User Interaction: Localization beyond Satellite Systems

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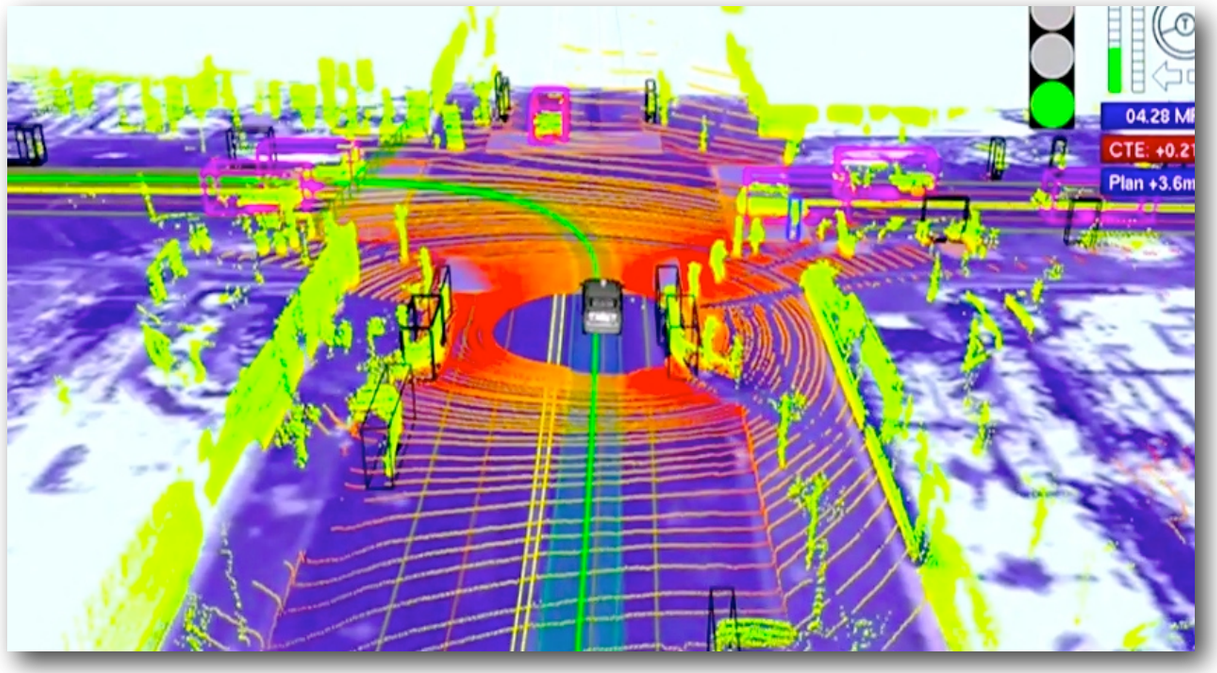
INF 133 Fall 2014

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.

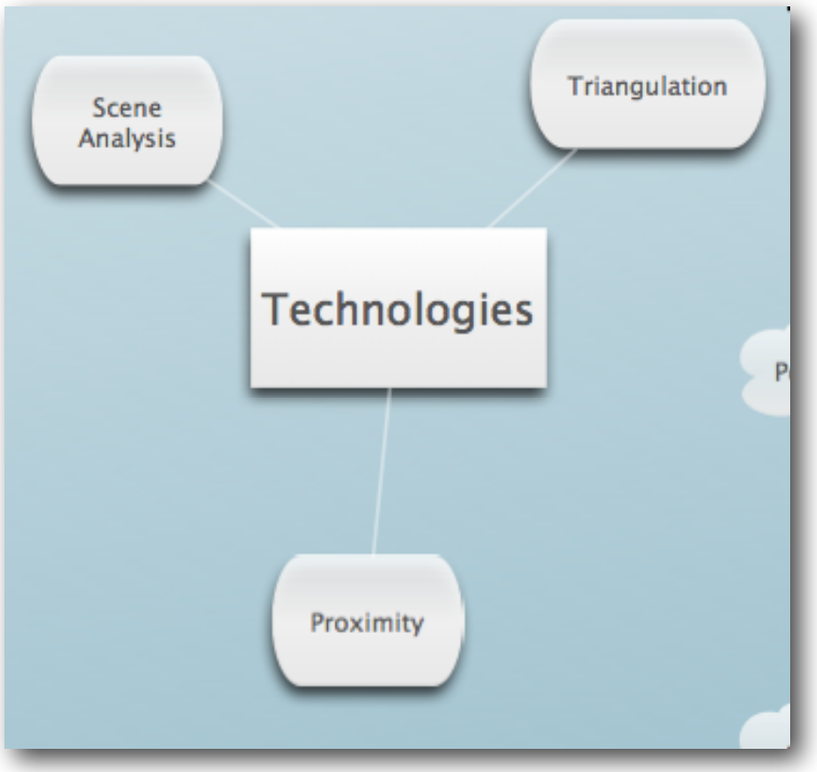
http://spectrum.ieee.org/automaton/robotics/artificial-intelligence/how-google-self-driving-car-works

