User Interaction: Localization beyond Satellite Systems

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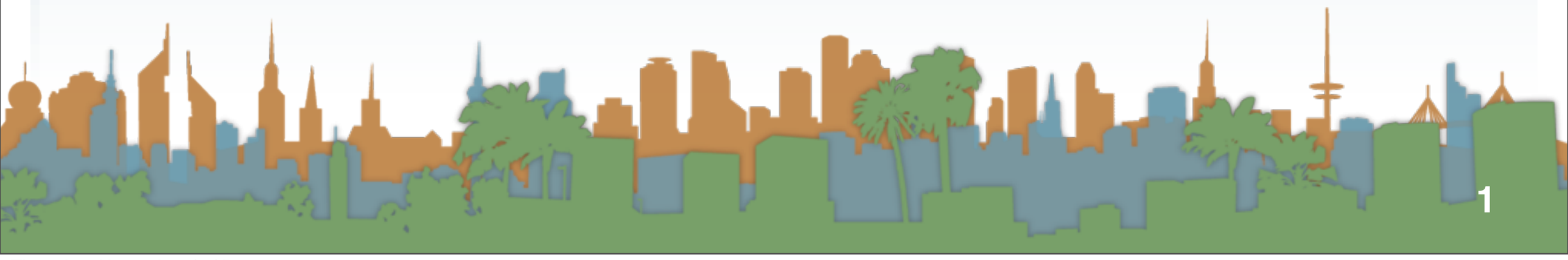
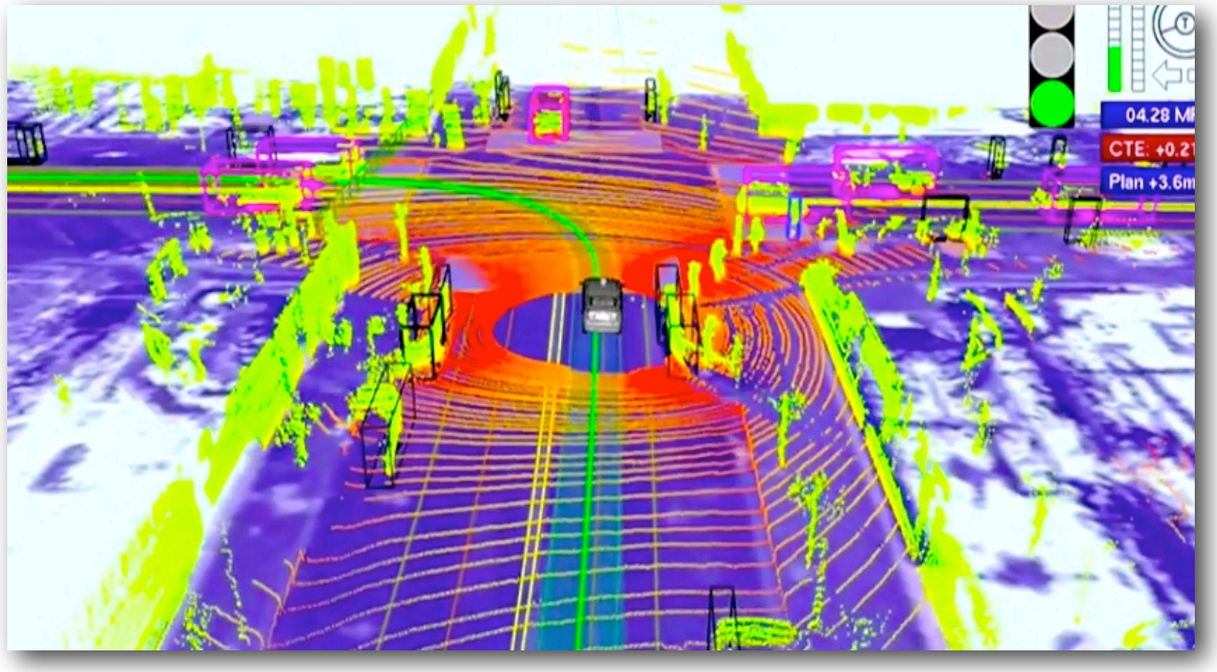
INF 133 Fall 2012



Google's self-driving car



Two things seem particularly interesting about Google's approach. First, it relies on very detailed maps of the roads and terrain, something that Urmson said is essential to determine accurately where the car is. Using GPS-based techniques alone, he said, the location could be off by several meters.

