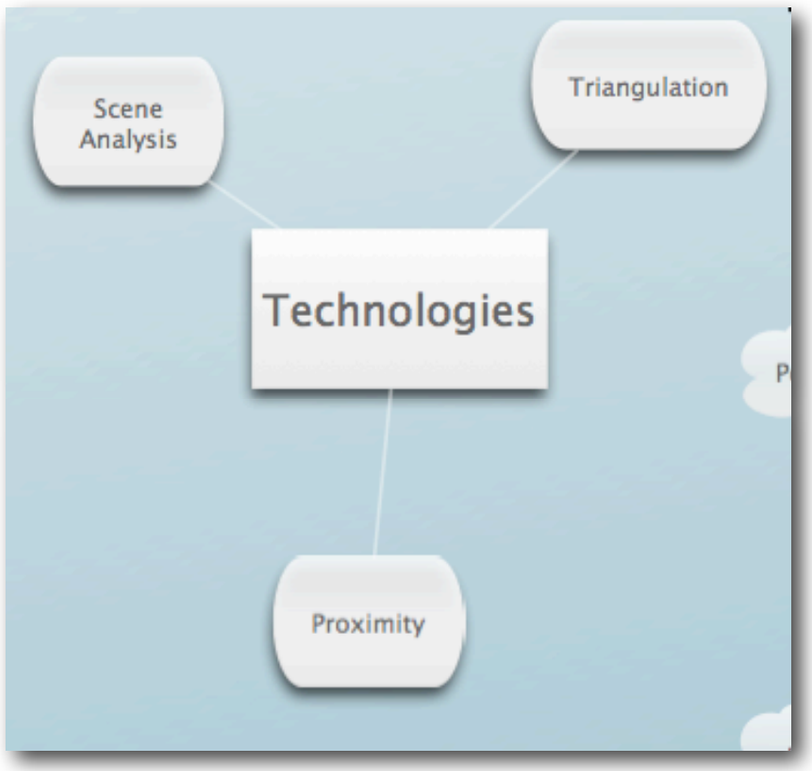
- Technologies
  - Scene Analysis
  - Triangulation
  - Proximity
- Physical Position
  - Position
  - Representation
    - Place
- Relativity
  - Relative
  - Absolute
- Limitations
  - Indoor/ Outdoor
  - Equipment needs
  - Battery Power
- Accuracy
- Scale
  - Regional
  - Global
  - Local
- Recognition
  - GUID
- Cost
  - Infrastructure
  - Incremental Users/ Improvements
  - Deployment
  - Maintenance
- Computation
  - Assisted
    - Cell-phone
  - Infrastructure
    - Broadcast ID
  - Local
    - GPS

Properties of Location Systems



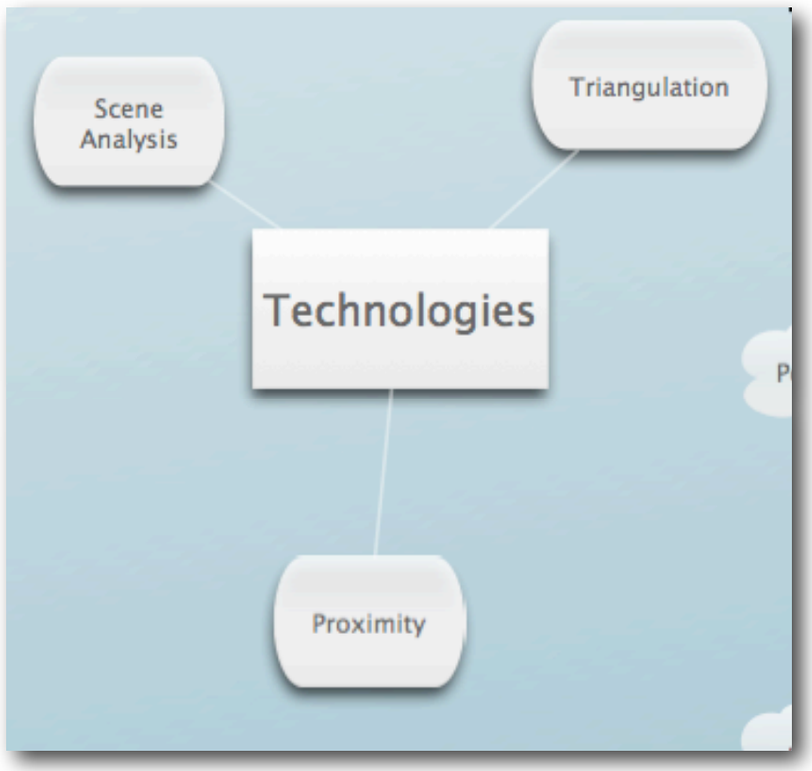
- Technologies
  - Triangulation
    - GPS is an example
  - Multiple references to fixed locations which resolve position