Global Location GPS

Properties of Location Systems

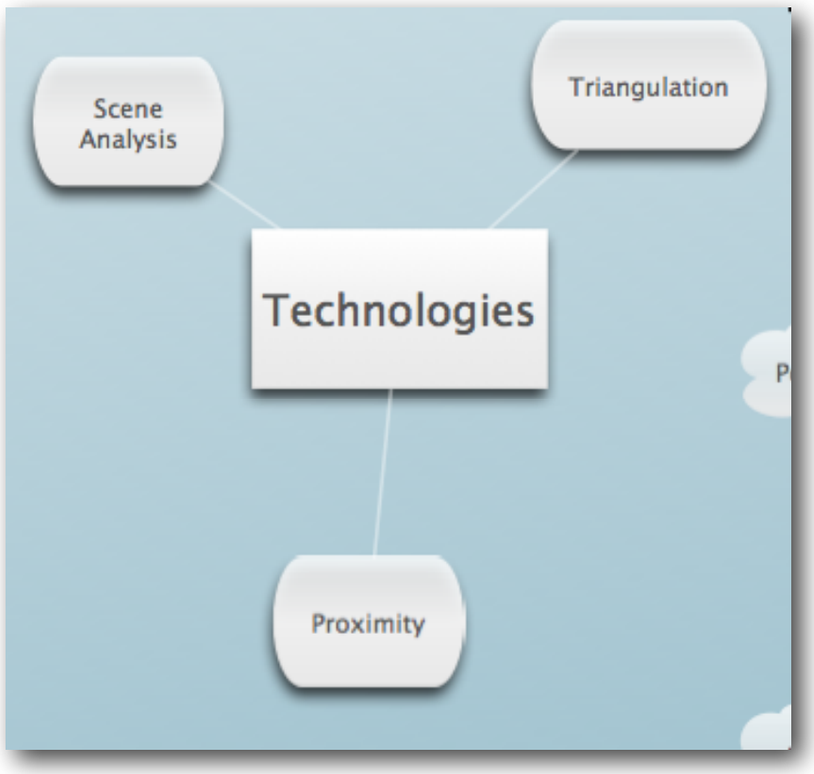
- Technologies
  - Scene Analysis
  - Triangulation
  - Proximity
- Physical Position
  - Position
  - Representation
    - Place
  - Relativity
    - Relative
    - Absolute
- Limitations
  - Indoor/ Outdoor
  - Equipment needs
  - Battery Power
- Cost
  - Infrastructure
  - Incremental Users/ Improvements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

