Intro to Location

Mobile and Ubiquitous Games

ICS 163

Donald J. Patterson

All about GPS

Global Location GPS

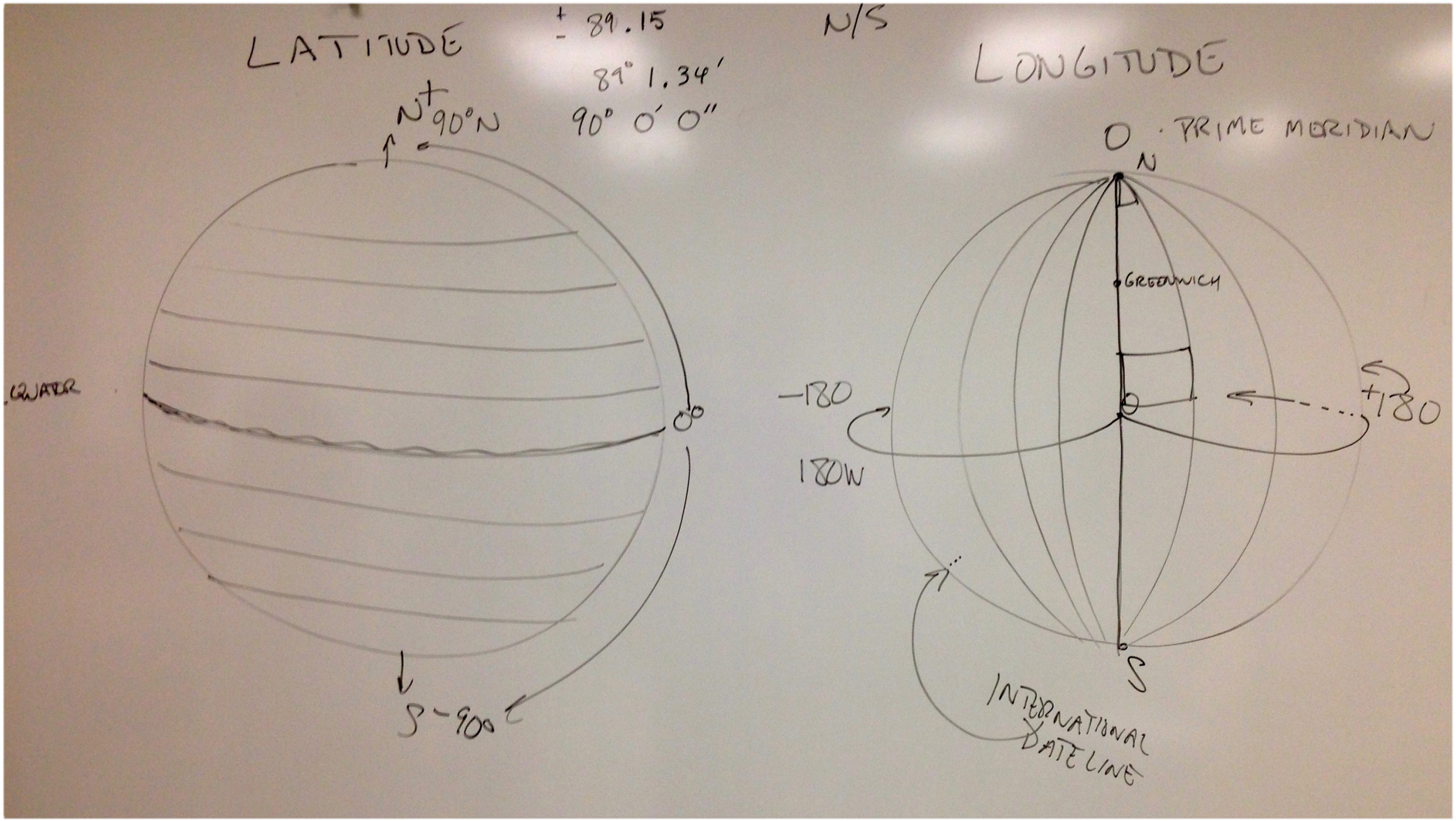
- Latitude and Longitude
  - What are they?
  - Datum