Properties of Location Systems



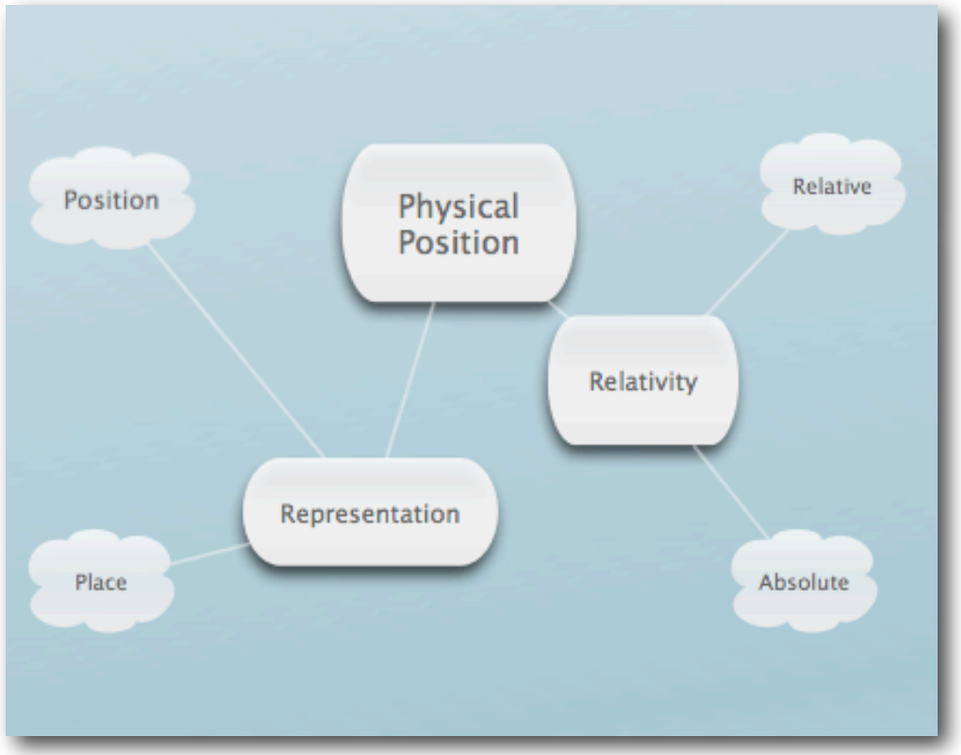
- Technologies
  - Proximity
    - Knowing that you are near a fixed location
    - Typically based on non-localization technology
    - Cell-towers, Credit card usage, login information

Properties of Location Systems



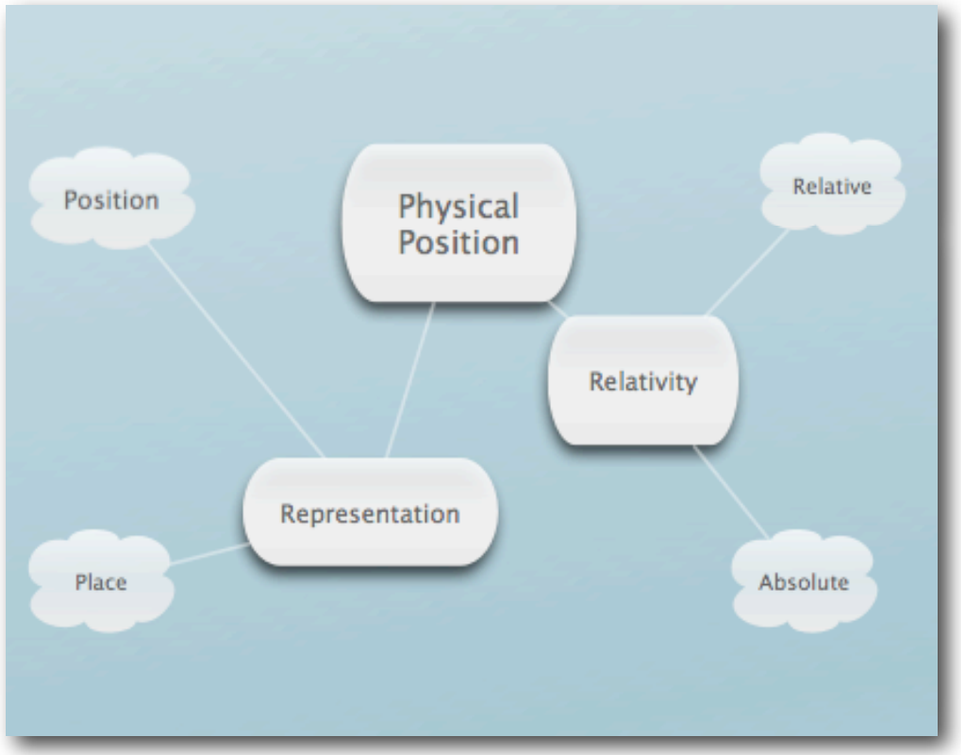
- Technologies
  - Scene Analysis
    - Evaluating content from a fixed camera
      - Color histograms from doorways
    - Evaluating content from a mobile camera
      - tour guide scene matching