Properties of Location Systems



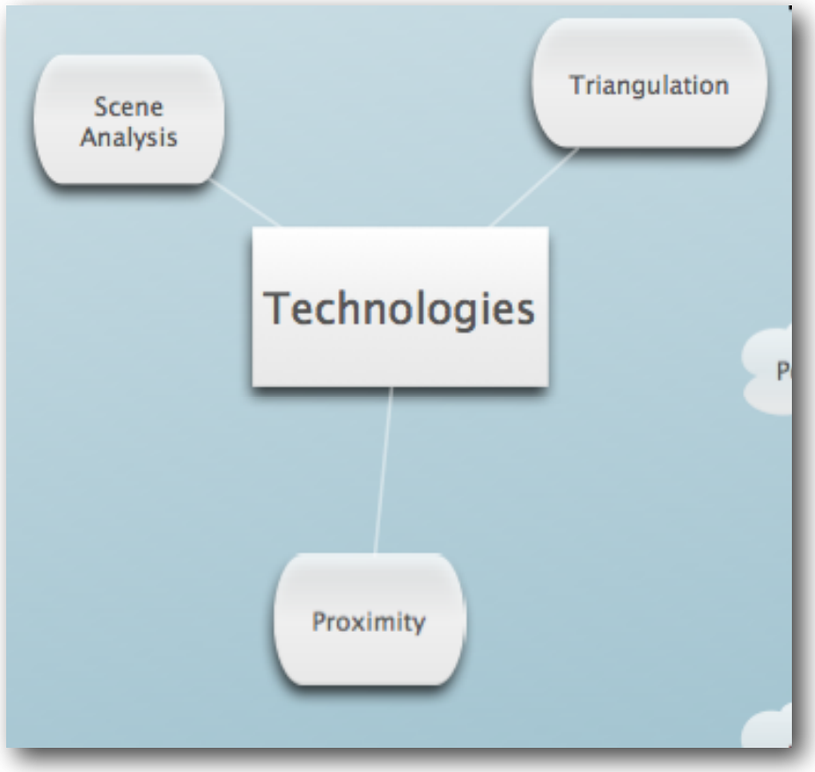
- Technologies
  - Triangulation
    - GPS is an example
    - Multiple references to fixed locations which resolve position

Properties of Location Systems



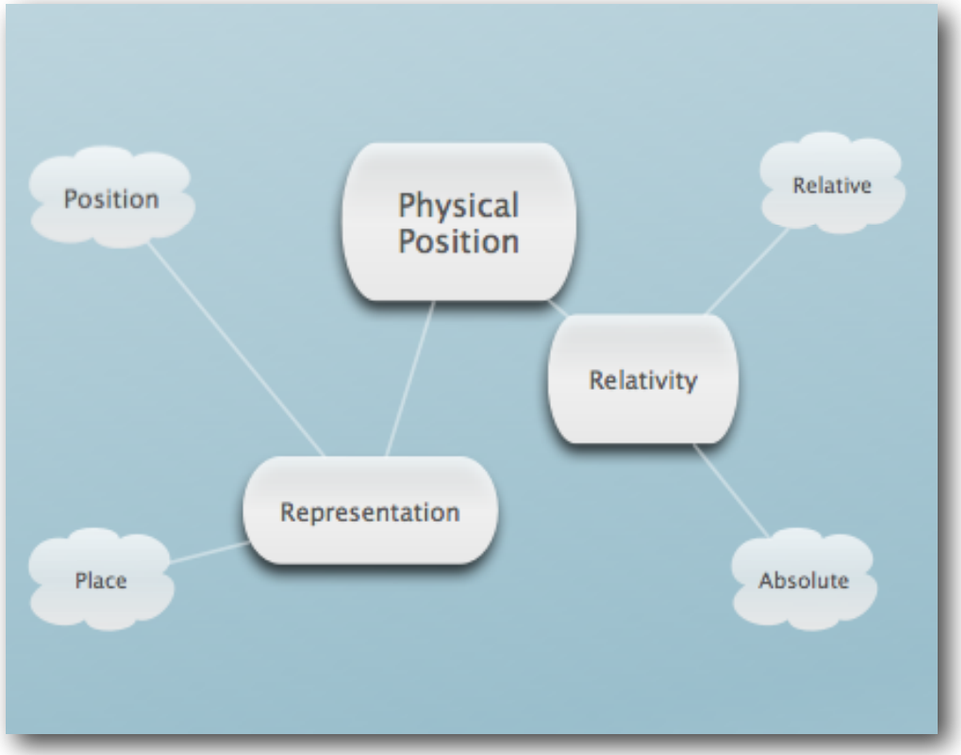
- Technologies
  - Proximity
    - Knowing that you are near a fixed location
  - Typically based on non-localization technology
  - Cell-towers, Credit card usage, login information

