

User Interaction: Localization beyond Satellite Systems

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INF 133 Fall 2013

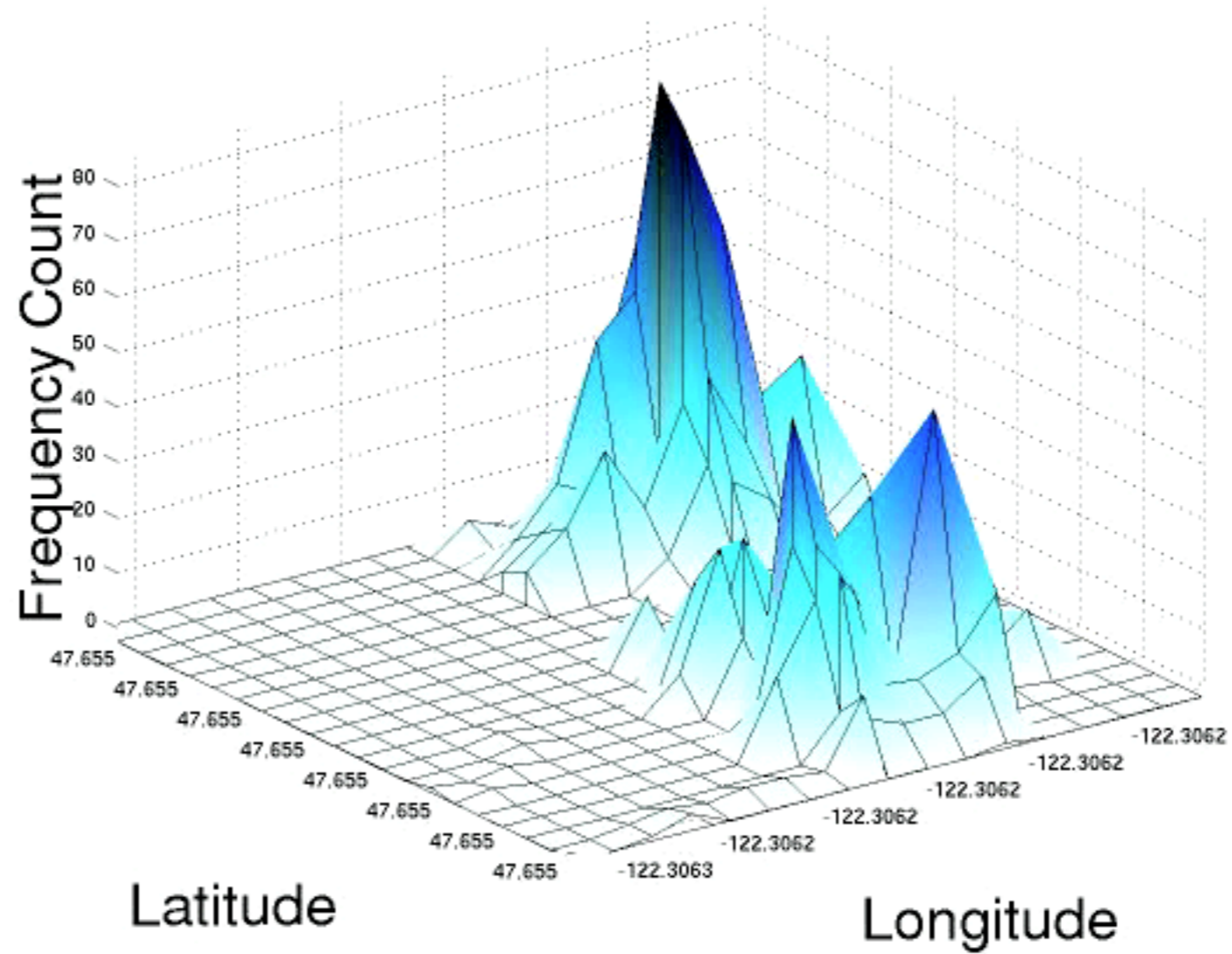


Global Location GPS

- 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?
- Urban canyons
 - What are they?
 - Japanese response, European response



Global Location GPS



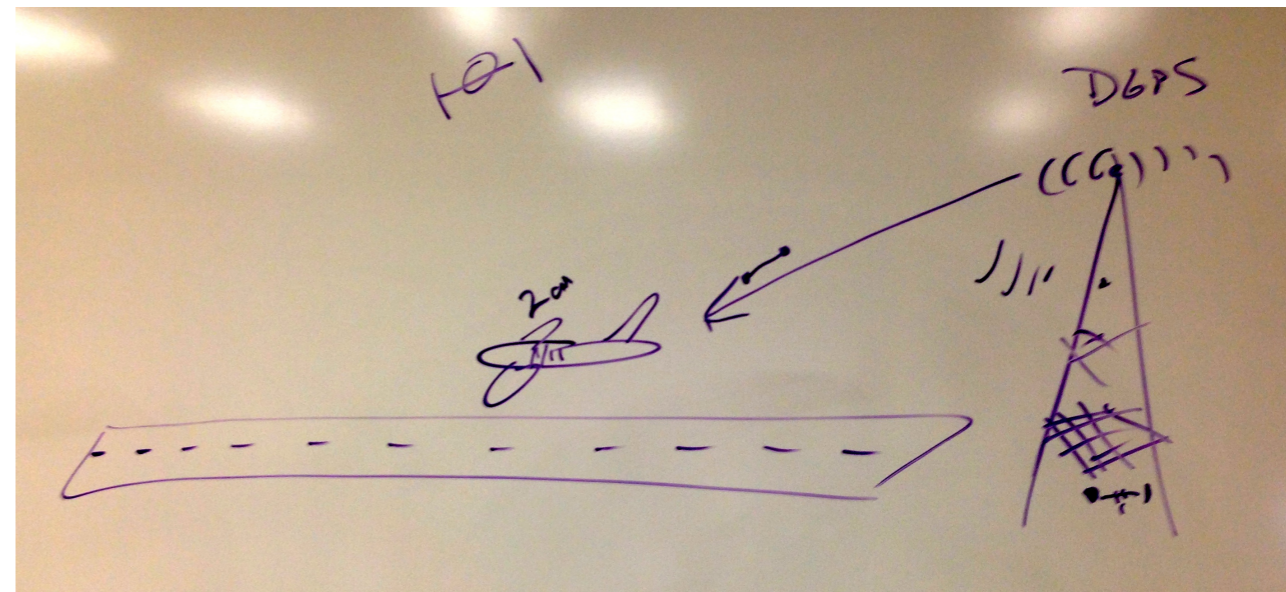
Global Location GPS

- The current and future of GPS
 - WAAS
 - Additional satellites in geosynchronous orbit
 - DGPS assistance from a land based receiver
 - Galileo
 - European competitor
 - GPS compatible
 - GLONASS
 - Russian competitor