Properties of Location Systems



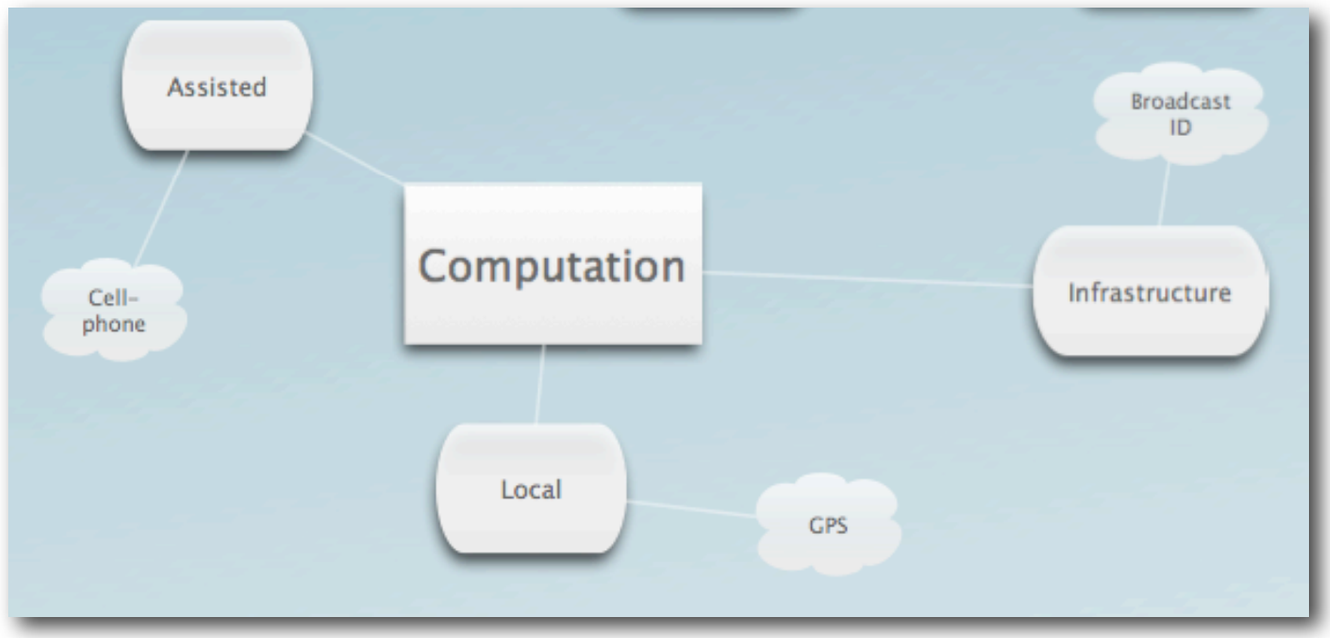
- Properties
  - Physical Position/Symbolic location
    - Position
      - Exact, Unambiguous, Machine friendly
  - Place
    - Inexact, Ambiguous, Human Friendly