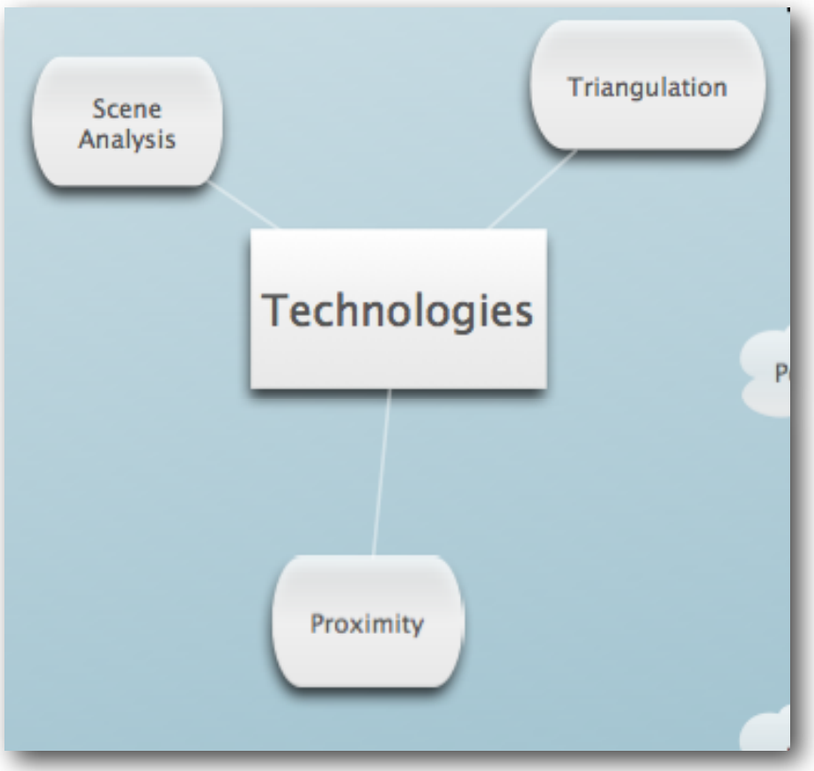
http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/how-google-self-driving-car-works

Global Location GPS

Properties of Location Systems

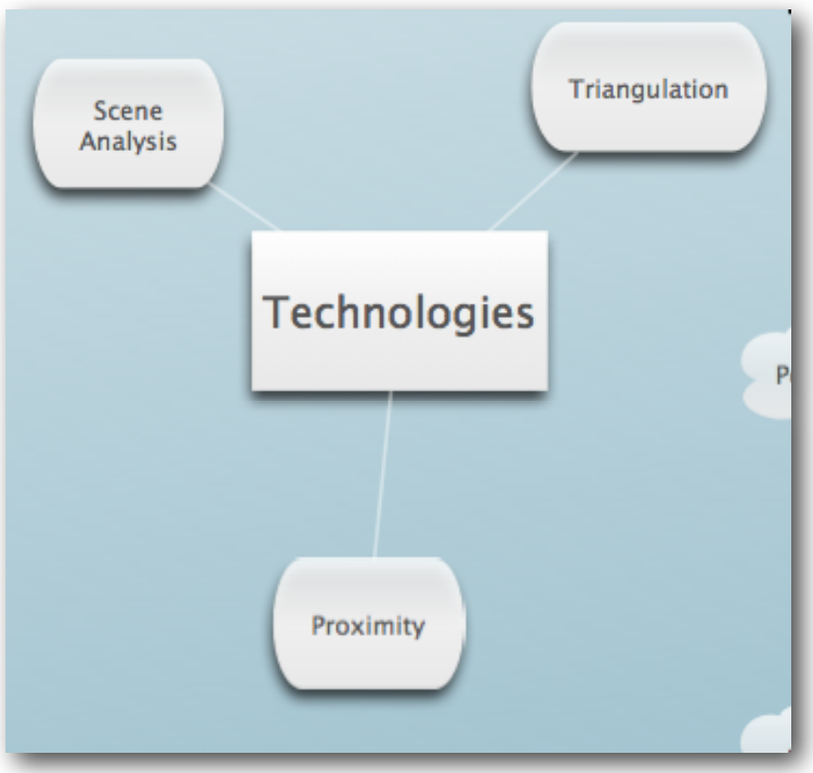
- Technologies
  - Scene Analysis
  - Triangulation
  - Proximity
- Physical Position
  - Position
  - Relative
- Representation
  - Place
- Relativity
  - Absolute
- Limitations
  - Indoor/ Outdoor
  - Equipment needs
  - Battery Power
- Accuracy
- Scale
  - Regional
  - Global
  - Local
- Cost
  -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