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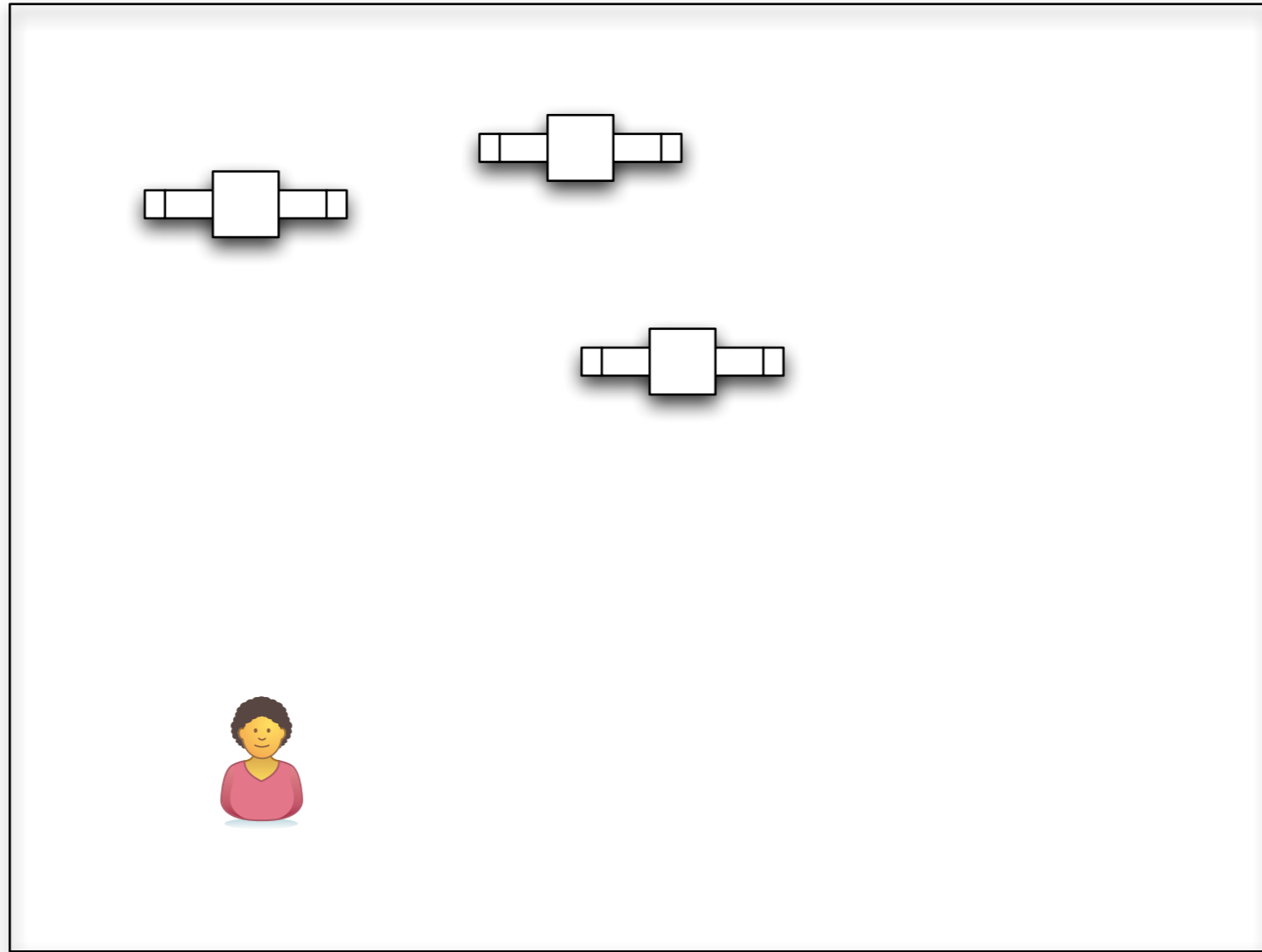


Global Location GPS

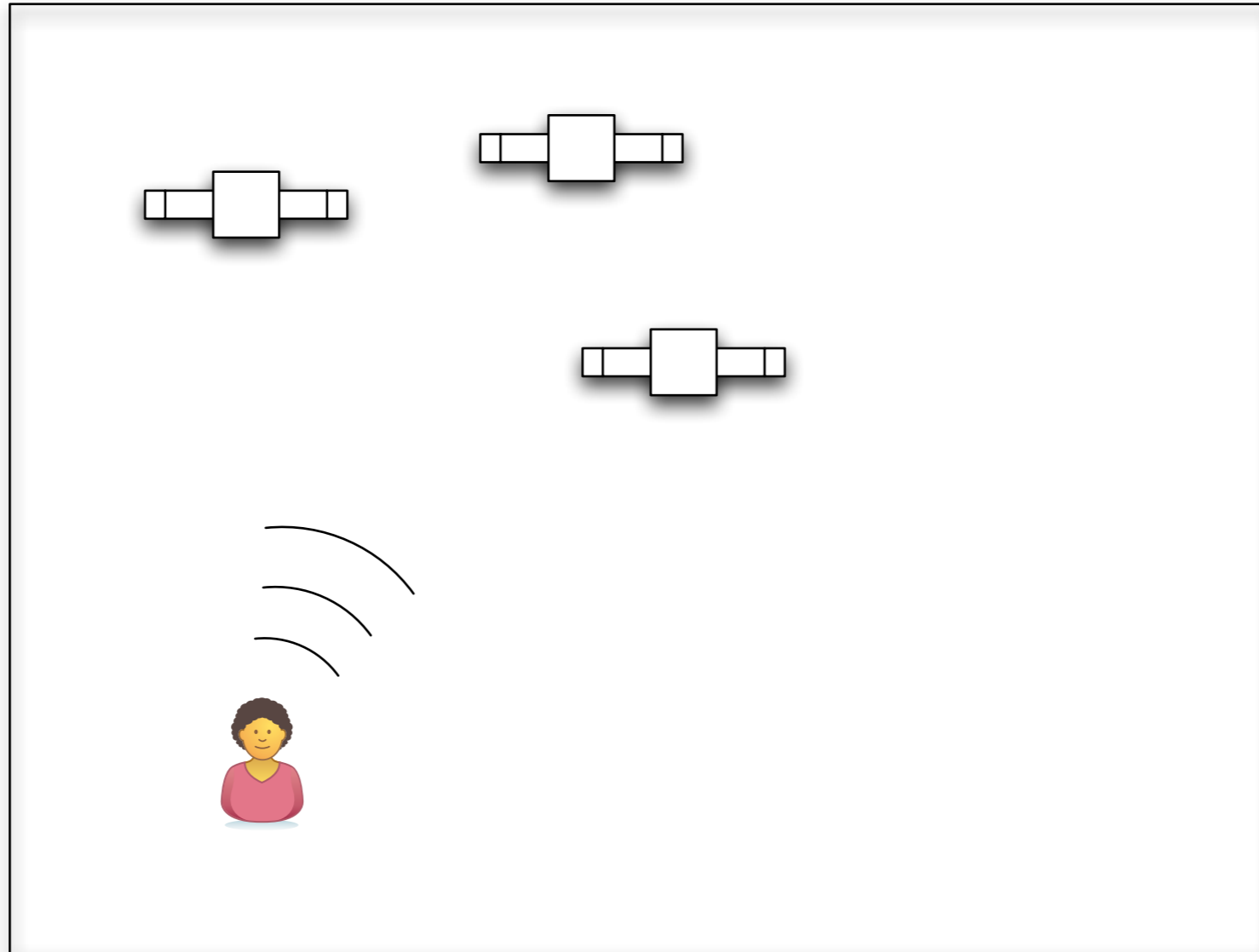
- The current and future of GPS
 - BeiDou
 - Chinese competitor
 - centralized system