Properties of Location Systems



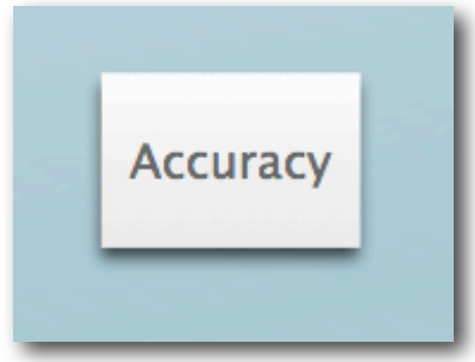
- Properties
  - Absolute/Relative
    - GPS is absolute
    - Laser range finder is relative
  - Transforming between the two is possible with additional information

Properties of Location Systems



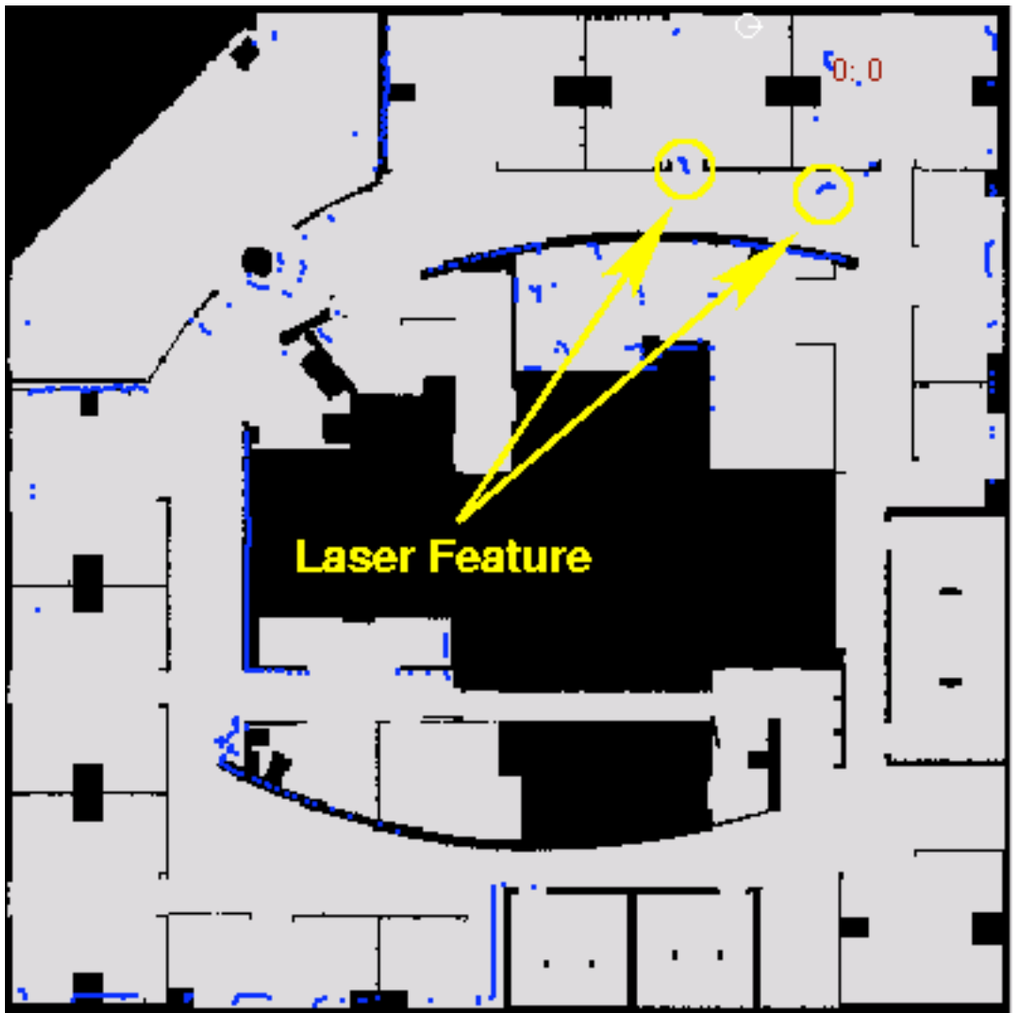
- Properties
  - Where is the computation done?
    - GPS locally - private, scalable
    - Cell-phone positioning - assisted, scalable to a degree, location is revealed
    - Broadcast ID-badge systems - localization is in infrastructure

Properties of Location Systems



- Properties
  - Accuracy and precision
    - GPS 15m - 95% of the time
    - Sensor fusion tries to improve accuracy and/or precision by combining sensors
  - Accuracy and precision may change to conserve battery life.