Flickr: akash_k

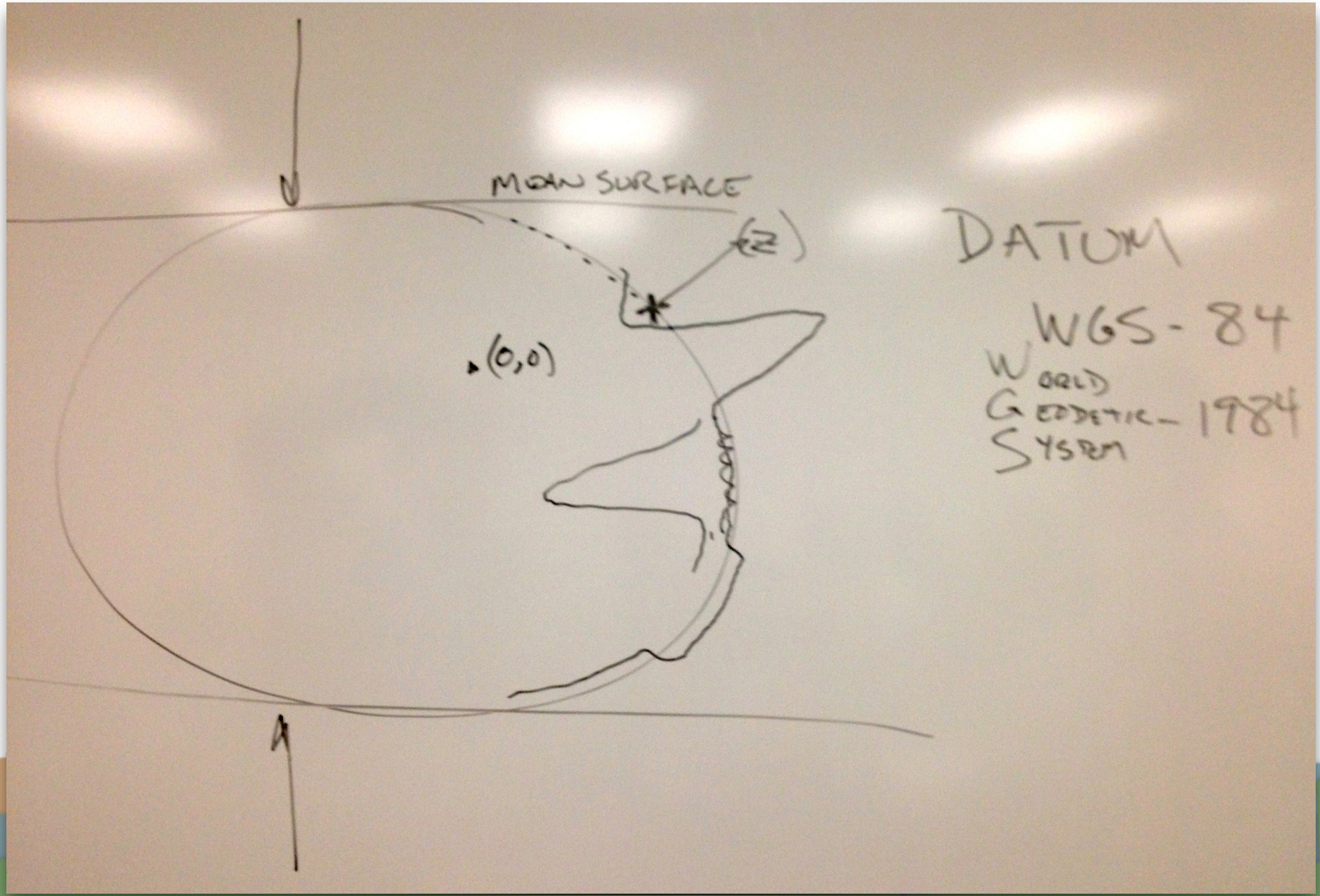
Intro to Location

- Describe Lat,Long
  - (x,y)
- Datum
  - mean
  - earth models

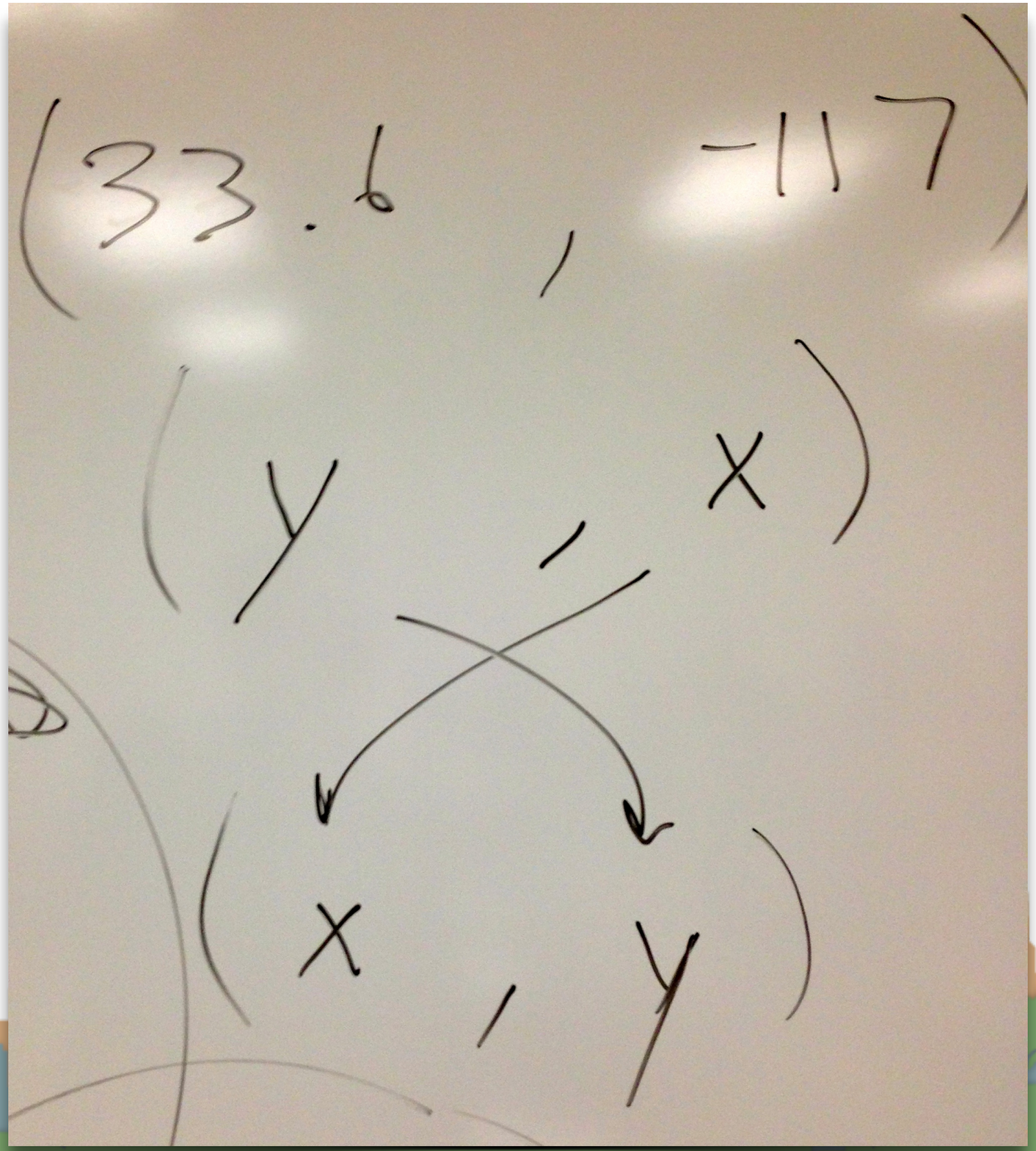
Global Location GPS



Global Location GPS

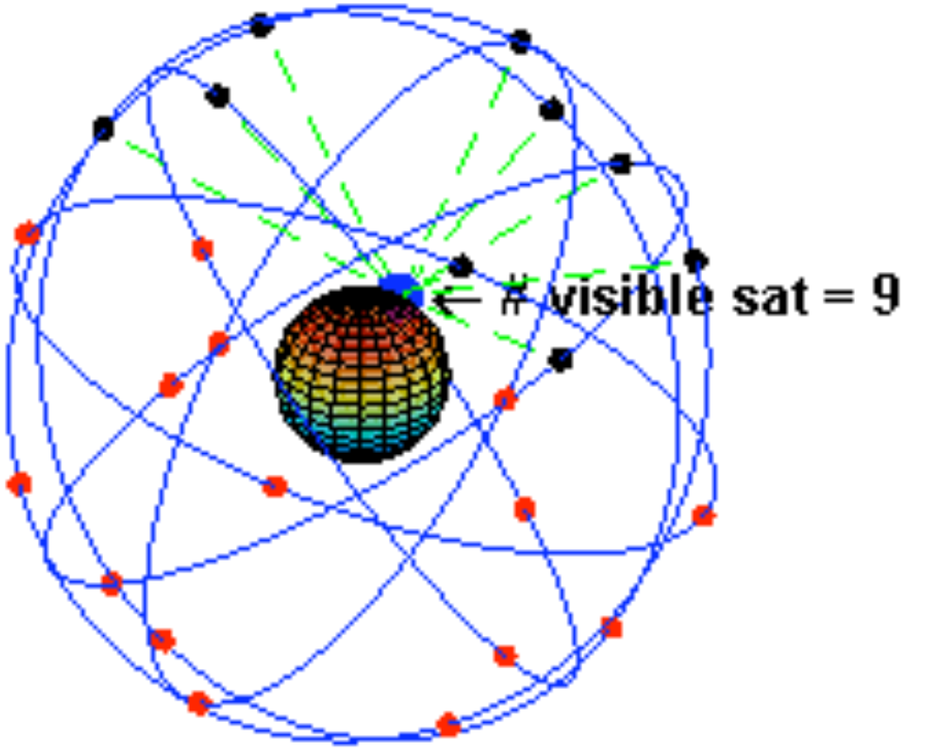


Global Location GPS



Global Location GPS

- Current GPS
  - Fully operational
  - accurate, continuous, global 3-D position and velocity
  - also distributes universal coordinated time
  - 24 original satellites
  - 6 orbital places
  - 4 satellites per plane
  - not geosynchronous
  - world-wide monitoring stations



http://en.wikipedia.org/wiki/GPS,Flickr: girardi

Global Location GPS

- Current GPS
  - Receiver requirements
    - Must have local clock
    - 3-D position requires four satellites
      - four unknowns (what are they?)
      - time or height reduces this