Properties of Location Systems



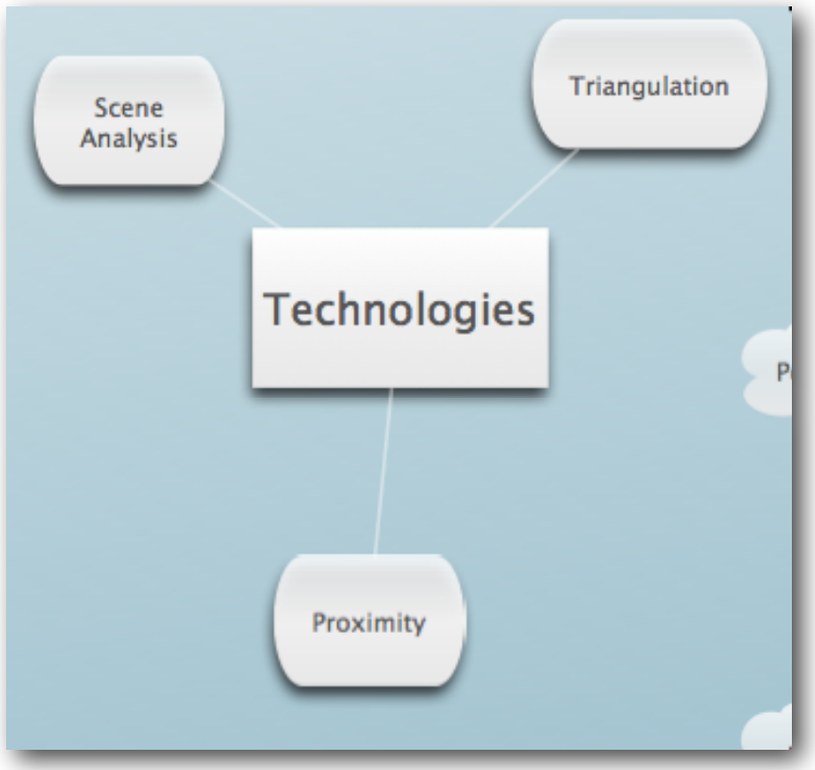
- Technologies
  - Triangulation
    - GPS is an example
    - Multiple references to fixed locations which resolve position

Properties of Location Systems



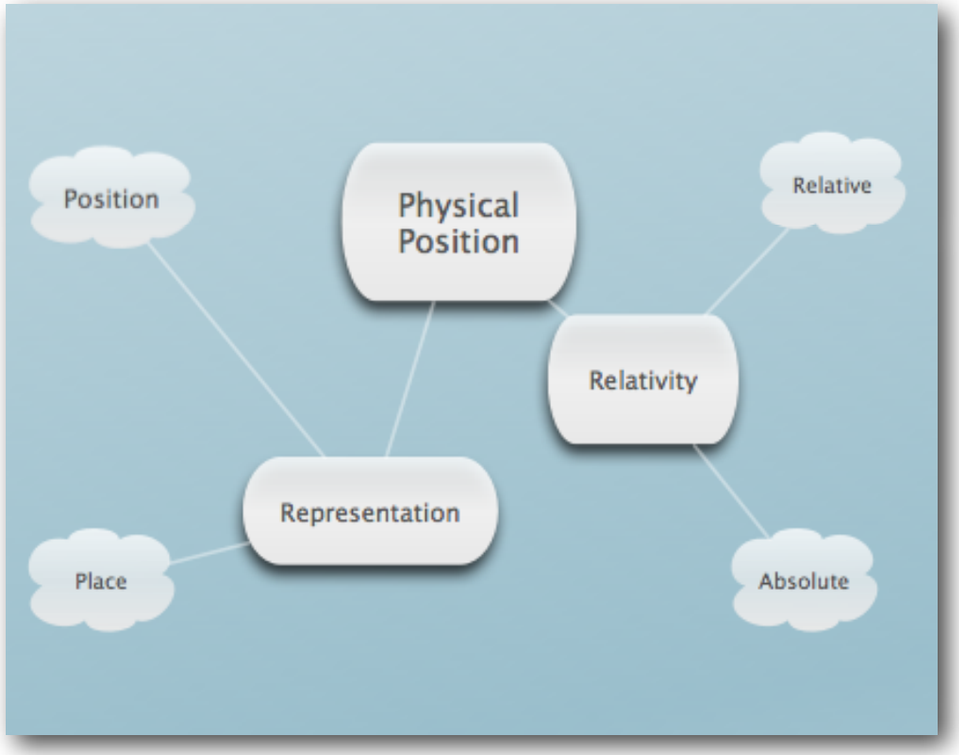
- Technologies
  - Proximity
    - Knowing that you are near a fixed location
  - Typically based on non-localization technology
  - Cell-towers, Credit card usage, login information

Properties of Location Systems



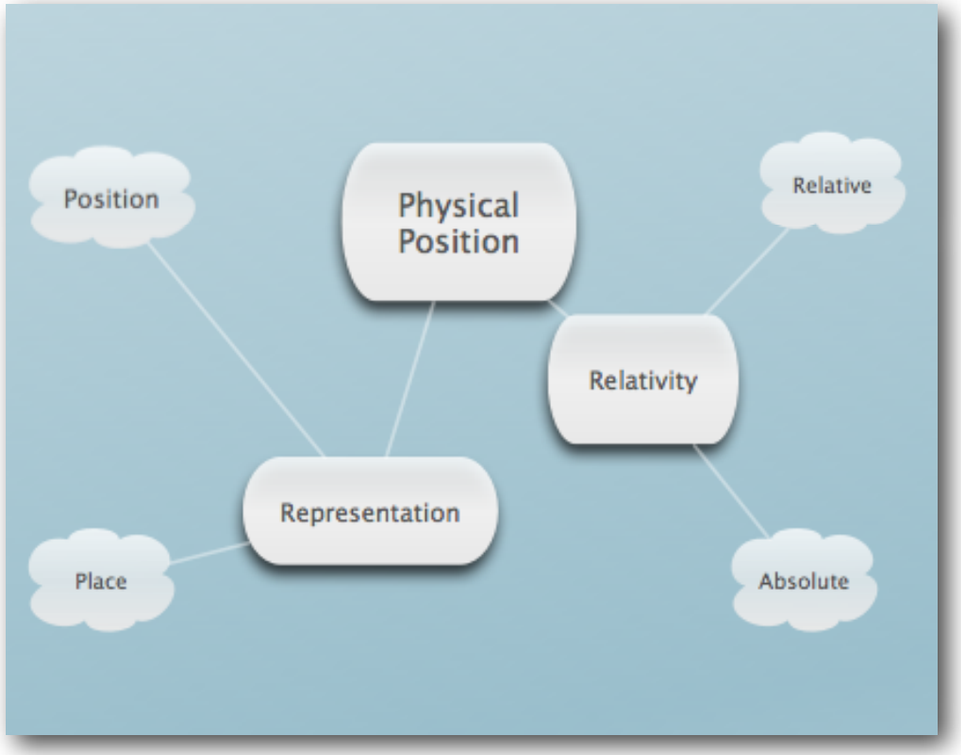
- Technologies
  - Scene Analysis
    - Evaluating content from a fixed camera
      - Color histograms from doorways
  - Evaluating content from a mobile camera
    - tour guide scene matching