Properties of Location Systems



Properties of Location Systems

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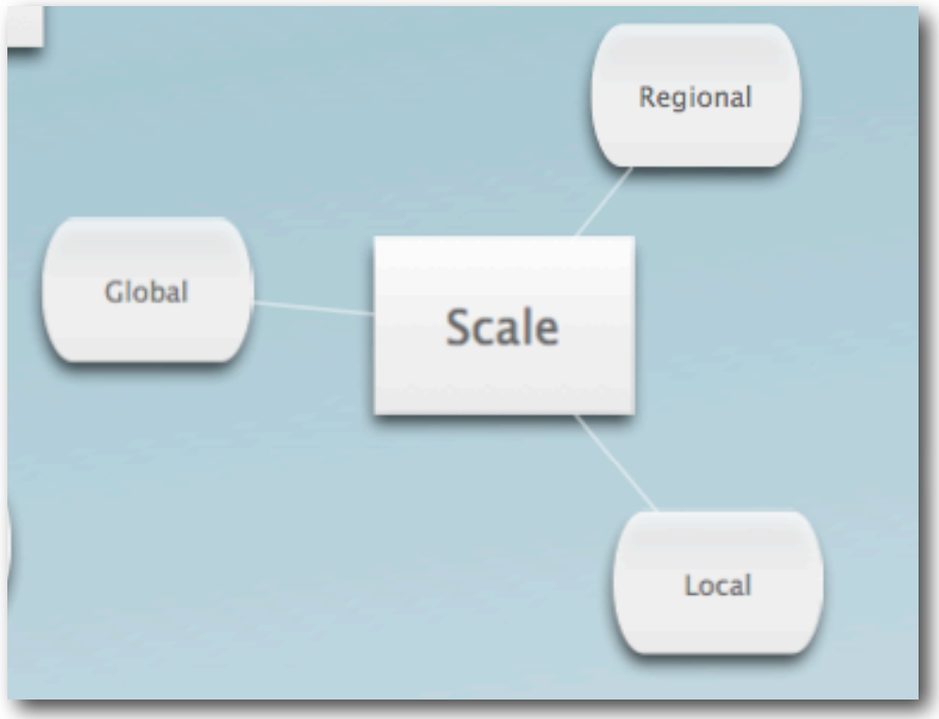
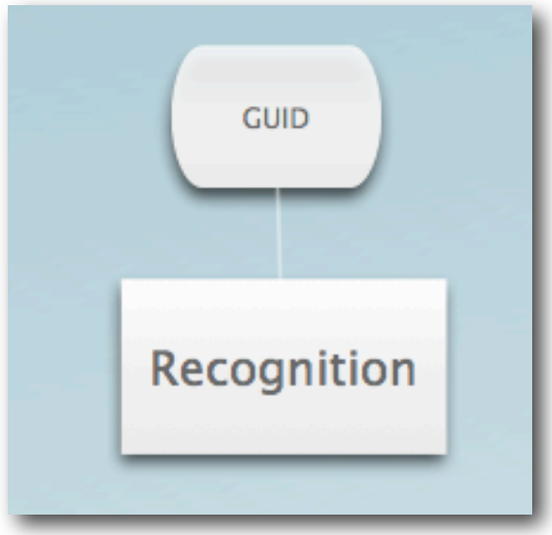


- Properties
  - Scale
    - Global, Regional, Local
      - GPS - Global
      - RFID Readers -local
      - Cell-phone localization regional