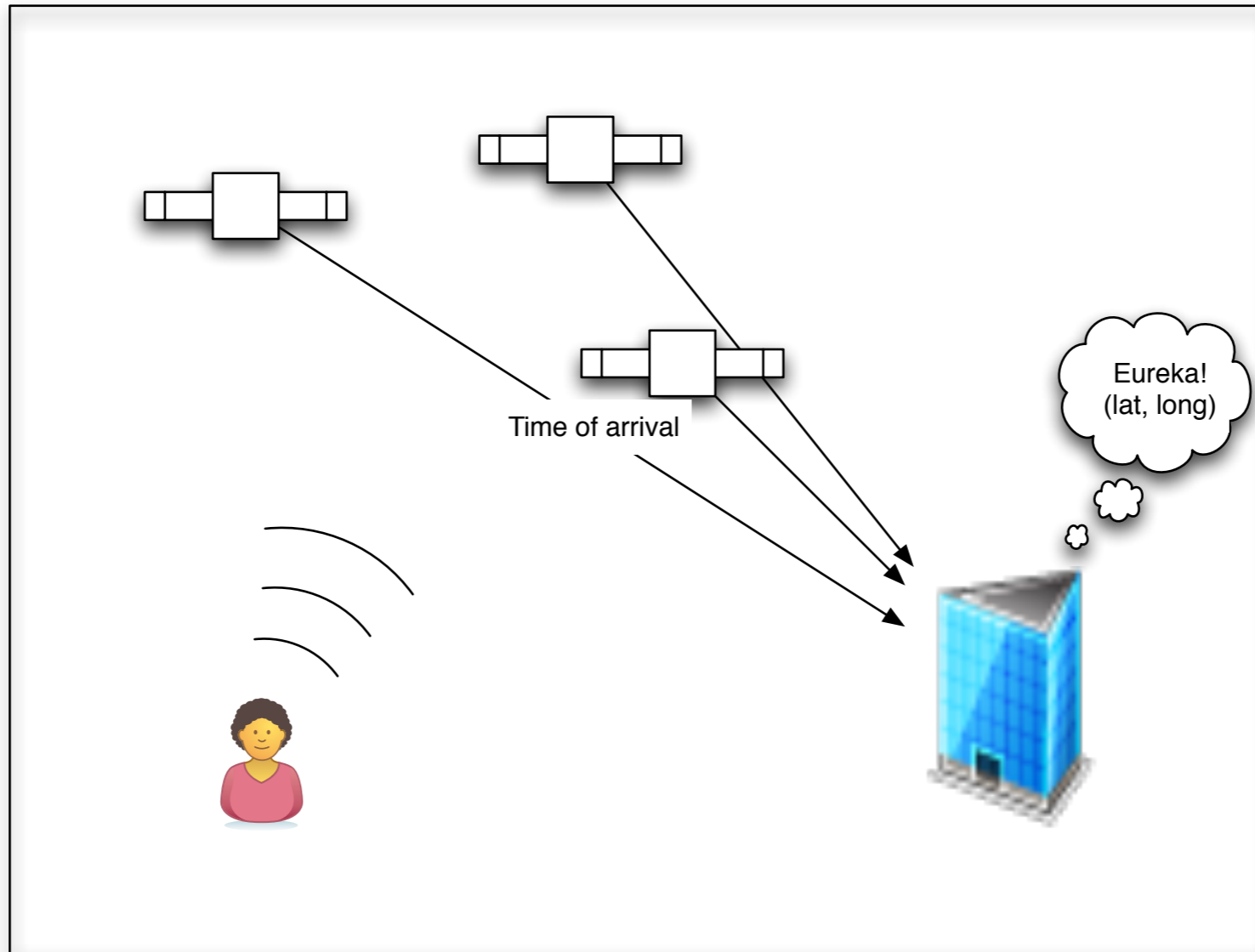


Bei-dou

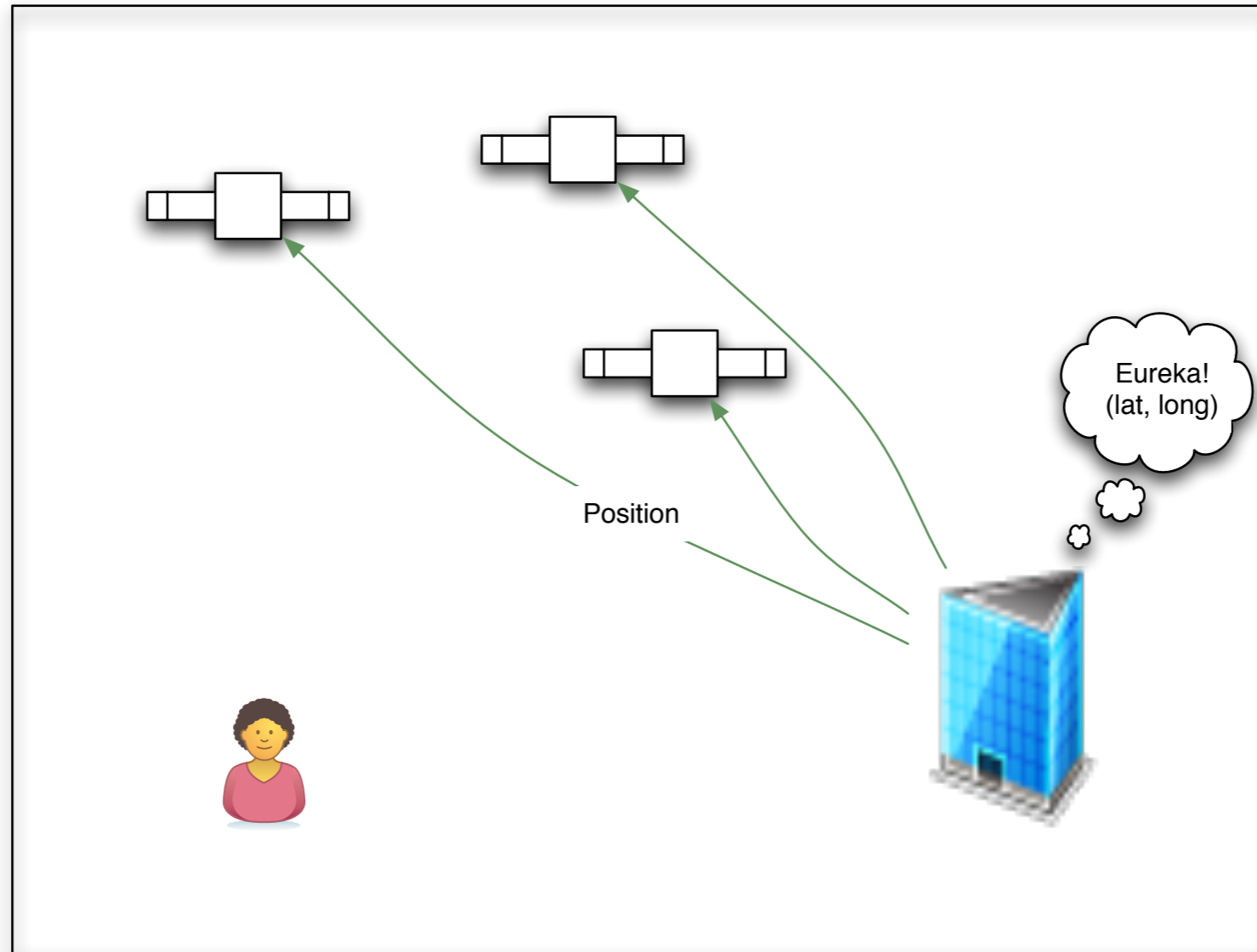


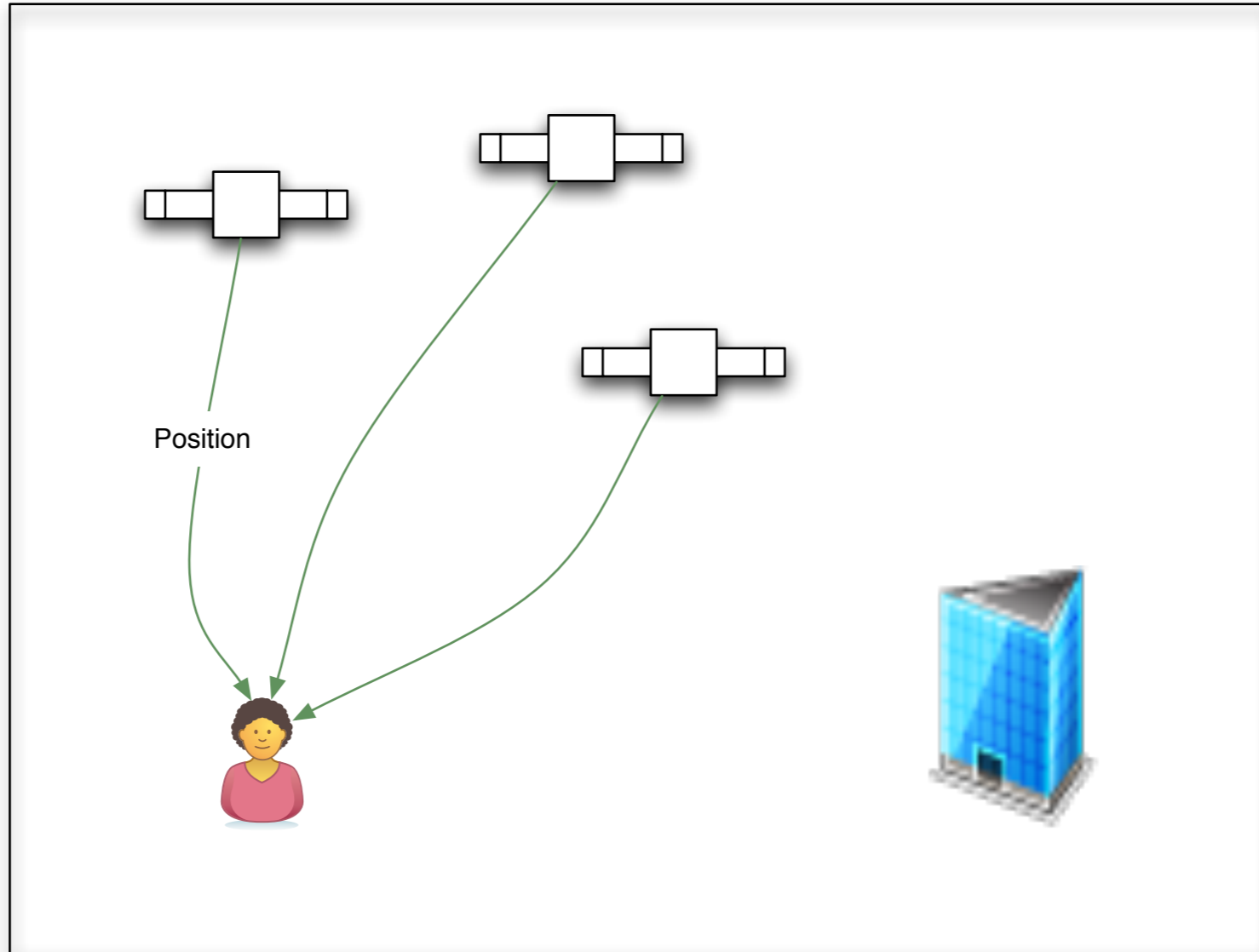
Bei-dou





Bei-dou





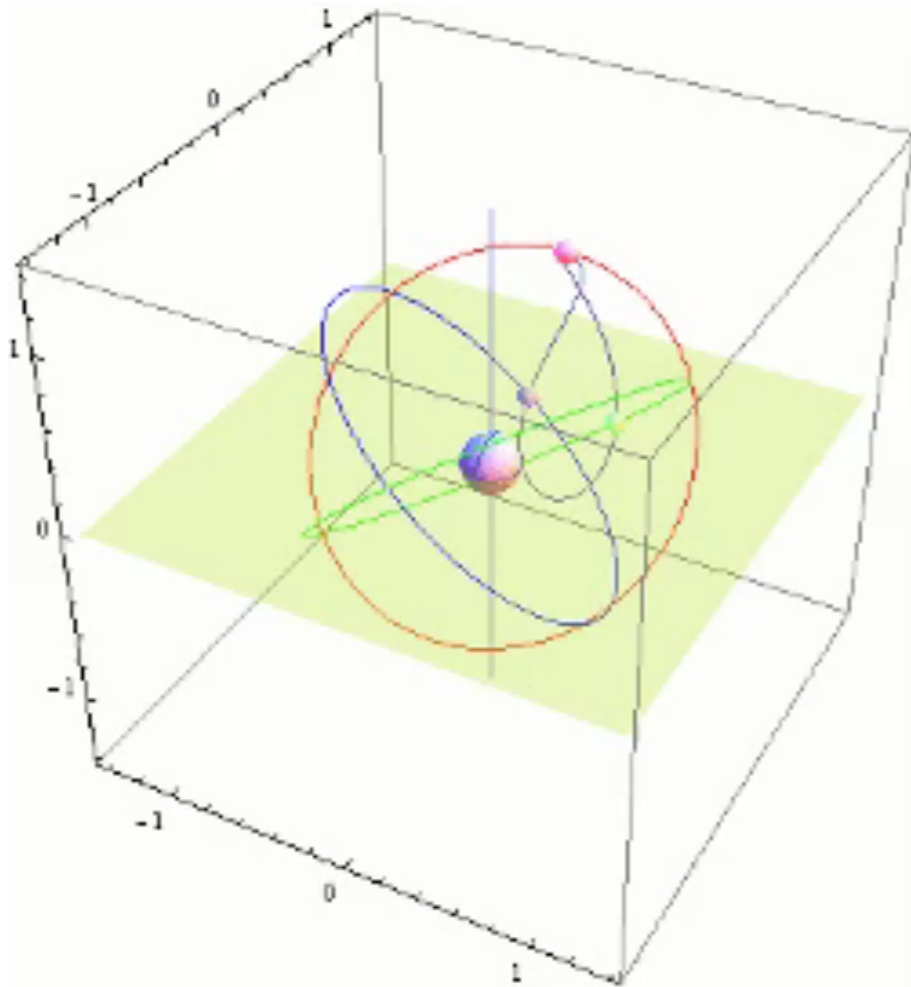
Intro to Location

- What are the implications of this design on
 - scalability of the system?
 - privacy of users?
 - security of users?
 - reliability?
 - implications on device?