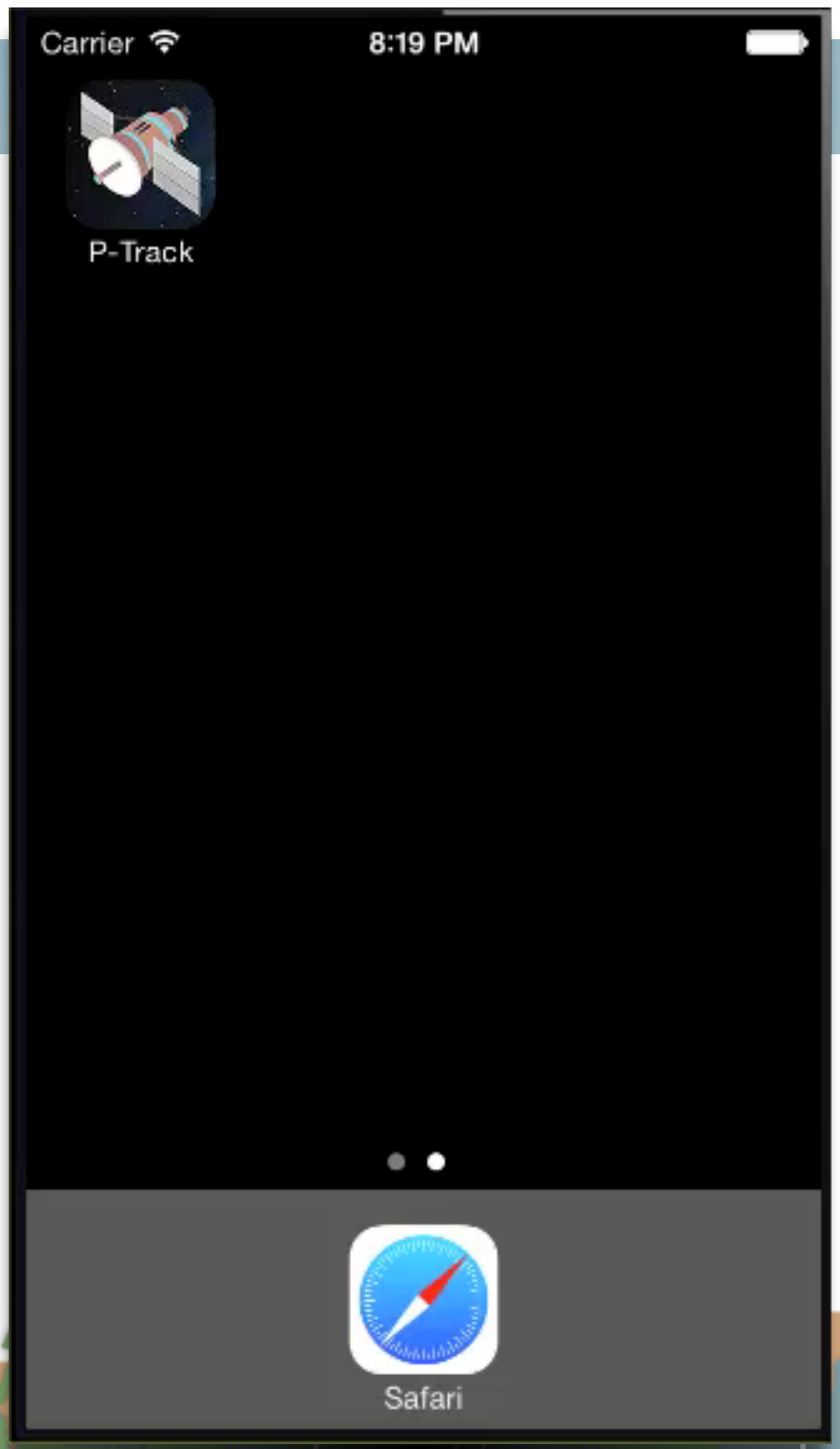
Global Location GPS

- Current GPS
  - Based on
    - Time Of Arrival (TOA) of radio signal
    - knowledge of satellite orbits
  - Satellites have atomic clocks on board
  - 2 frequencies
    - L1 1575.42 MHz
    - L2 1227.6 MHz

Global Location GPS

- Current GPS
  - Broadcasts
    - Time of transmission
    - Ephemeris: Precise satellite orbital info
    - Almanac: System health info, rough orbital info for all satellites

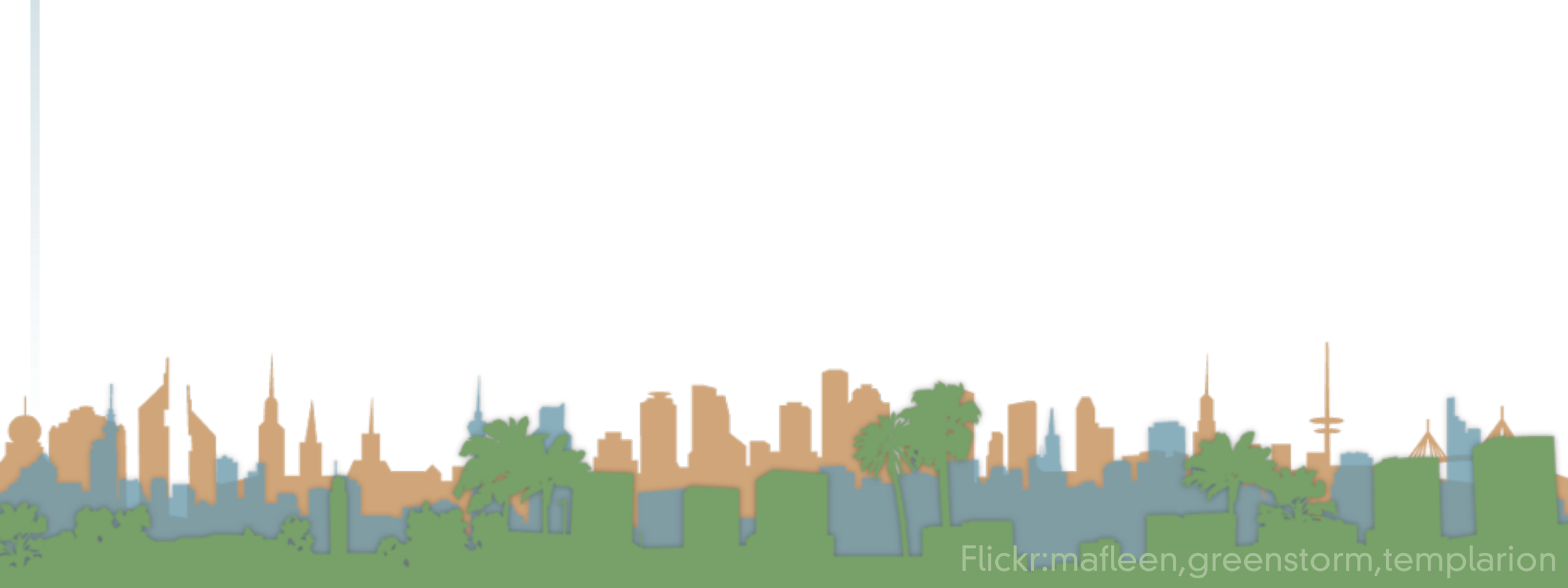
Intro to Location



http://www.ptrackapp.com/index.html

Global Location GPS

- Basic concept is based on the foghorn paradigm
  - but in 3-D



Global Location GPS

- Basic concept is based on a foghorn paradigm
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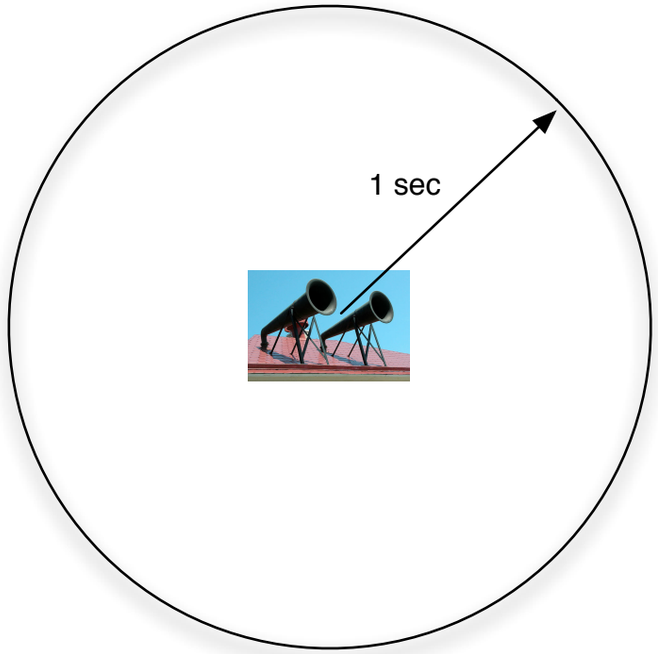
Flickr:mafleen,greenstorm,templarion