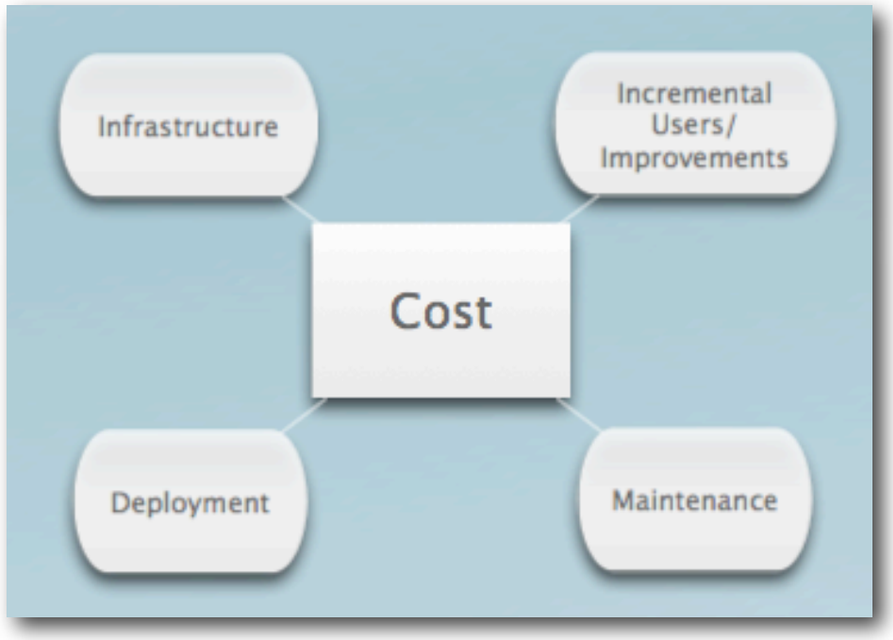
Properties of Location Systems

- Properties
  - Recognition
    - GUID - globally unique identifier
      - Do we know who or what you are?
      - GPS - no
      - Sensor fusion - maybe

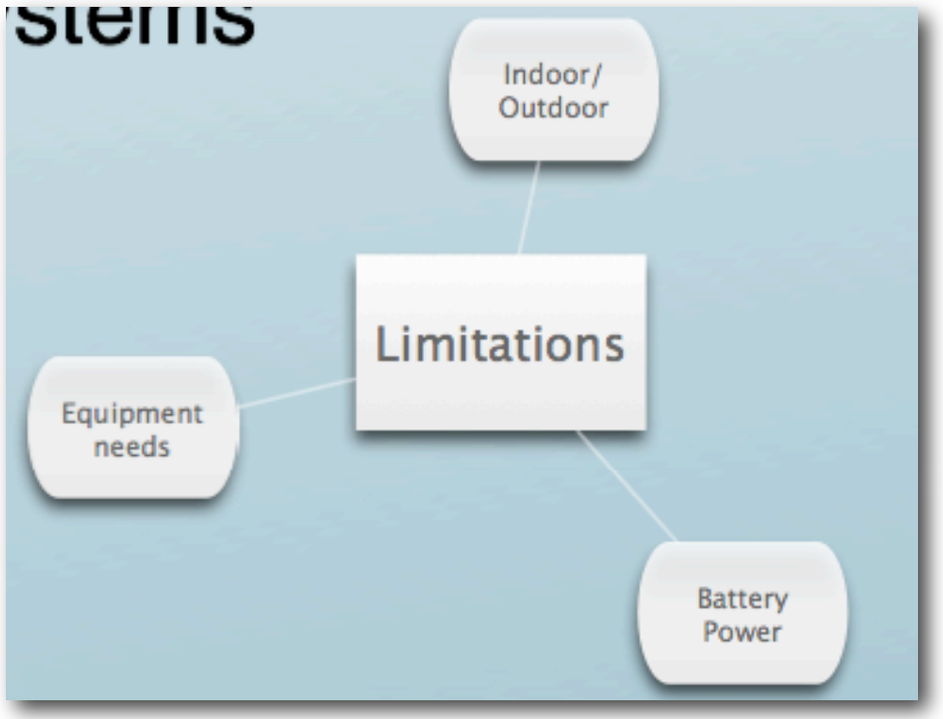


Properties of Location Systems

- Properties
  - Cost
    - Deployment
    - Infrastructure
    - Maintenance
    - Incremental Users or Improvements



Properties of Location Systems



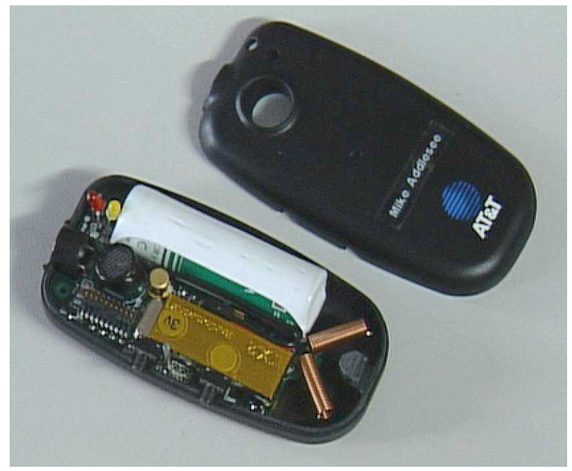
- Properties
  - Limitations
    - Indoor/ Outdoor
    - Battery Power
    - New Equipment