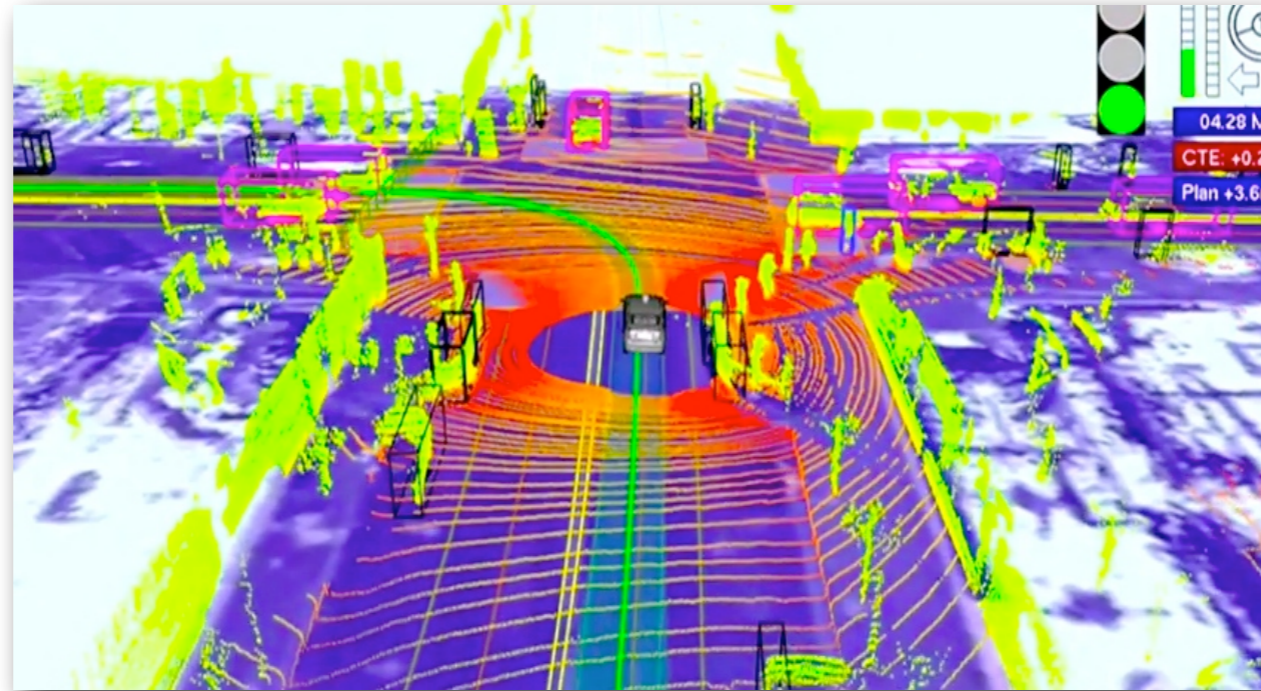


Global Location GPS

- The current and future of GPS
- Japanese Quasi-Zenith System



Google's self-driving car

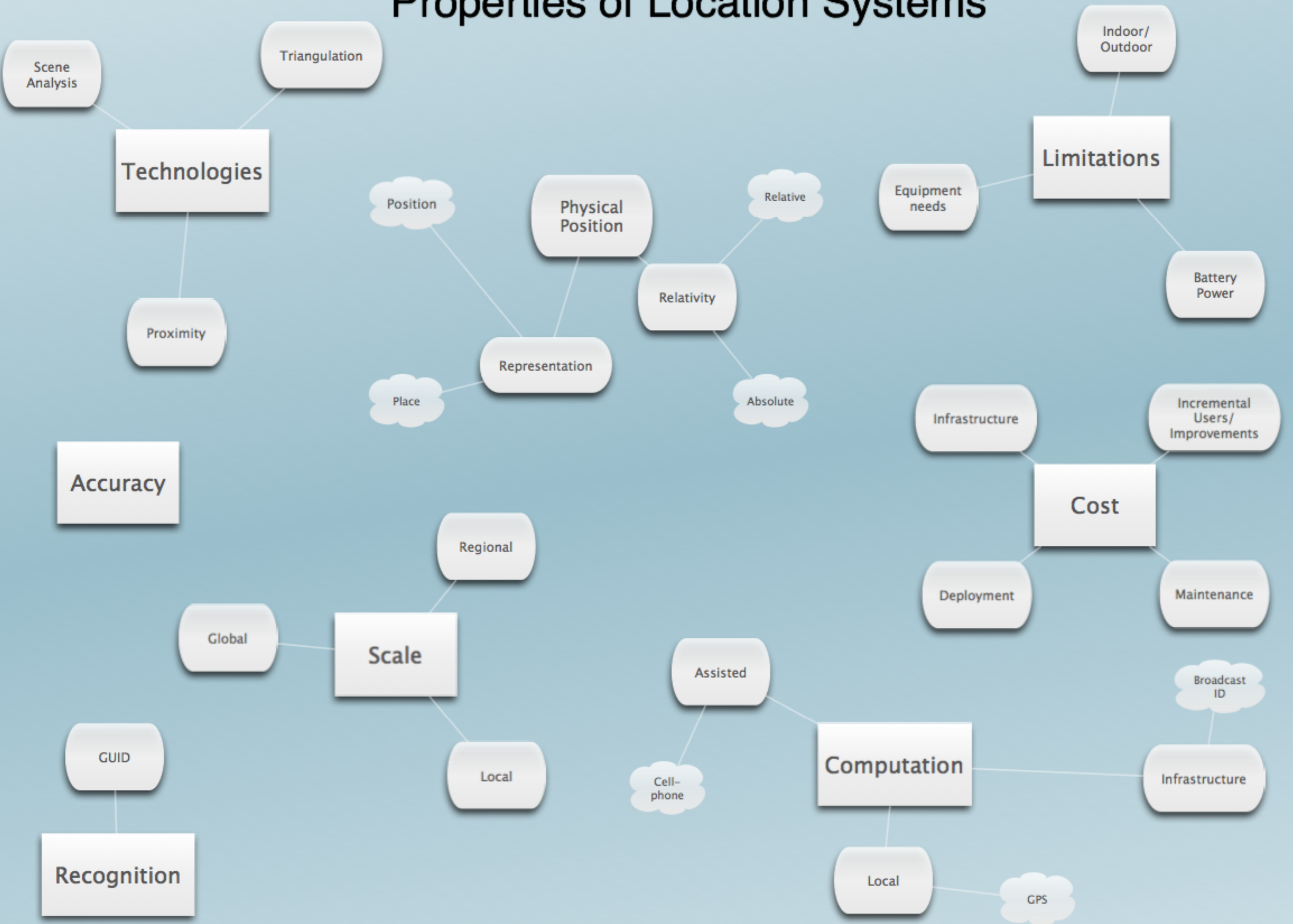


Two things seem particularly interesting about Google's approach. First, it relies on very detailed maps of the roads and terrain, something that Urmson said is essential to determine accurately where the car is. Using GPS-based techniques alone, he said, the location could be off by several meters.

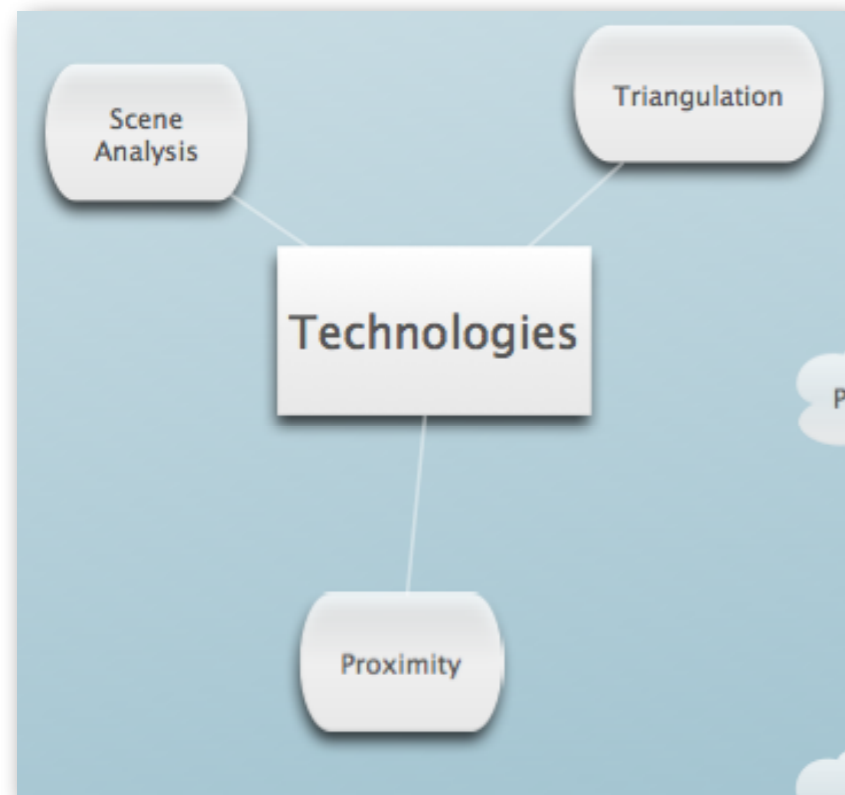
Global Location GPS



Properties of Location Systems

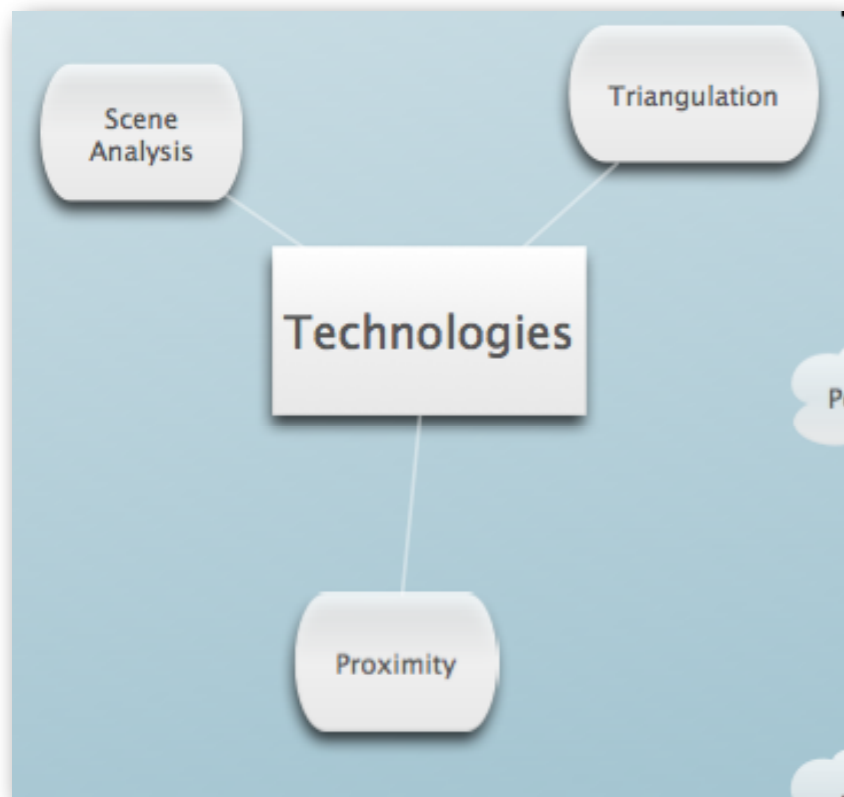


Properties of Location Systems



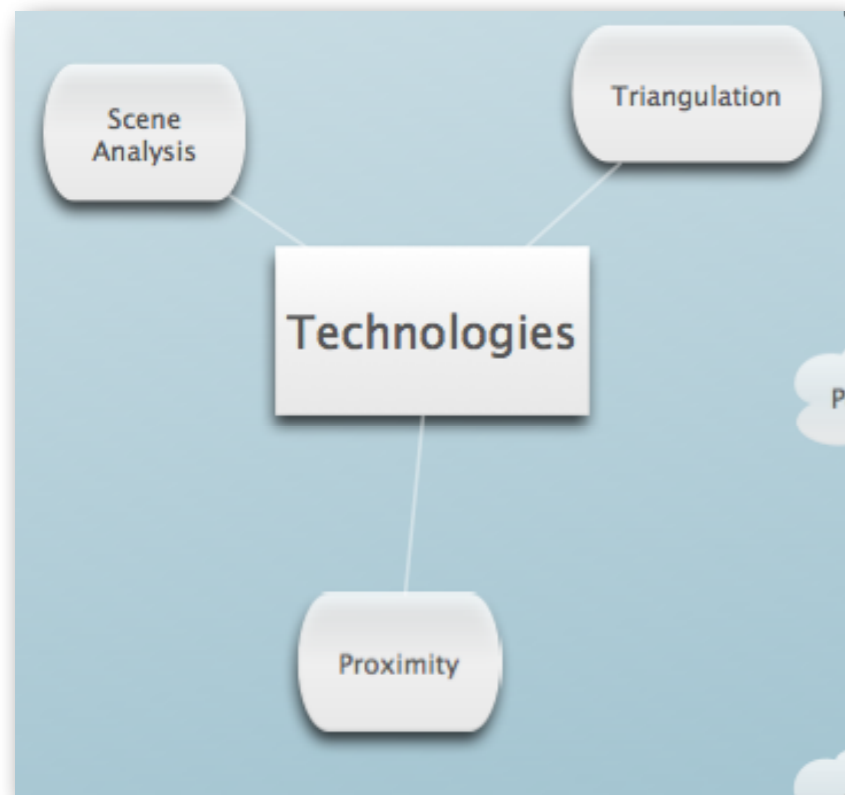
- Technologies
 - Triangulation
 - GPS is an example
 - Multiple references to fixed locations which resolve position