Global Location GPS

1 sec

Global Location GPS



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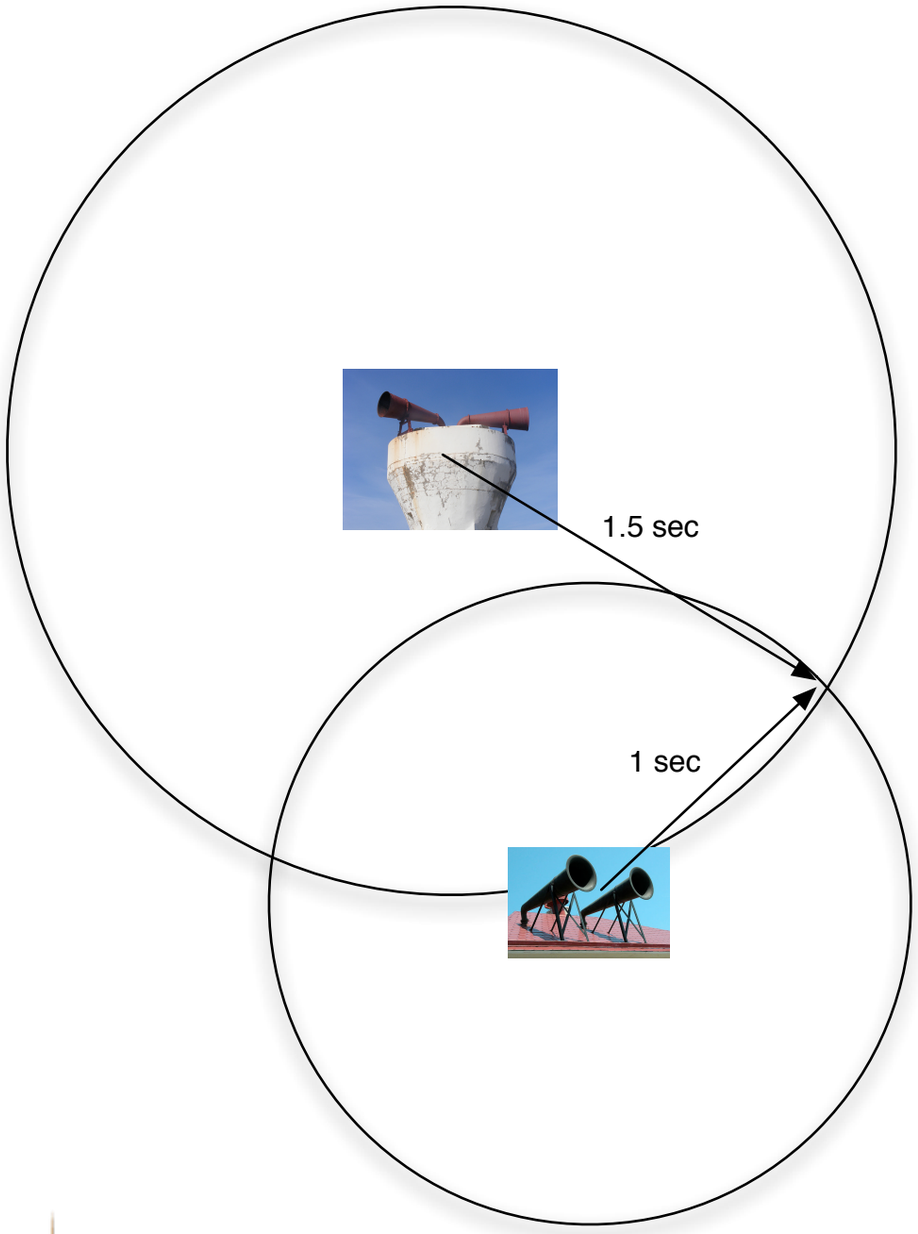
Global Location GPS



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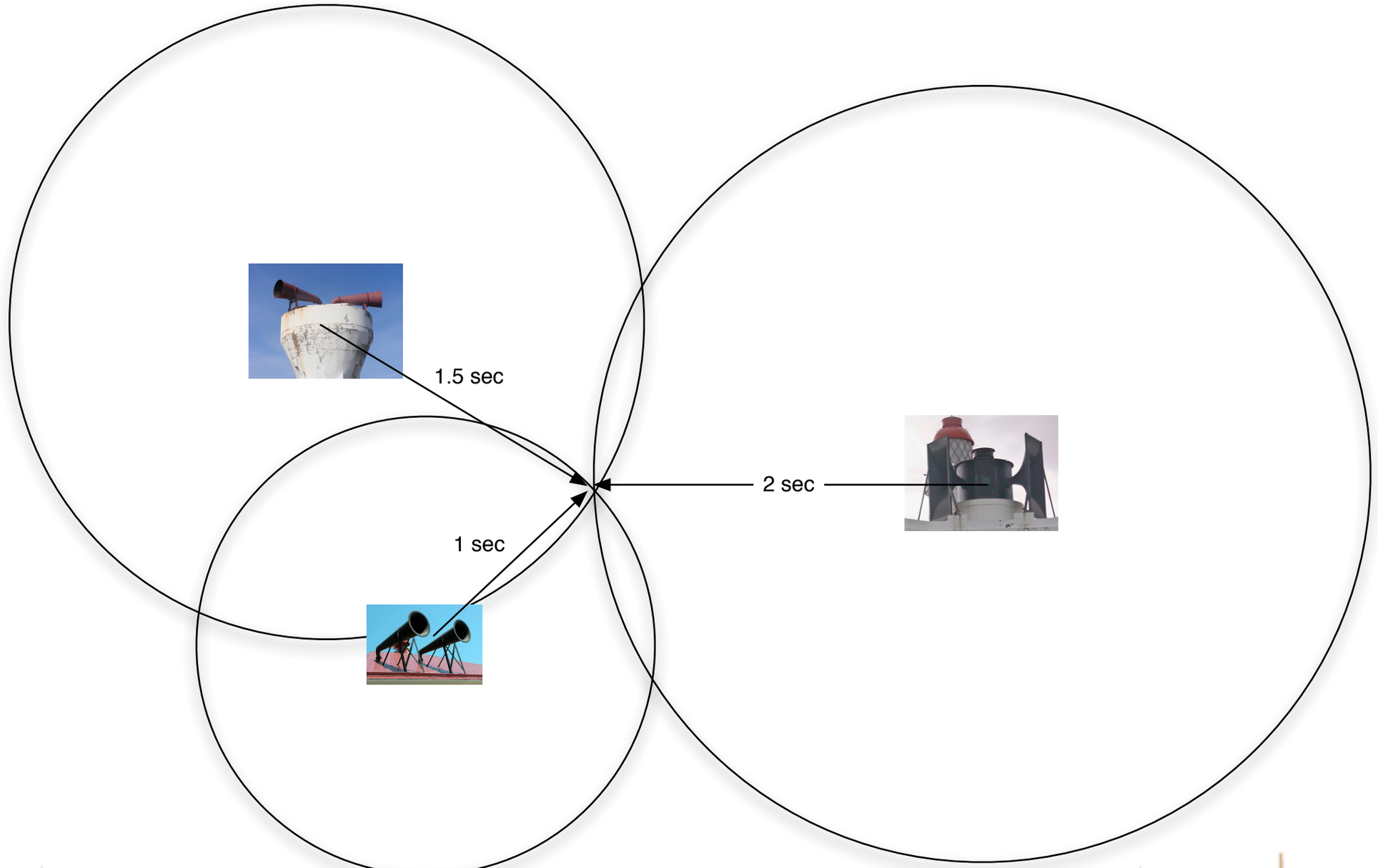
Global Location GPS