Examples

- Active Badge
  - GUID broadcast by infrared
  - symbolic proximity
  - absolute positioning
  - sunlight/fluorescent lighting

Properties of Location Systems

Examples

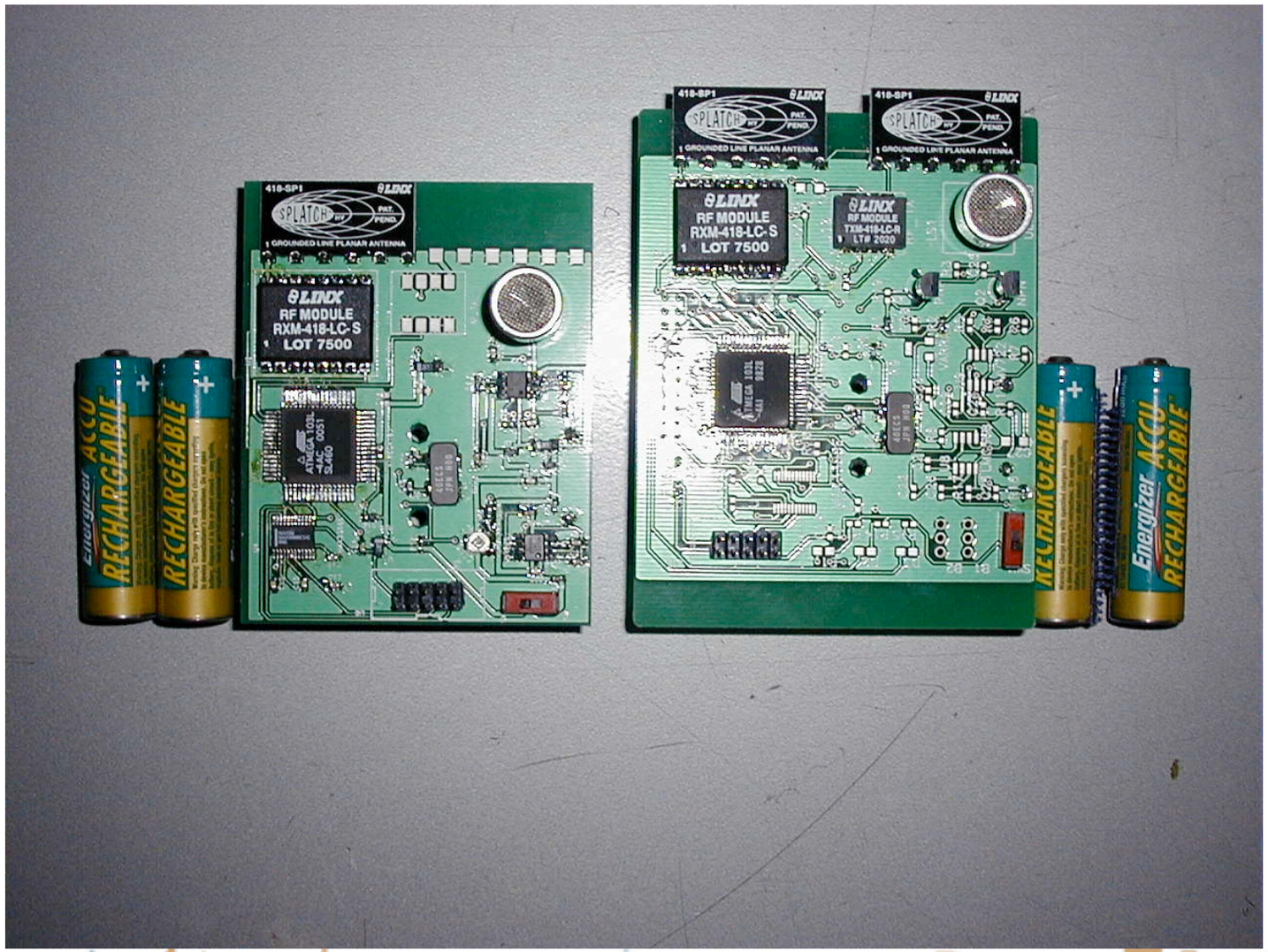


- Active Bat
  - GUID ultrasonic broadcast by radio request
  - infrastructure computes absolute proximity
  - 9cm 95% of the time
  - bad scalability, hard to deploy, maybe costly

Examples

- Cricket
  - Object based ultrasonic localization
  - radio frequency control signal
  - triangulation base on time-of-flight
  - private, decentralized scalability
  - local computation -> power drain