Properties of Location Systems



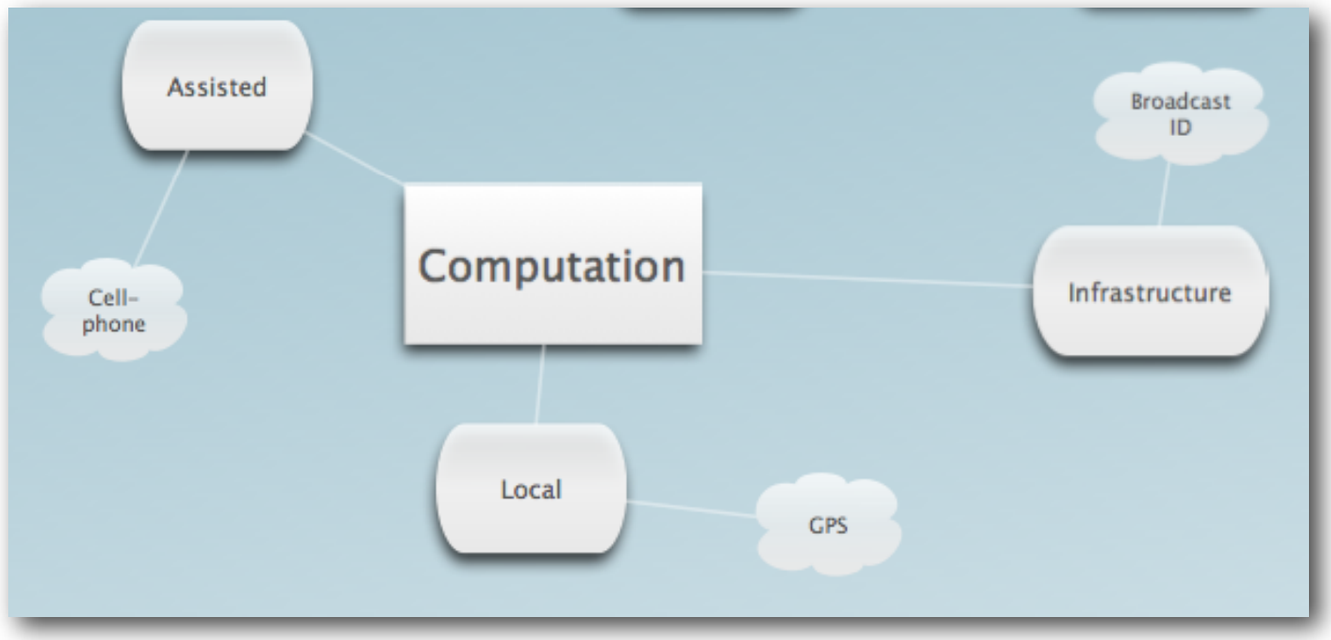
- Properties
  - Physical Position/Symbolic location
    - Position
      - Exact, Unambiguous, Machine friendly
  - Place
    - Inexact, Ambiguous, Human Friendly

Properties of Location Systems



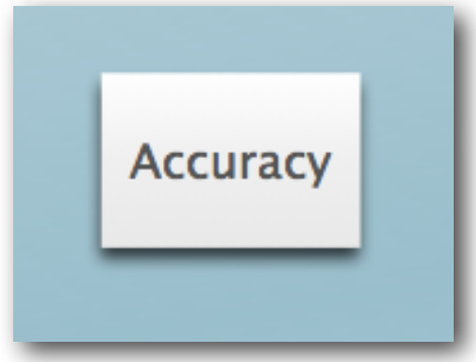
- Properties
  - Absolute/Relative
    - GPS is absolute
    - Laser range finder is relative
  - Transforming between the two is possible with additional information