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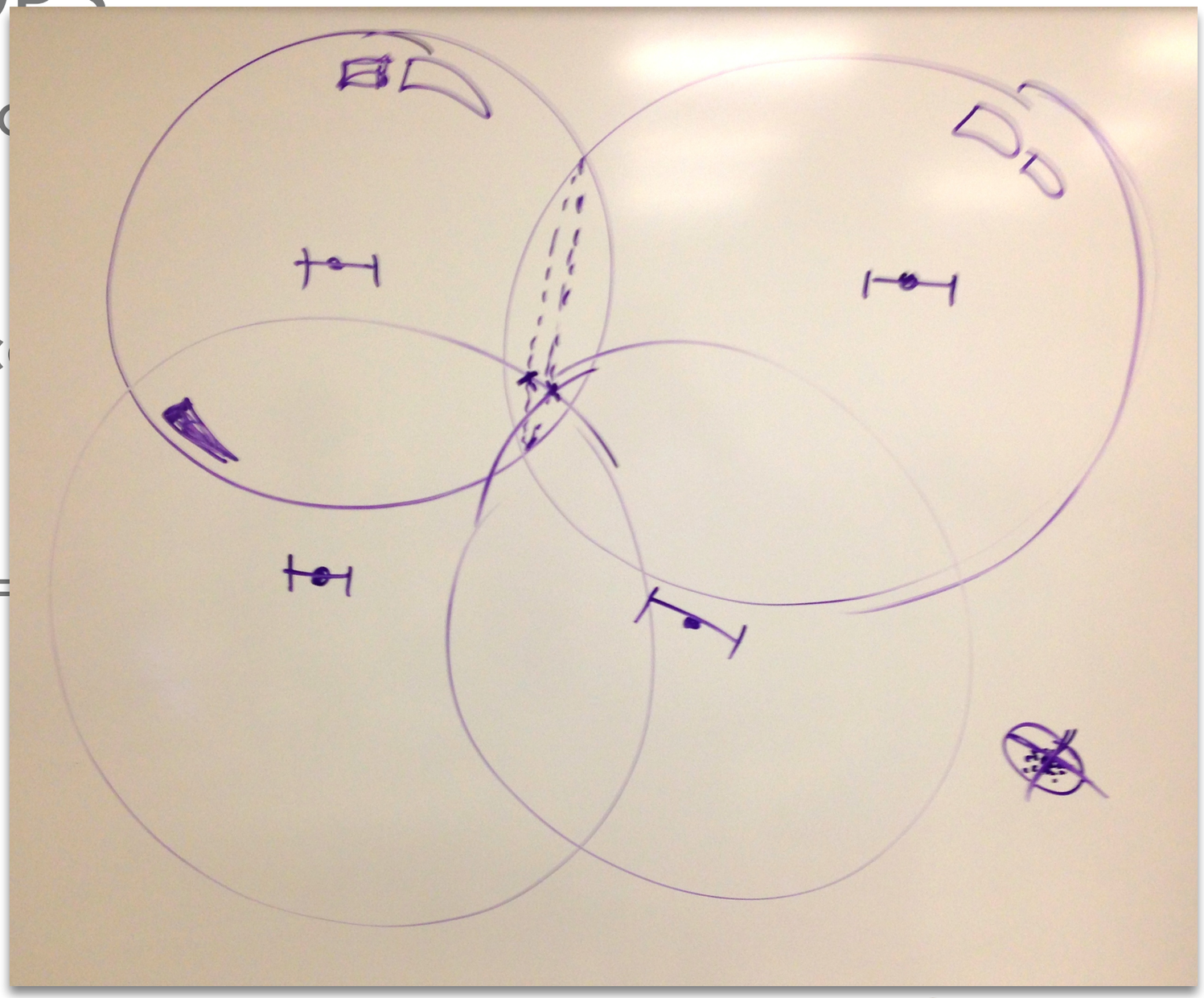
Global Location GPS

- Basic concept is based
  - but in 3-D
    - You need 1 source
      solving for
    - x,y,z,clock error =