Properties of Location Systems



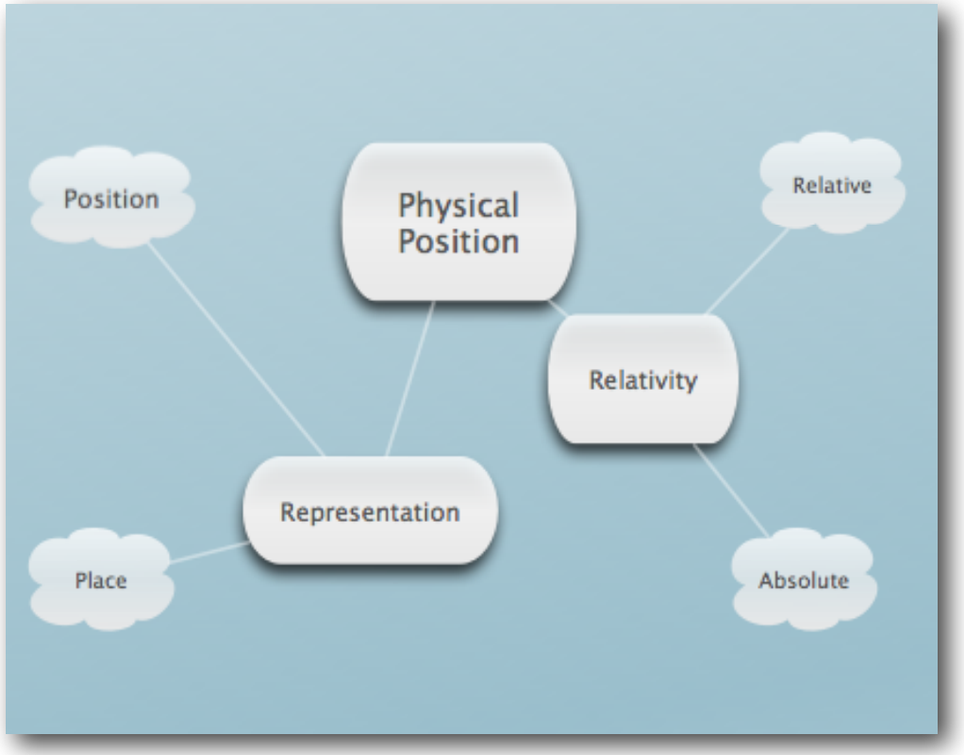
- Technologies
  - Scene Analysis
    - Evaluating content from a fixed camera
      - Color histograms from doorways
  - Evaluating content from a mobile camera
    - tour guide scene matching