Properties of Location Systems



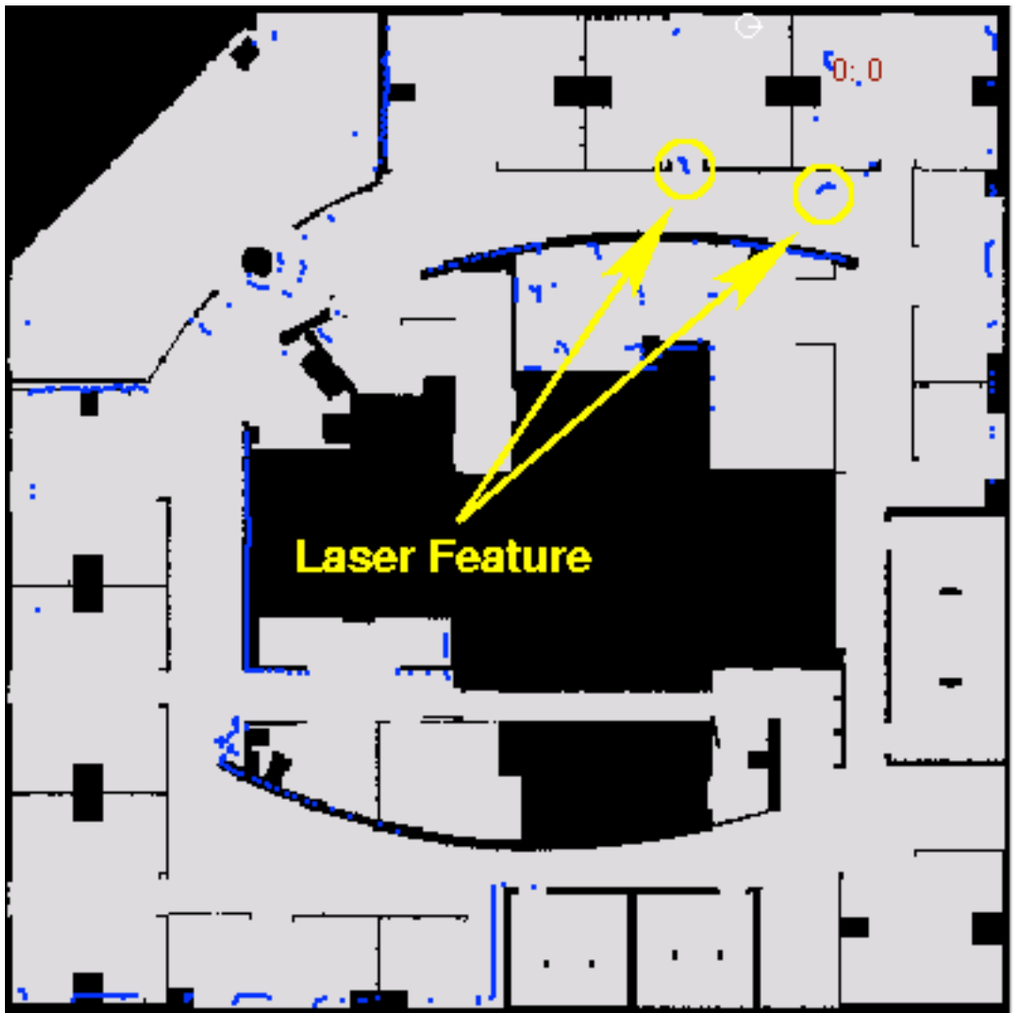
- Properties
  - Where is the computation done?
    - GPS locally - private, scalable
    - Cell-phone positioning - assisted, scalable to a degree, location is revealed
    - Broadcast ID-badge systems - localization is in infrastructure

Properties of Location Systems



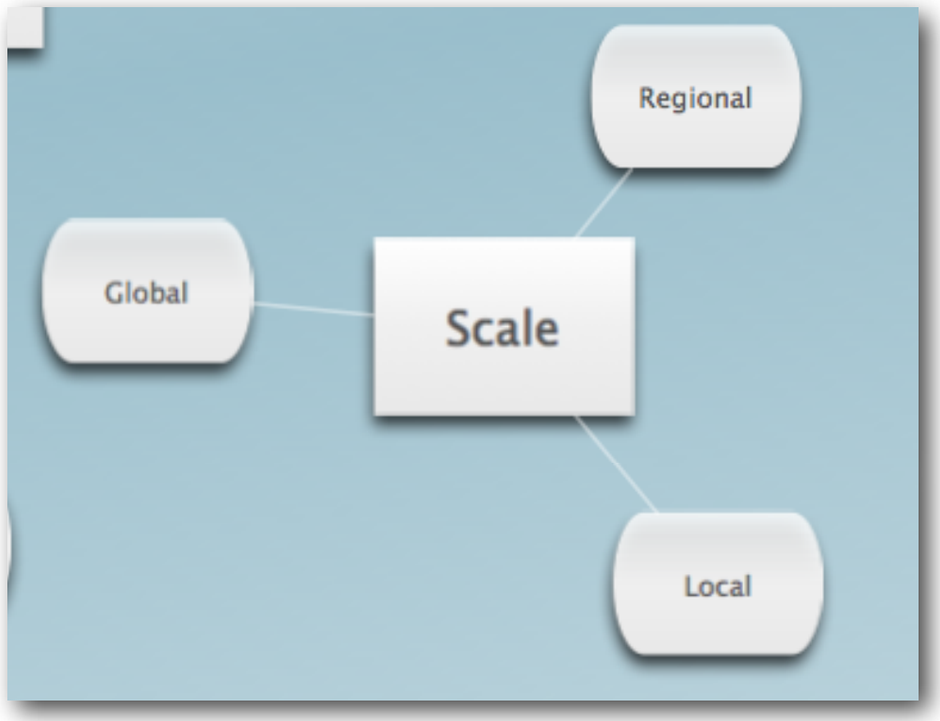
- Properties
  - Accuracy and precision
    - GPS 15m - 95% of the time
    - Sensor fusion tries to improve accuracy and/or precision by combining sensors
  - Accuracy and precision may change to conserve battery life.