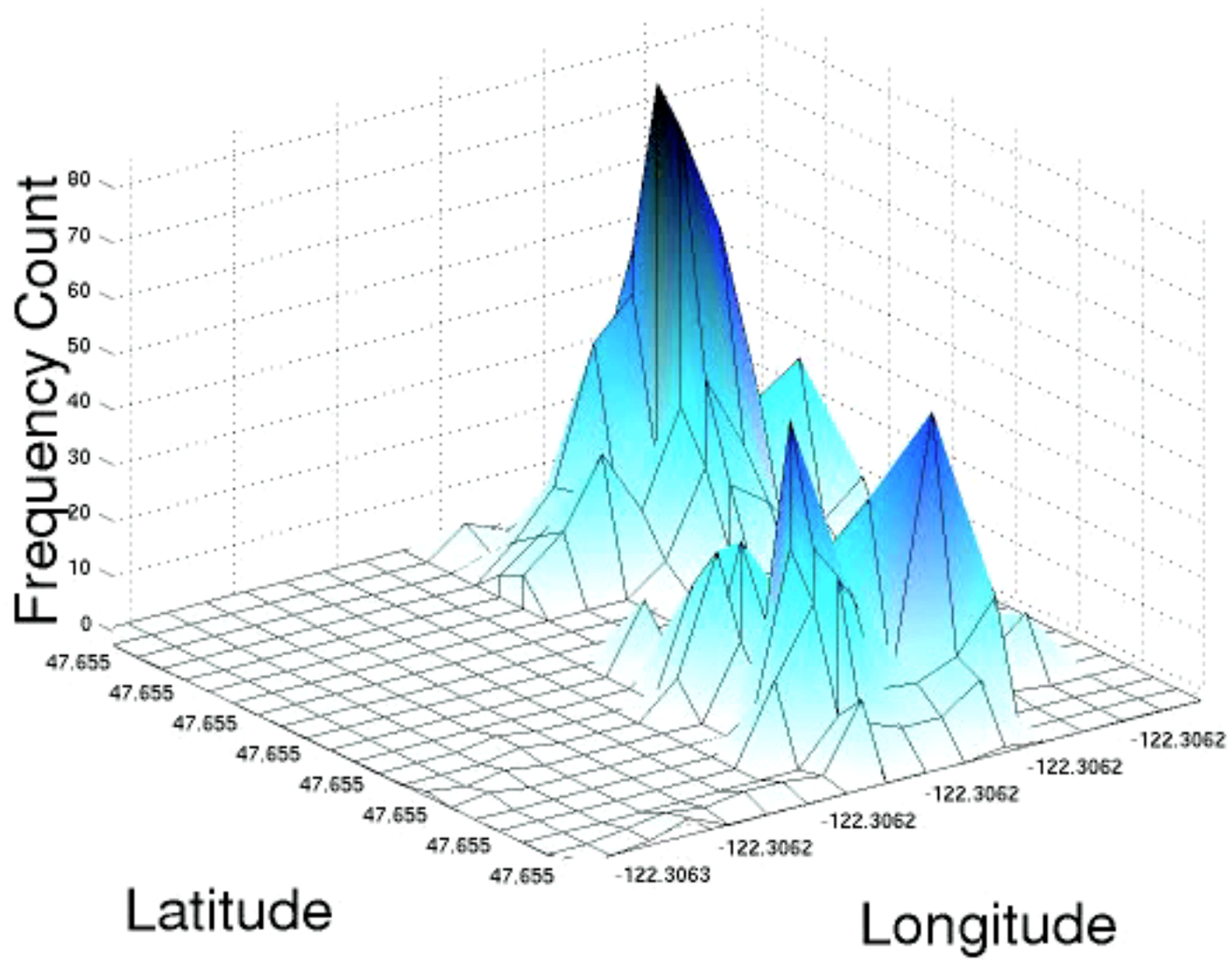
Global Location GPS

- 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

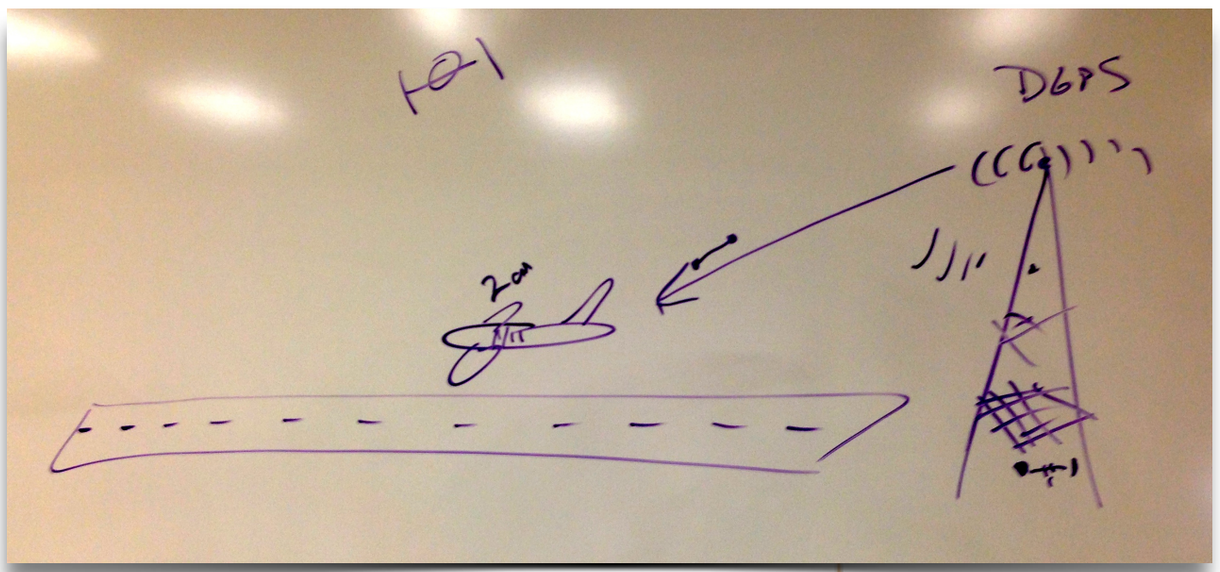
- GPS accuracy
  - 13 m 95% of the time horizontal
  - 22 m 95% of the time vertical system
  - 40 ns 95% of the time
    - How do you design for this?
- Urban canyons
  - What are they?
  - Japanese response, European response