Properties of Location Systems

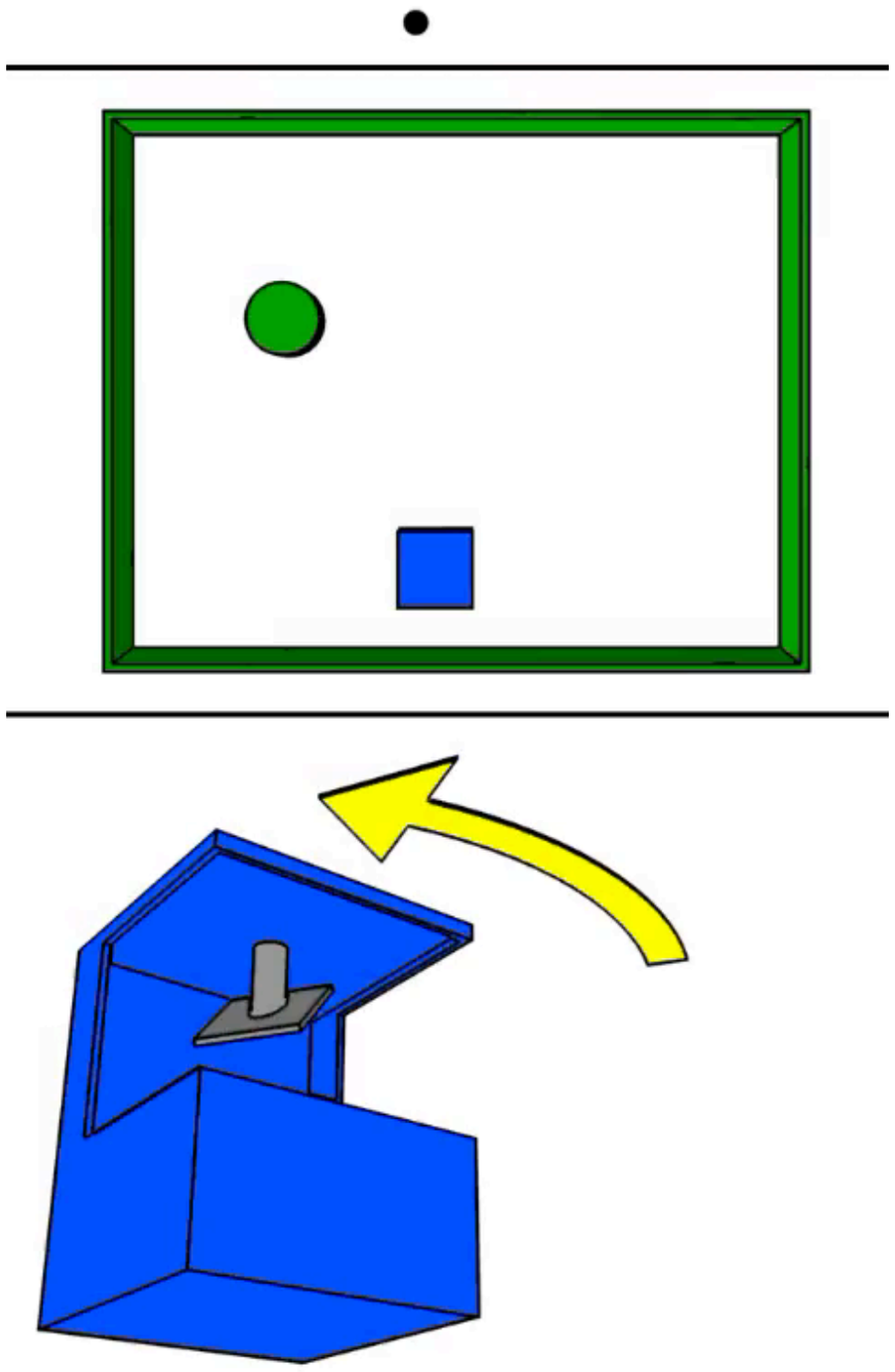


- Properties
  - Physical Position/Symbolic location
    - Position
      - Exact, Unambiguous, Machine friendly
  - Place
    - Inexact, Ambiguous, Human Friendly