Properties of Location Systems



Properties of Location Systems

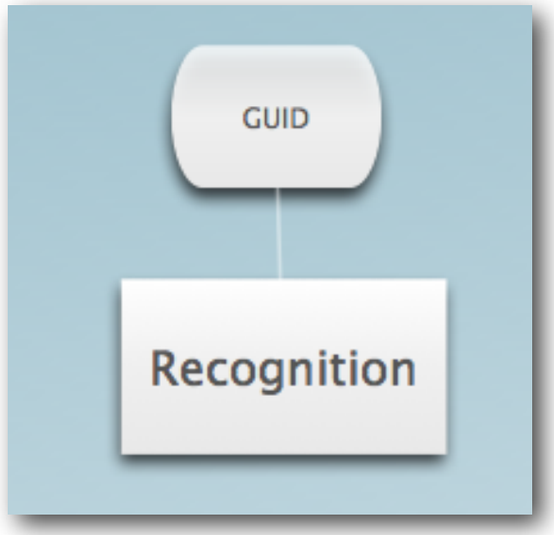
Properties of Location Systems



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

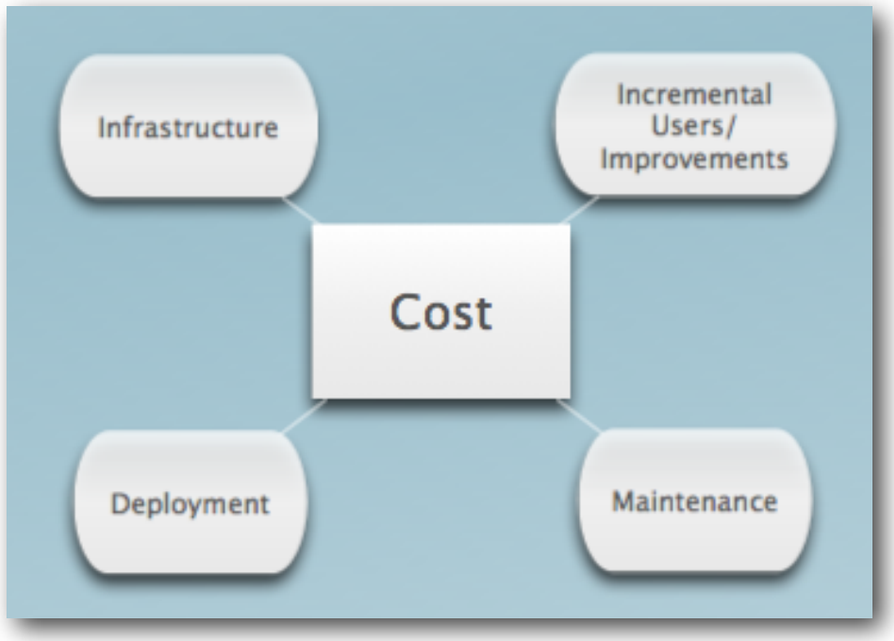
Properties of Location Systems

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

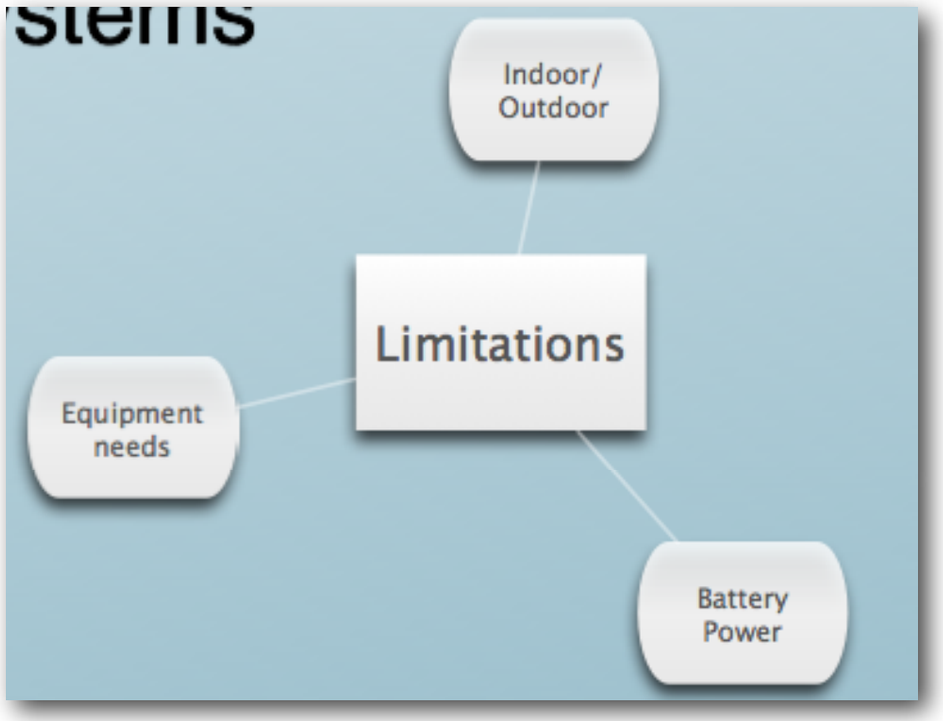


Properties of Location Systems

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



Properties of Location Systems

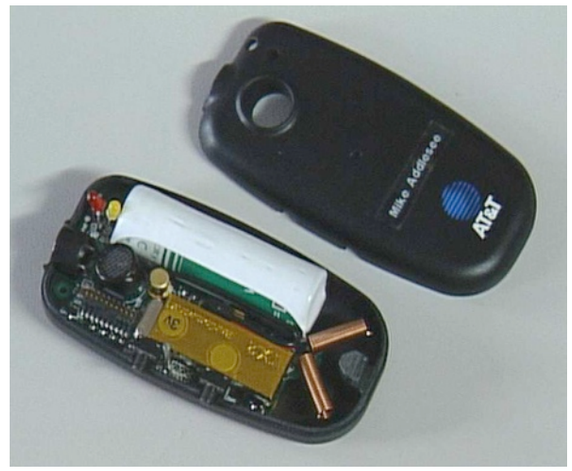


- Properties
  - Limitations
    - Indoor/ Outdoor
    - Battery Power
    - New Equipment