Global Location GPS



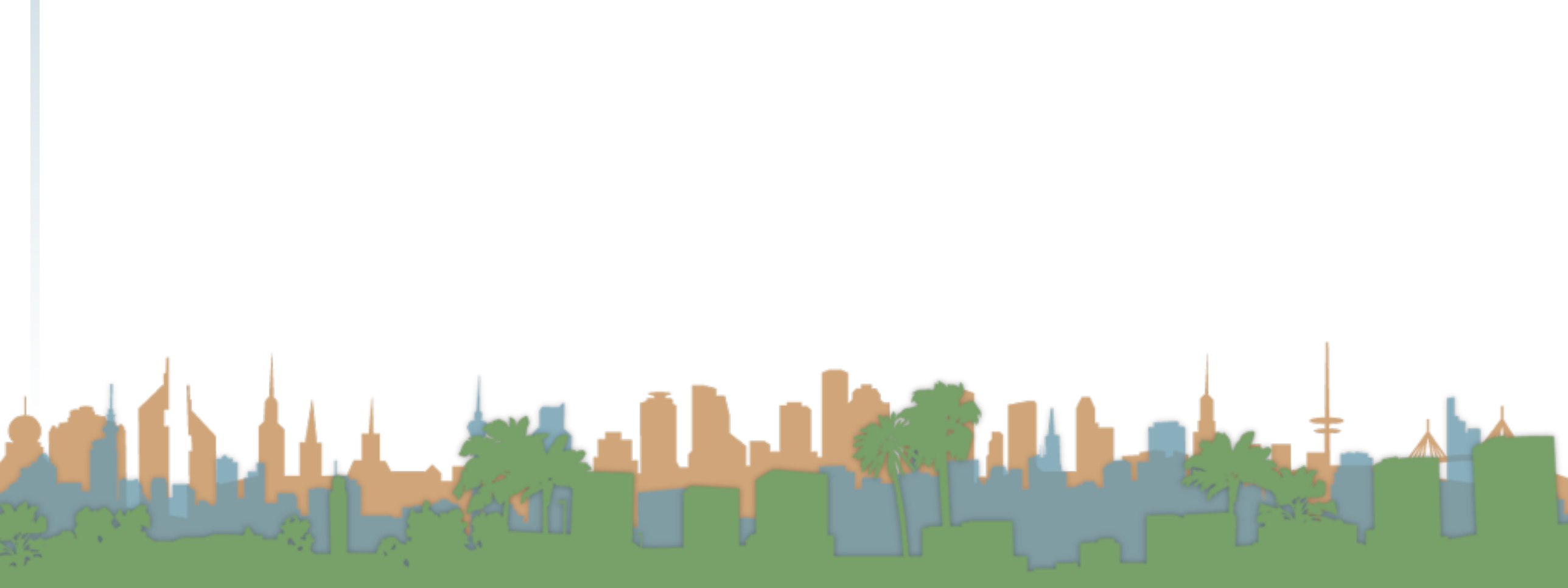
Global Location GPS

- 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

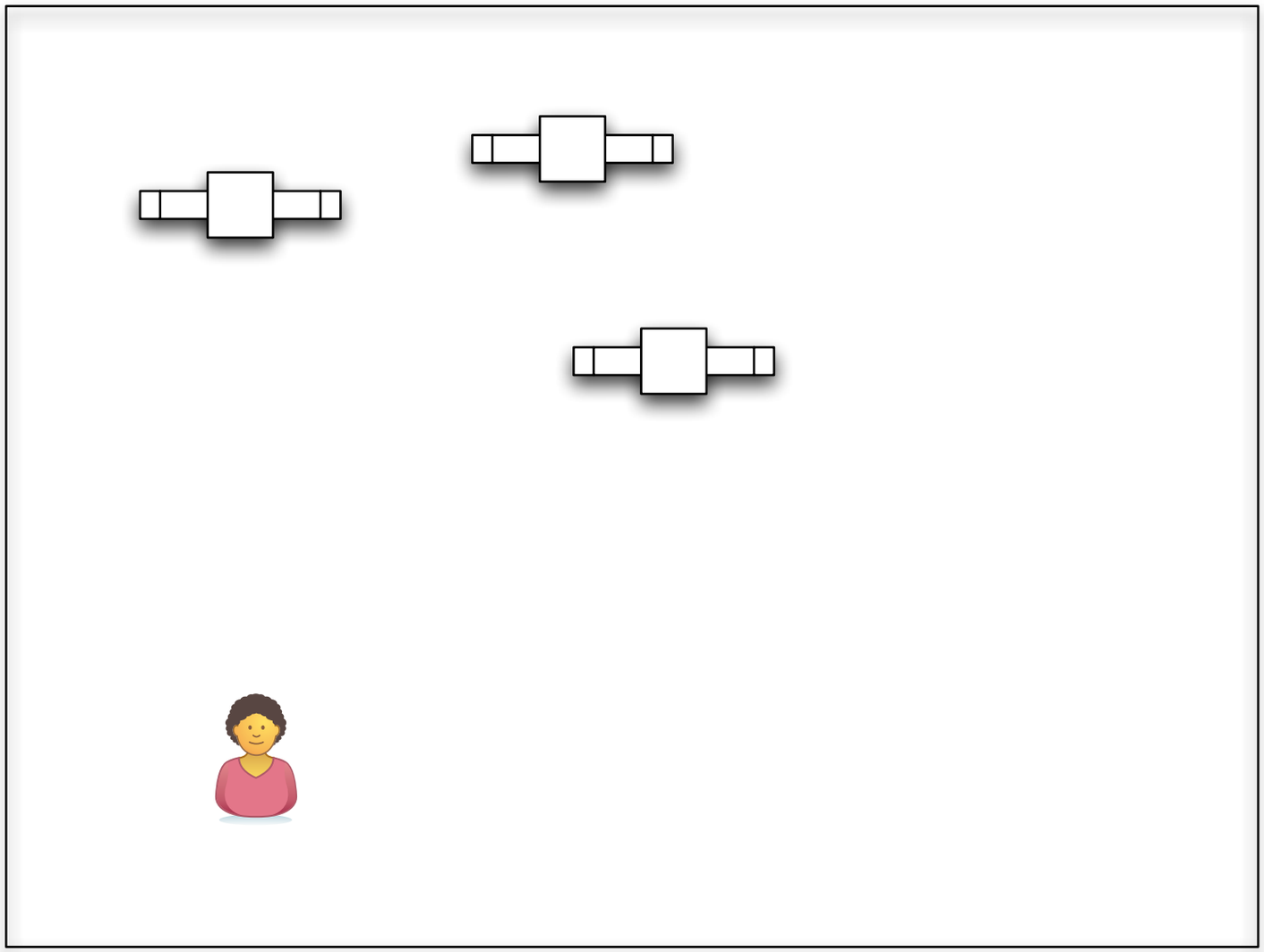


Global Location GPS

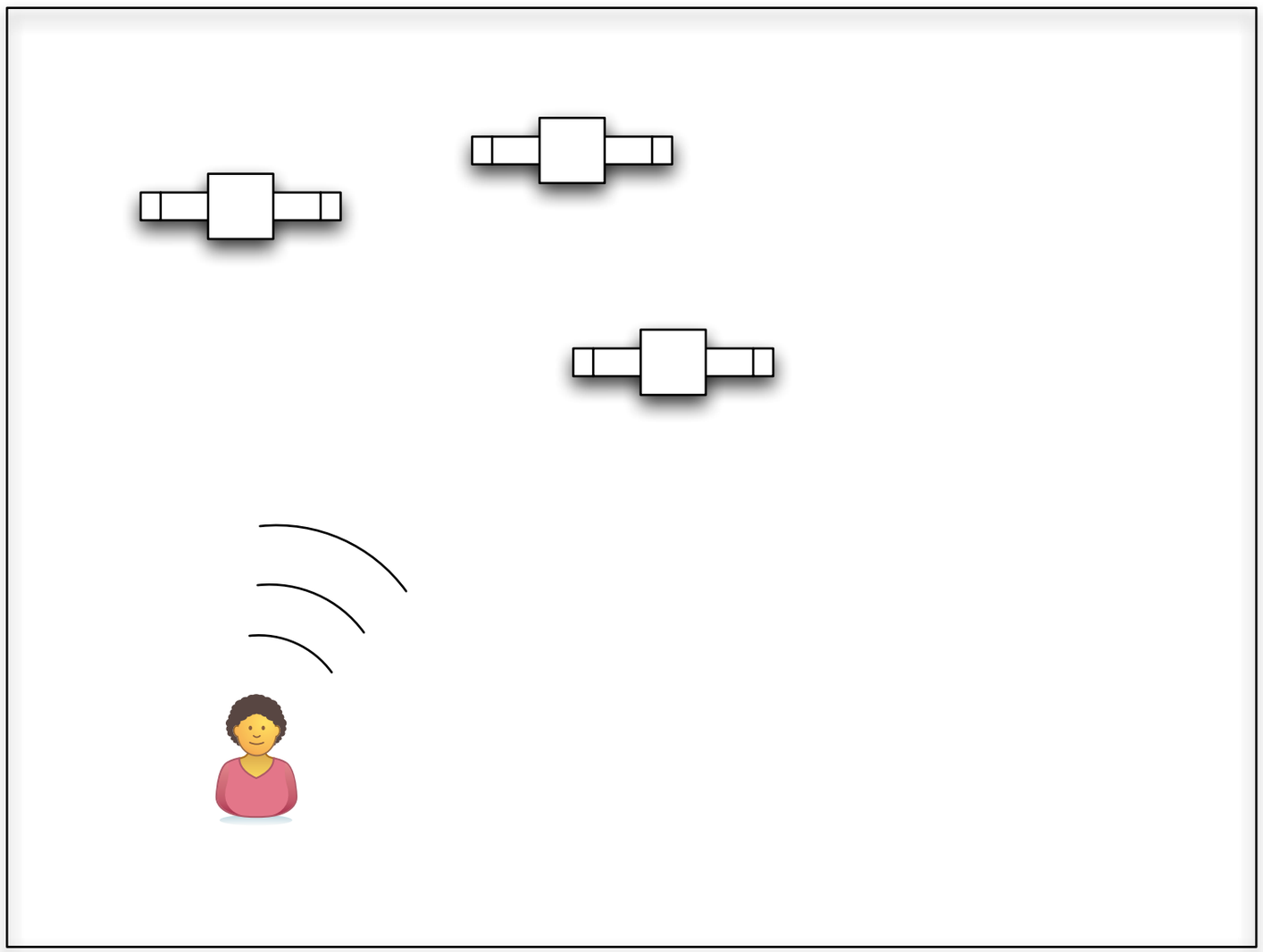
- The current and future of GPS
  - BeiDou
    - Chinese competitor
    - centralized system