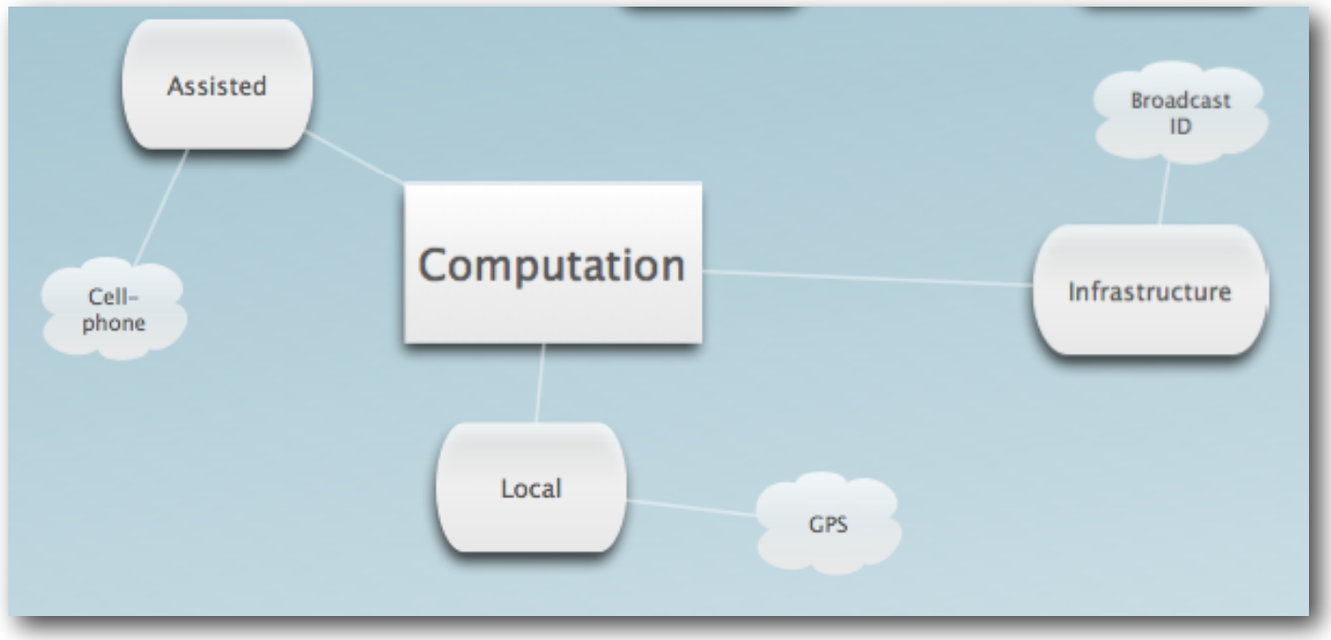
Properties of Location Systems



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

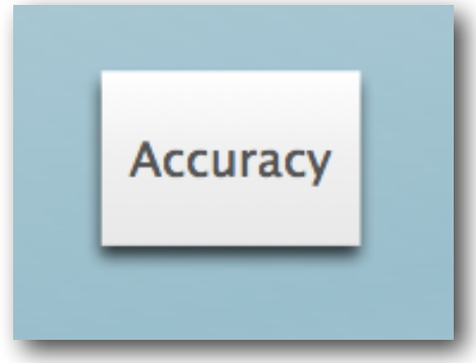


Properties of Location Systems



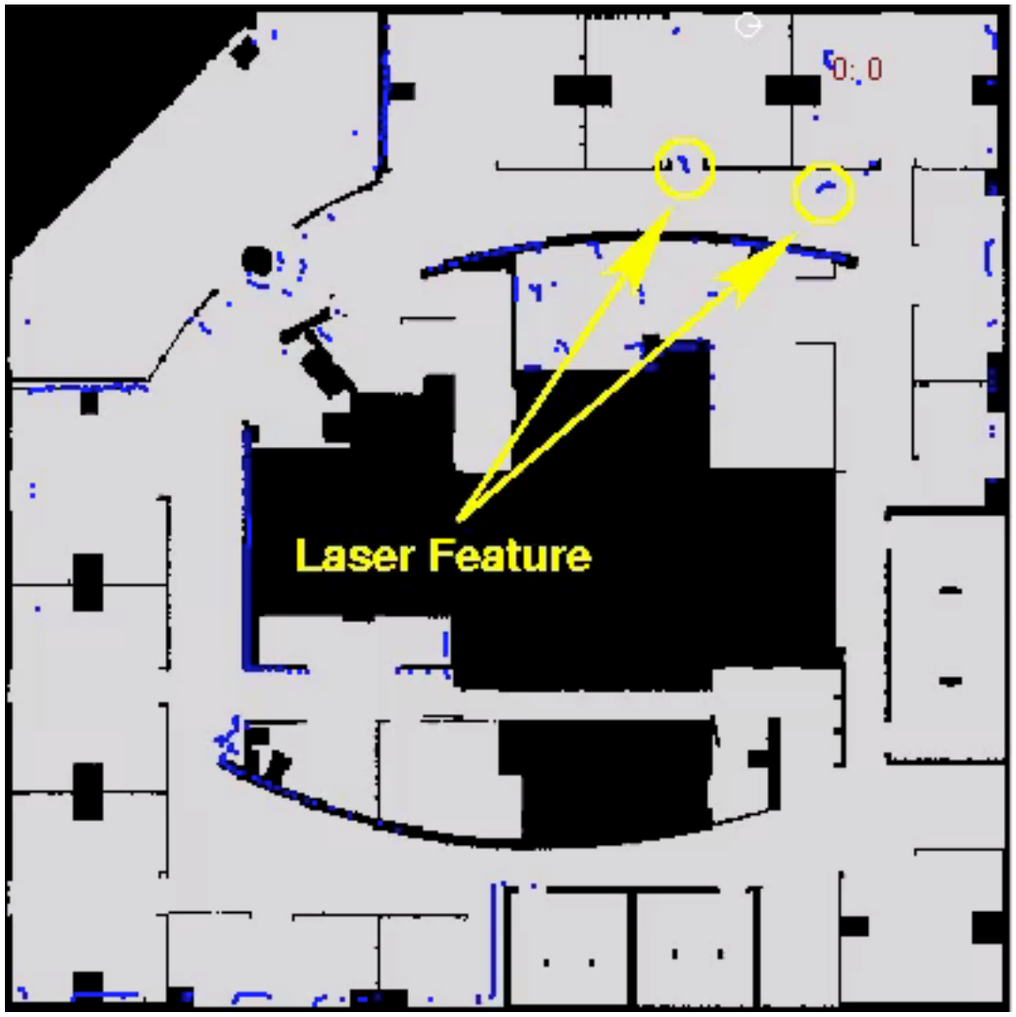
- Properties
  - Where is the computation done?
    - GPS locally - private, scalable
    - Cell-phone positioning - assisted, scalable to a degree, location is revealed
    - Broadcast ID-badge systems - localization is in infrastructure

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.