Examples

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

Properties of Location Systems



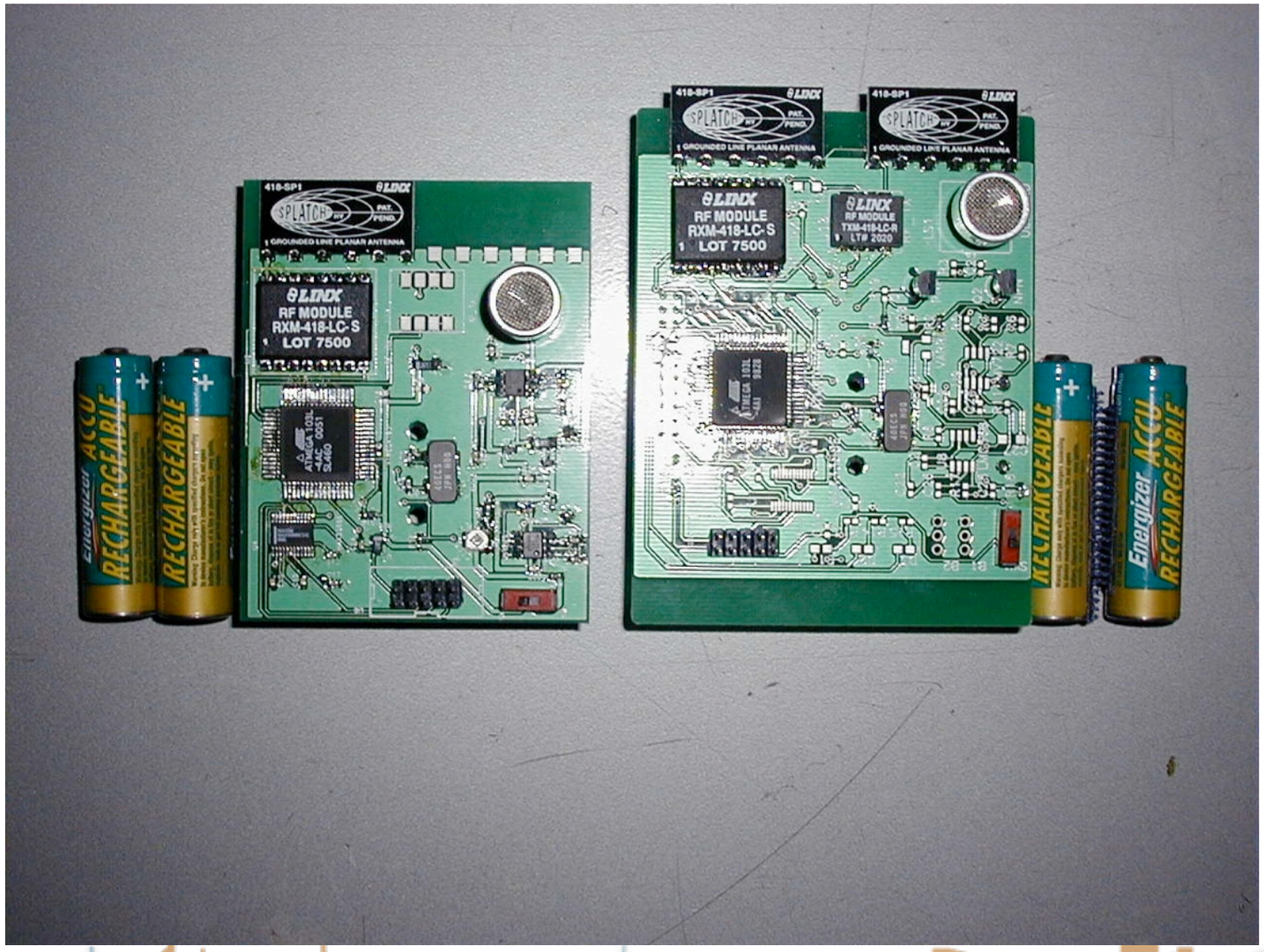
Examples

- 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

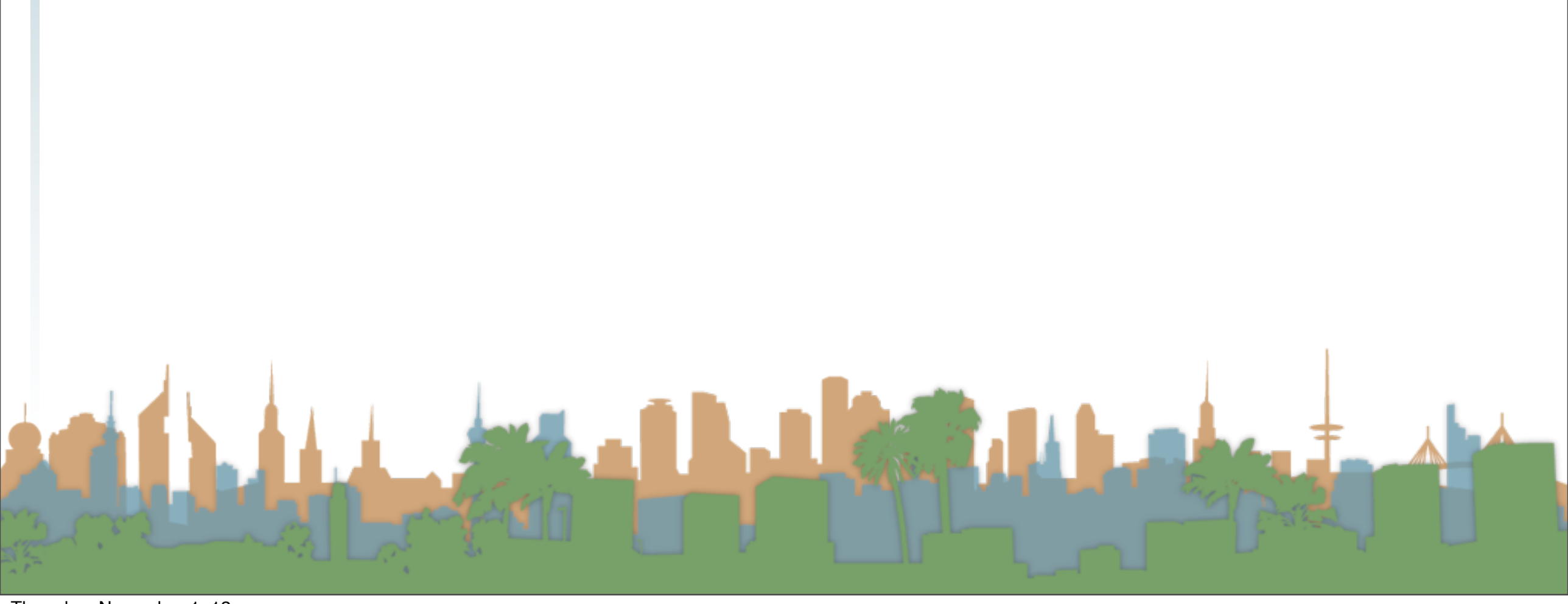
- RADAR
  - building-wide tracking system
  - 2-D Wifi based localization
  - “scene analysis” through fingerprinting
  - local computation -> power drain

Properties of Location Systems

Examples

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

Beyond Localization

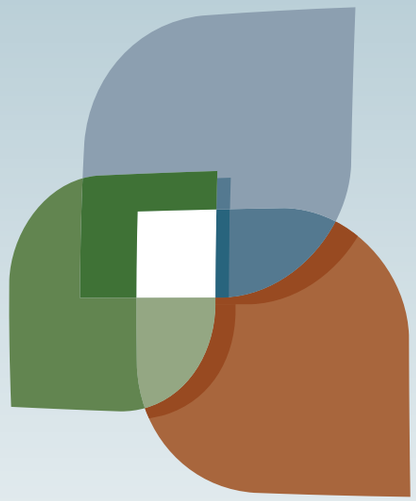


Properties of Location Systems

How does a phone find your location?

- "Real" GPS
- "Assisted" GPS
  - Help with "Real" GPS
  - Send your position
- WiFi based localization
- IP based localization

- What are the properties of each?
- What are other crazy ideas of how to figure out your location?



LUCI

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