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

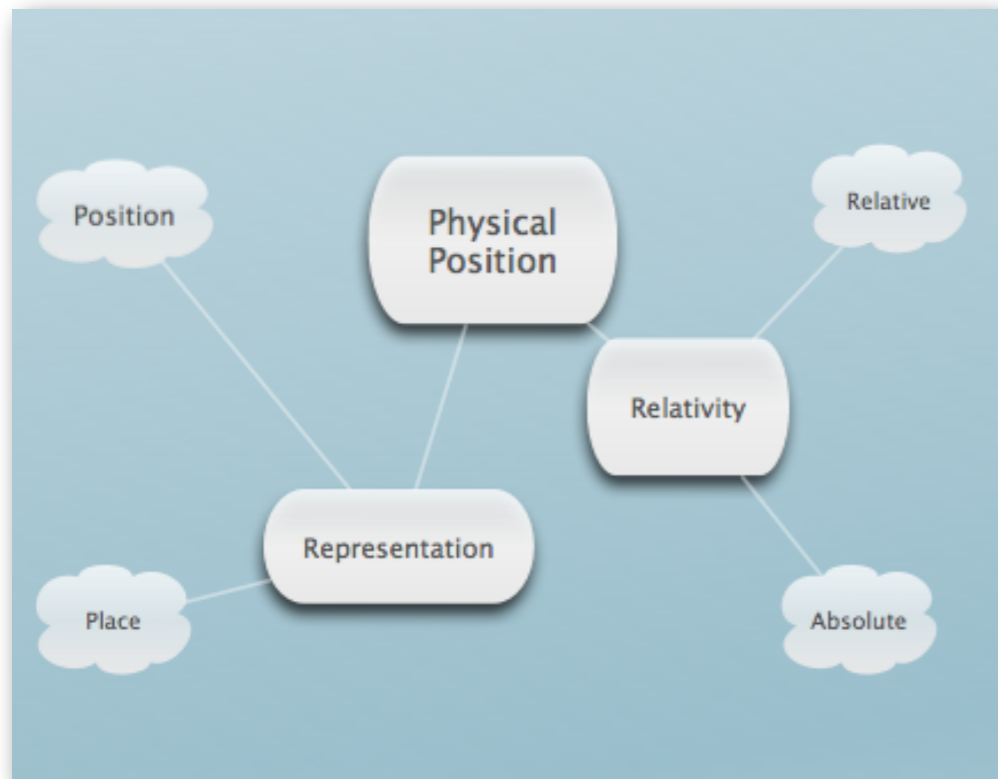
Properties of Location Systems



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



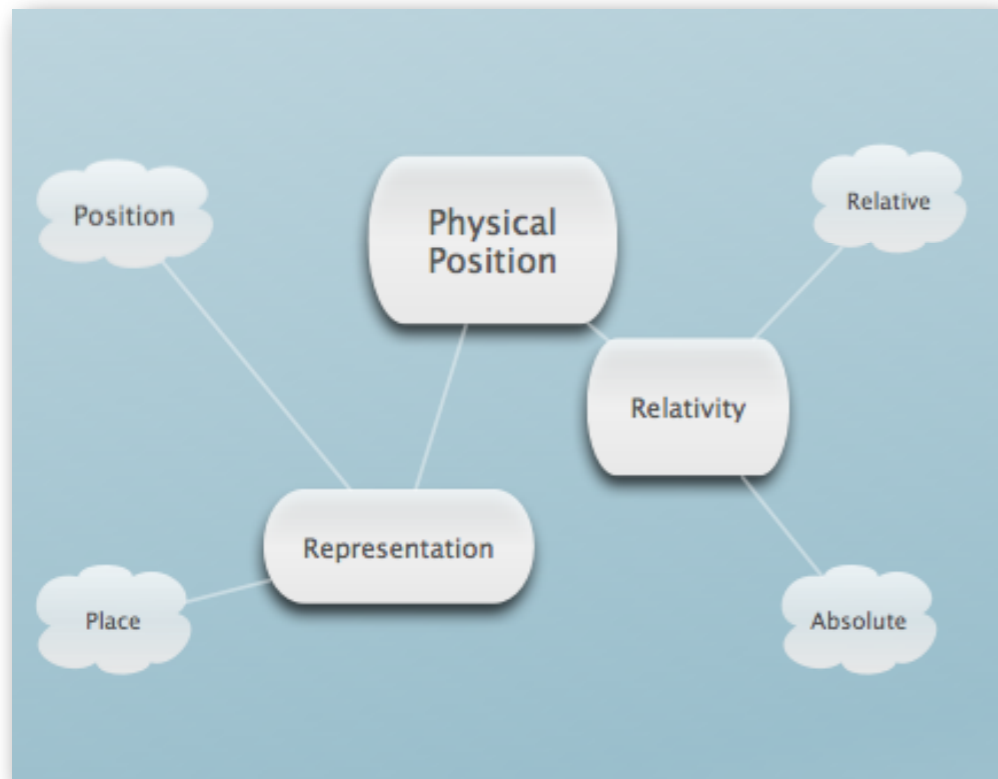
Properties of Location Systems



- 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

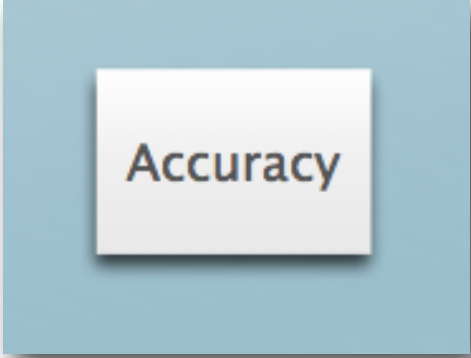


- Properties
 - Where is the computation done?
 - GPS locally - private, scalable
 - Cell-phone positioning - assisted, scalable to a degree, location is revealed
 - Broadcast ID-badge systems - localization is in infrastructure