Examples


LINX
RF MODULE
RXM-418-LC-S
LOT 7500
SPLATCH
1 GROUNDED LINE PLANAR ANTENNA
Energizer
RECHARGEABLE

Examples

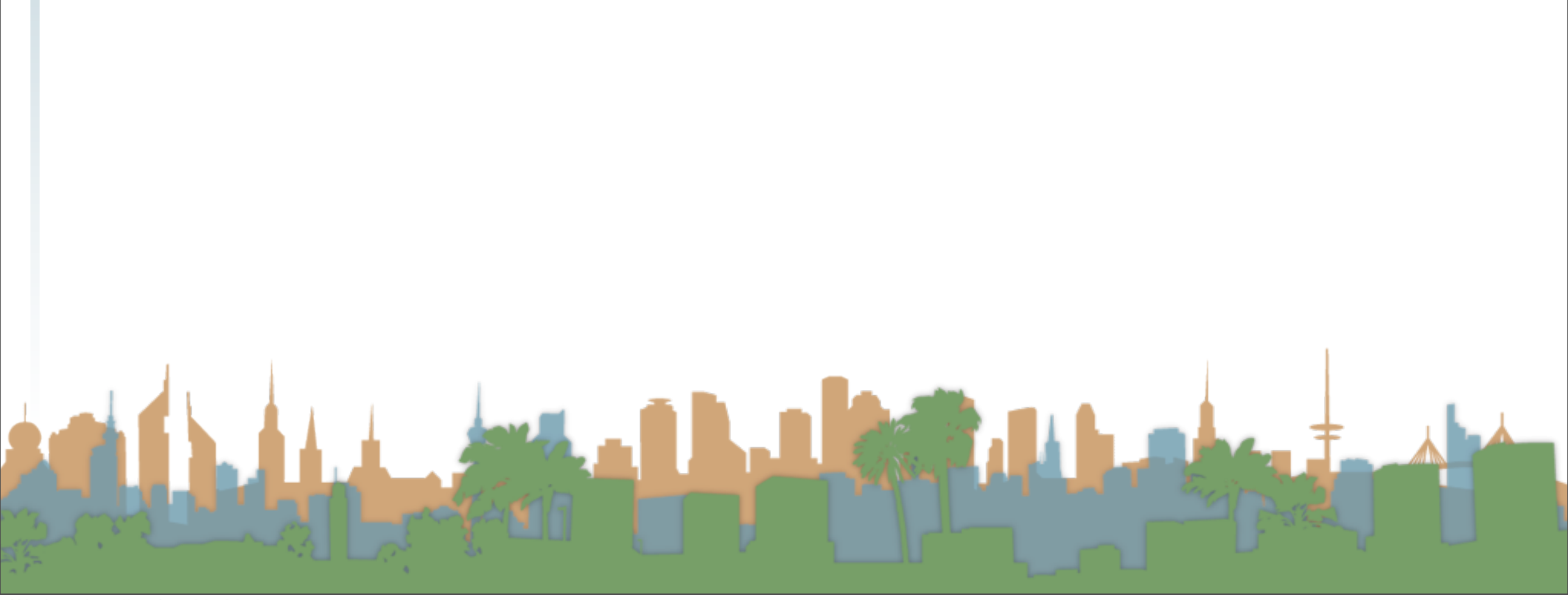
- RADAR
  - building-wide tracking system
  - 2-D Wifi based localization
  - “scene analysis” through fingerprinting
  - local computation -> power drain

Properties of Location Systems

Examples

- Smart Floor
  - local tracking
  - anonymous
  - no additional equipment for a person
  - poor scalability
  - costly

Beyond Localization



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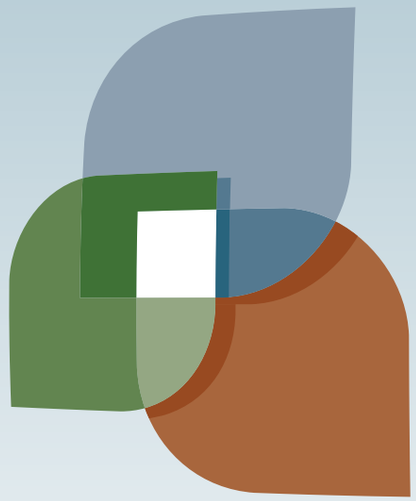

LUCI

Wednesday, October 20, 2010