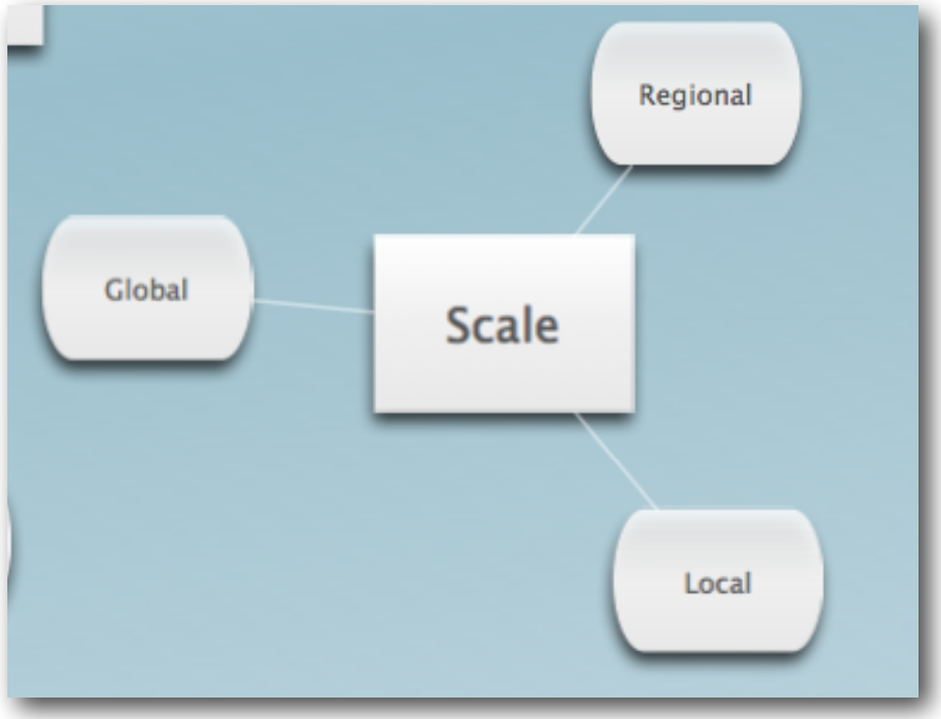
Properties of Location Systems



Properties of Location Systems

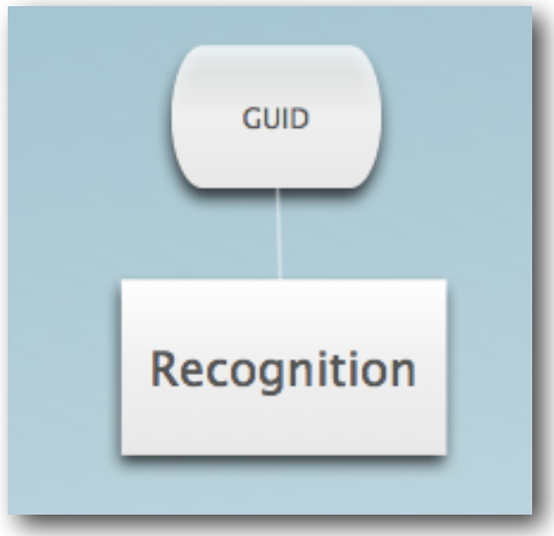
Properties of Location Systems

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



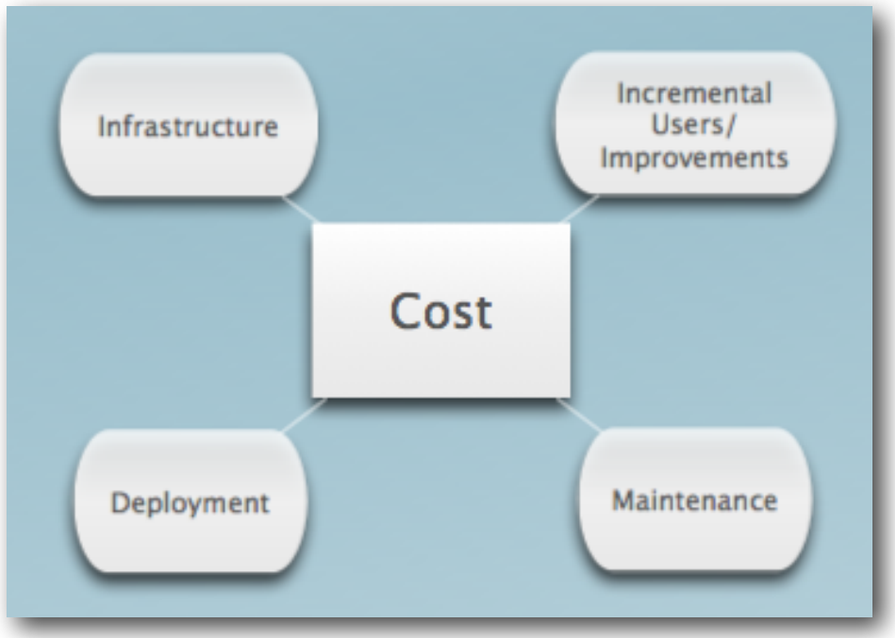
Properties of Location Systems

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