Properties of Location Systems

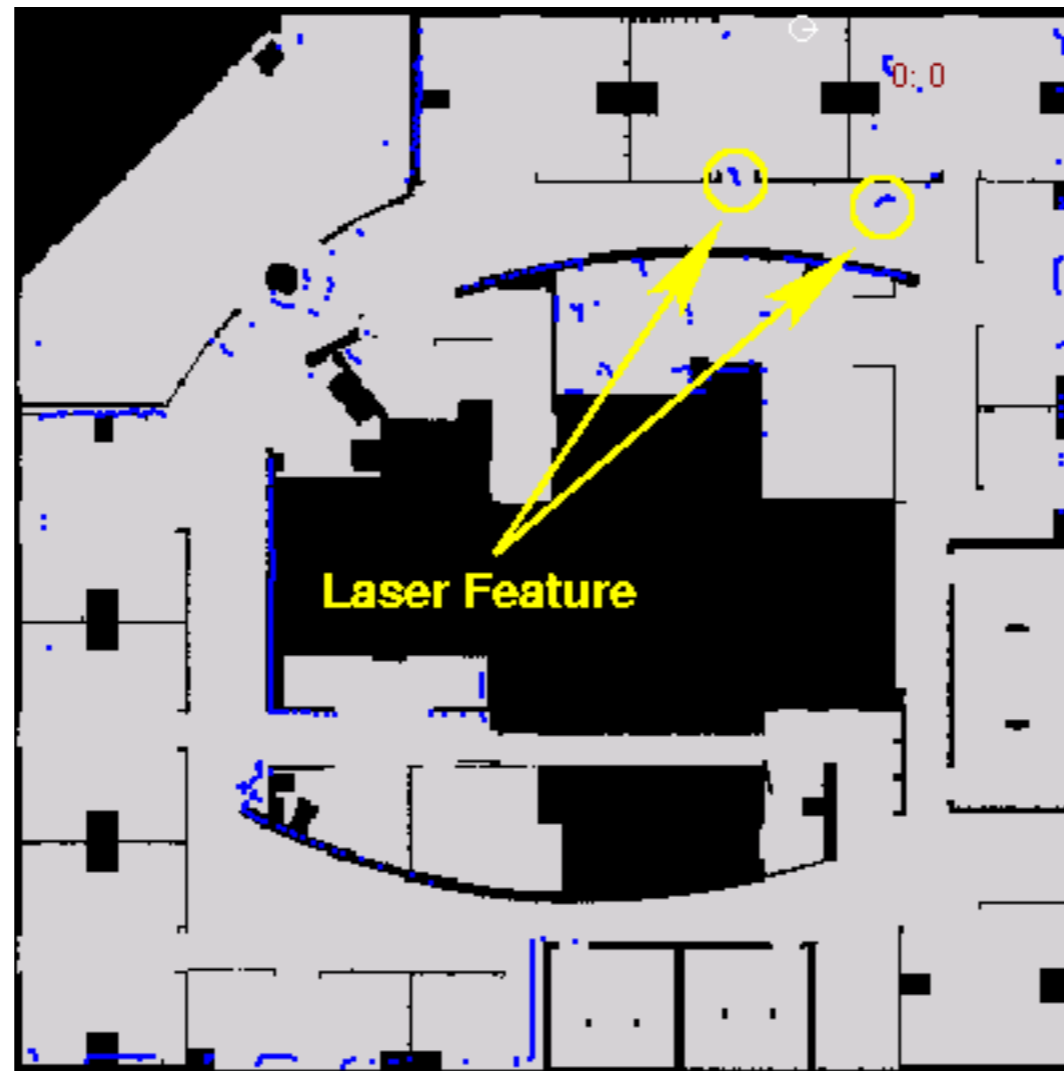
- Properties
 - Accuracy and precision
 - GPS 15m - 95% of the time
 - Sensor fusion tries to improve accuracy and/or precision by combining sensors
 - Accuracy and precision may change to conserve battery life.



Accuracy



Properties of Location Systems

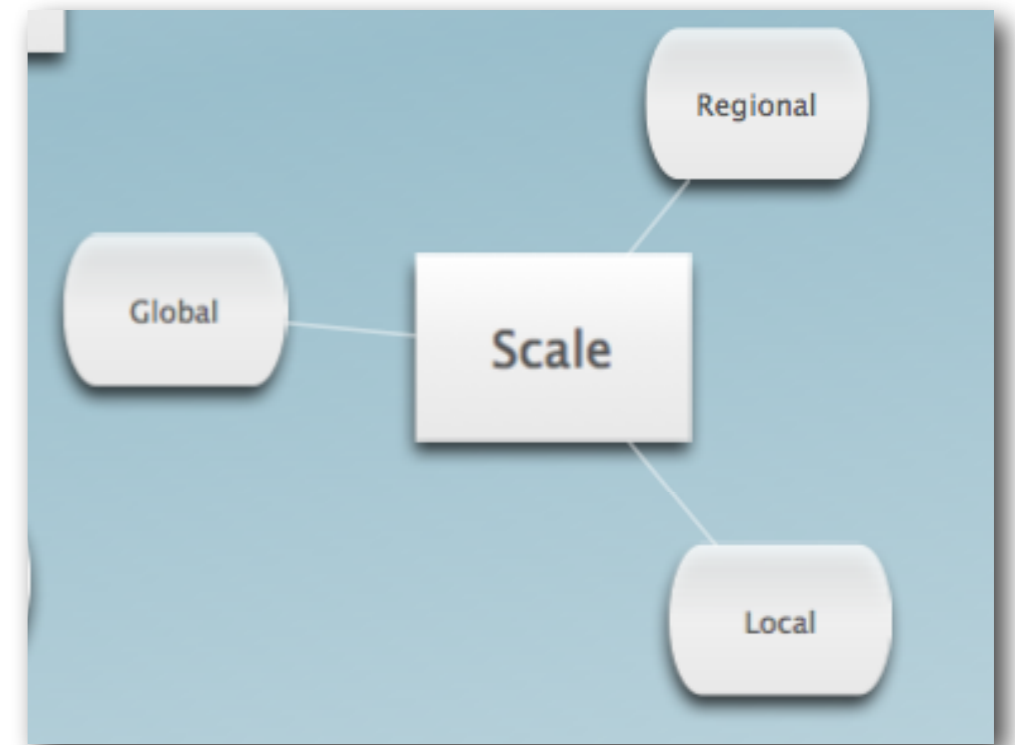


Properties of Location Systems



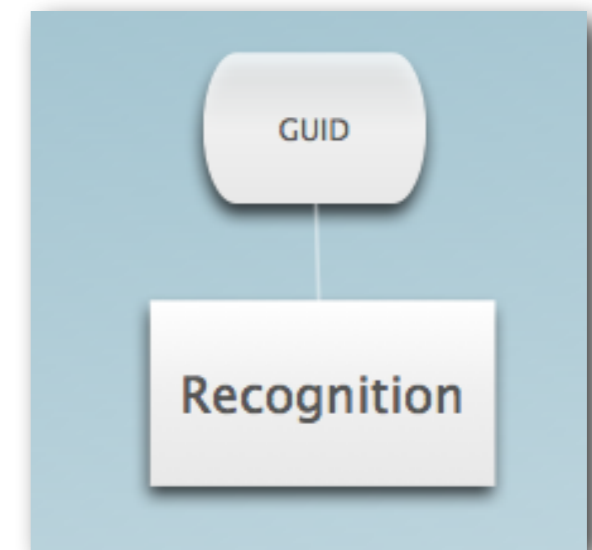
Properties of Location Systems

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



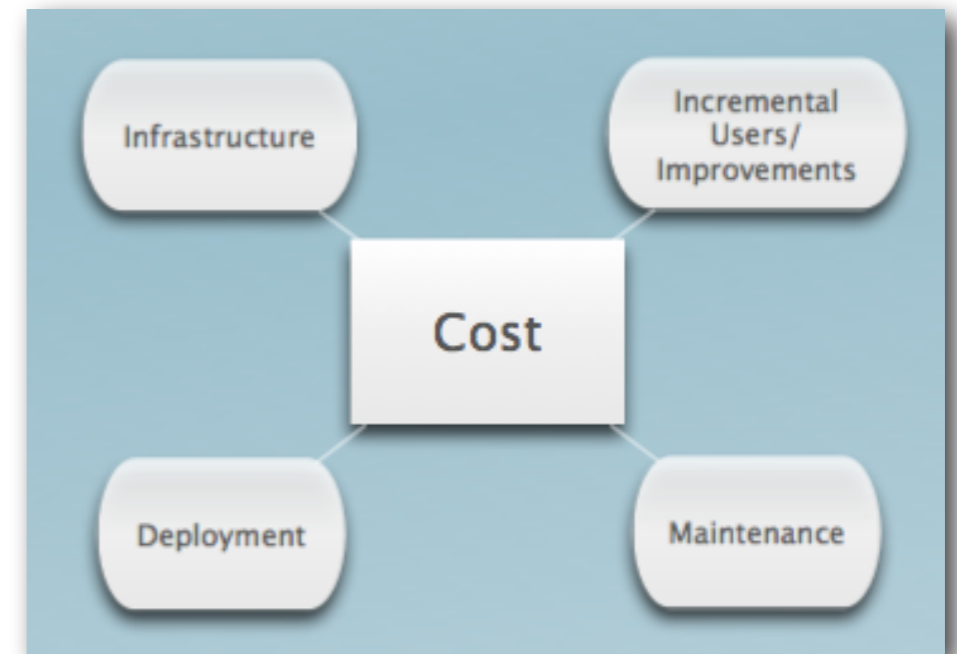
Properties of Location Systems

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

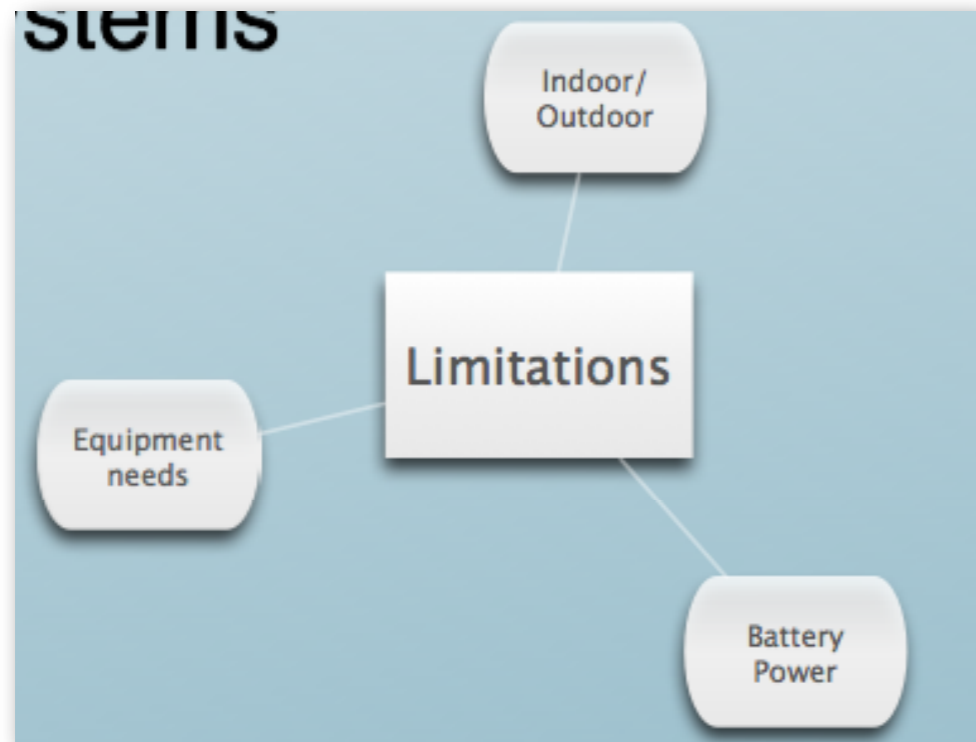


Properties of Location Systems

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



Properties of Location Systems



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

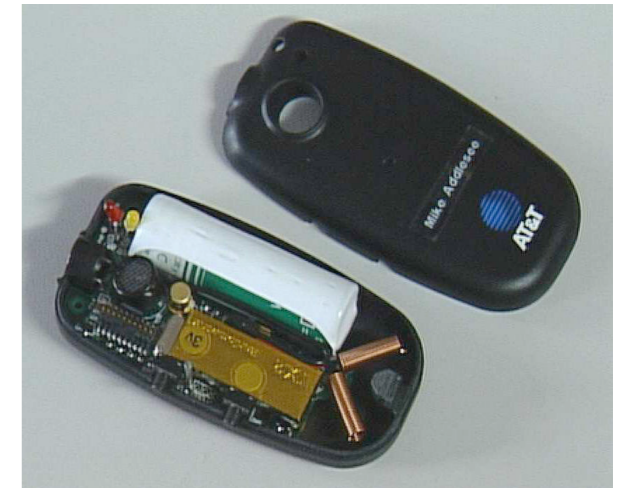
Examples

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



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



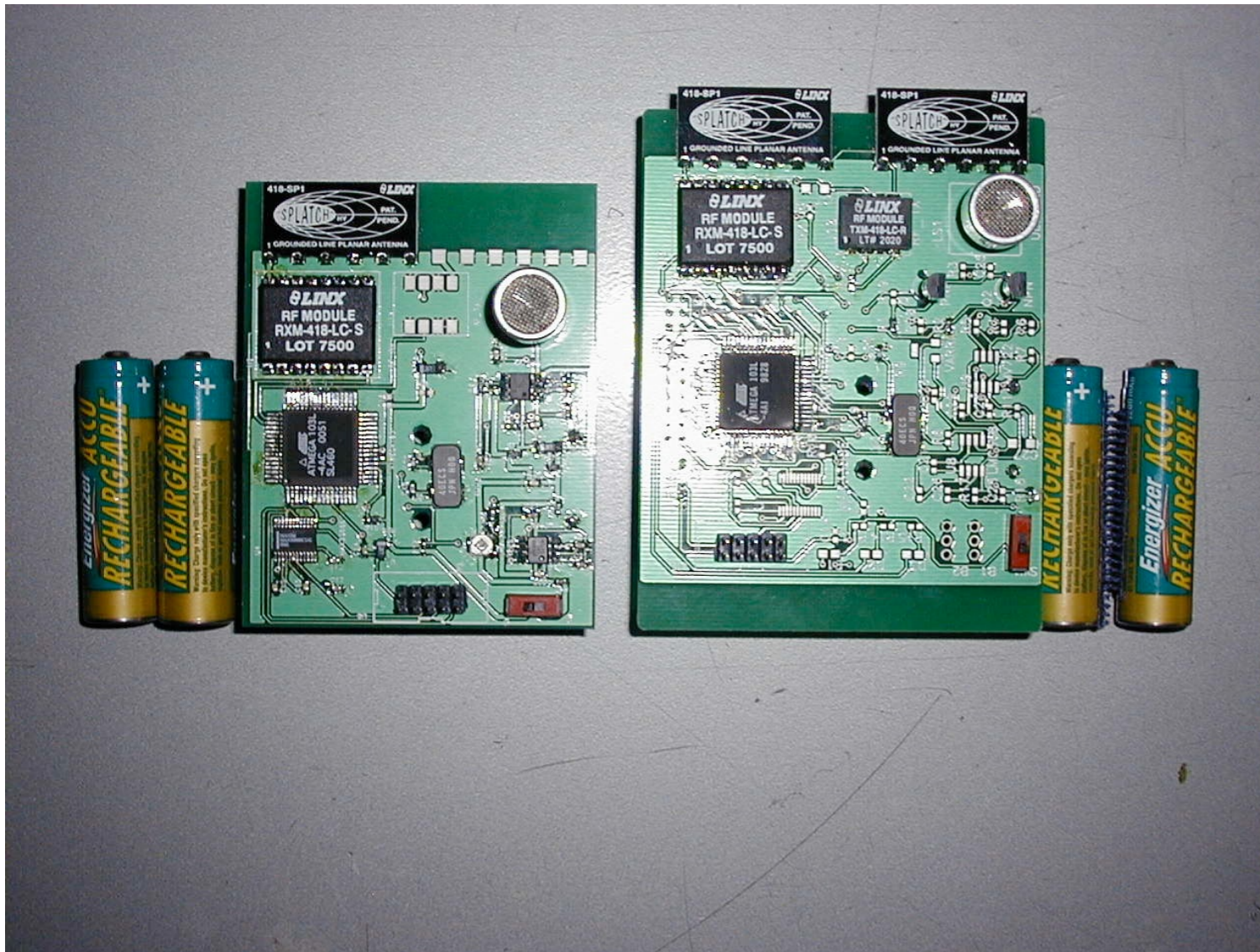
Examples

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



Properties of Location Systems

Examples



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



Properties of Location Systems

Sun 8/14 Mon 8/15 Tue 8/16 Wed 8/17 Thu 8/18 Fri 8/19 Sat 8/20

Color represents participants



Wifi Spot

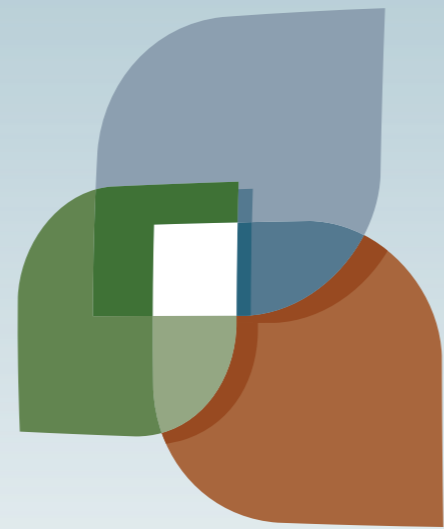
writing



How does a phone find your location?

- “Real” GPS
- “Assisted” GPS
 - Help with “Real” GPS
 - Send your position
 - Cell-tower based localization
- WiFi based localization
- IP based localization
- What are the properties of each?
- What are other crazy ideas of how to figure out your location?





L U C I