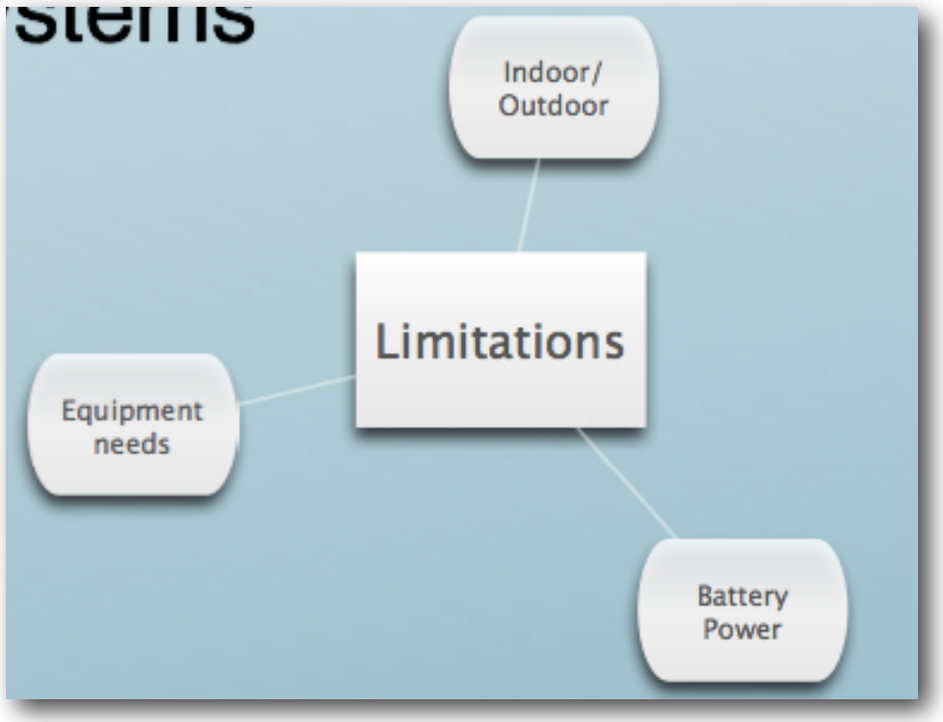


Properties of Location Systems

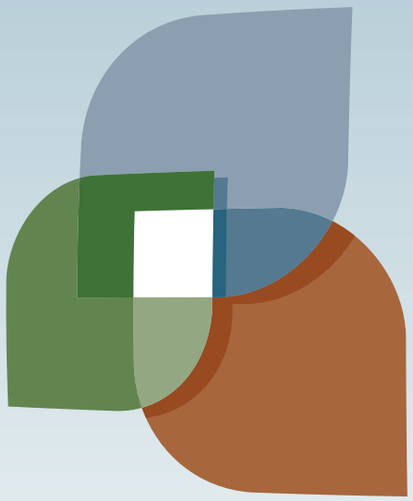
- Properties
  - Cost
    - Deployment
    - Infrastructure
    - Maintenance
    - Incremental Users or Improvements



Properties of Location Systems



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



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