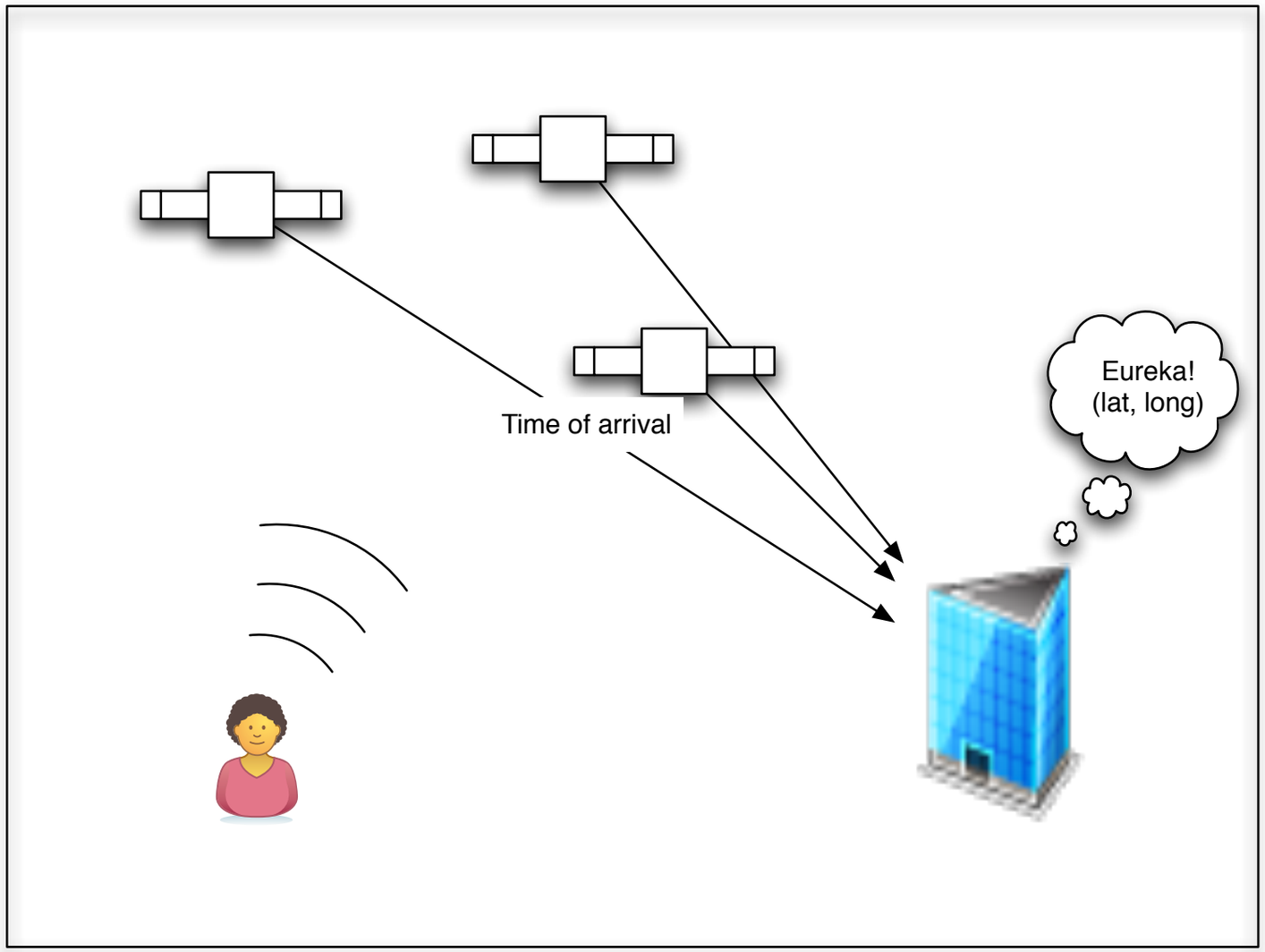
Bei-dou



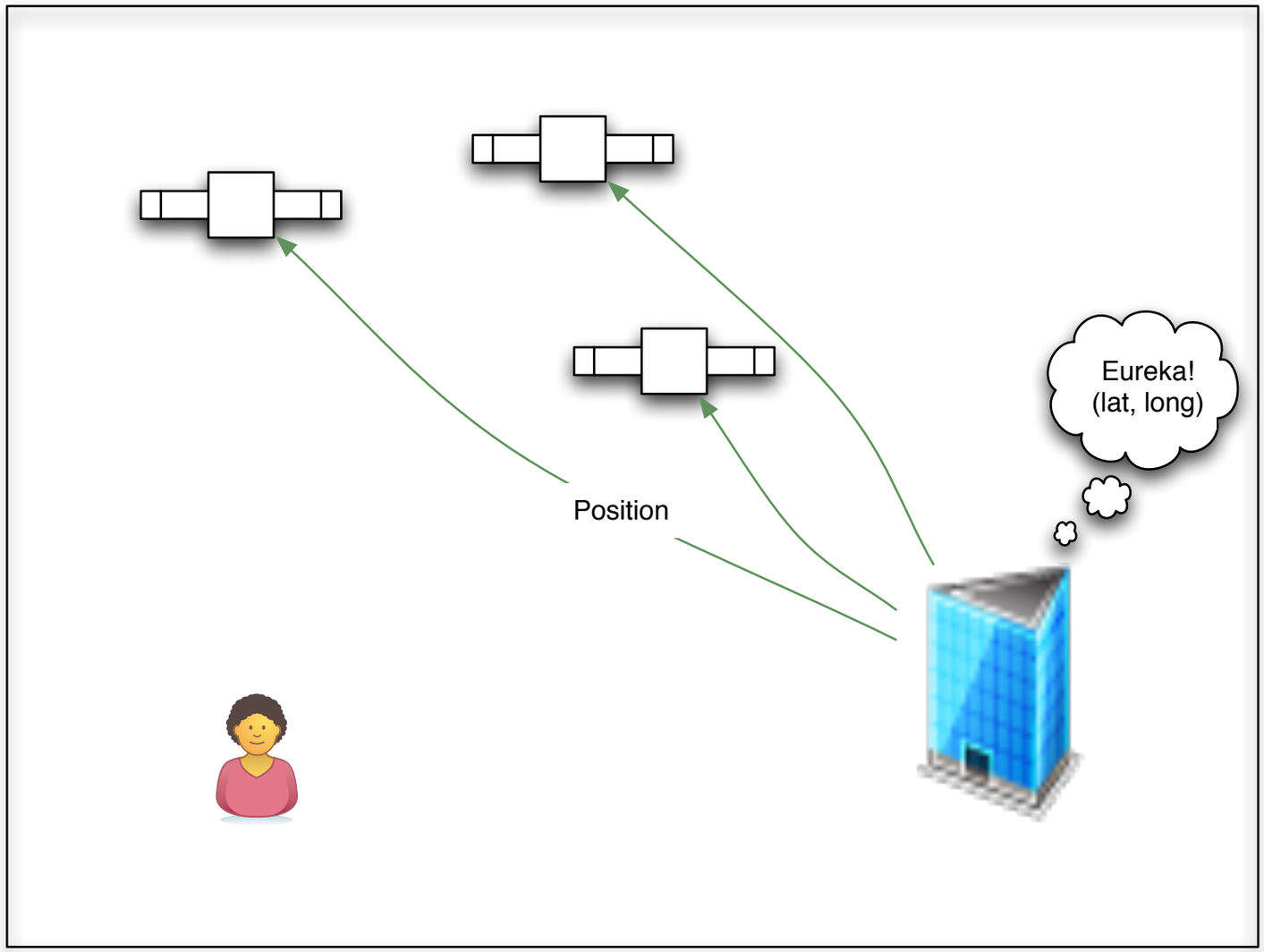
Bei-dou



Bei-dou



Bei-dou



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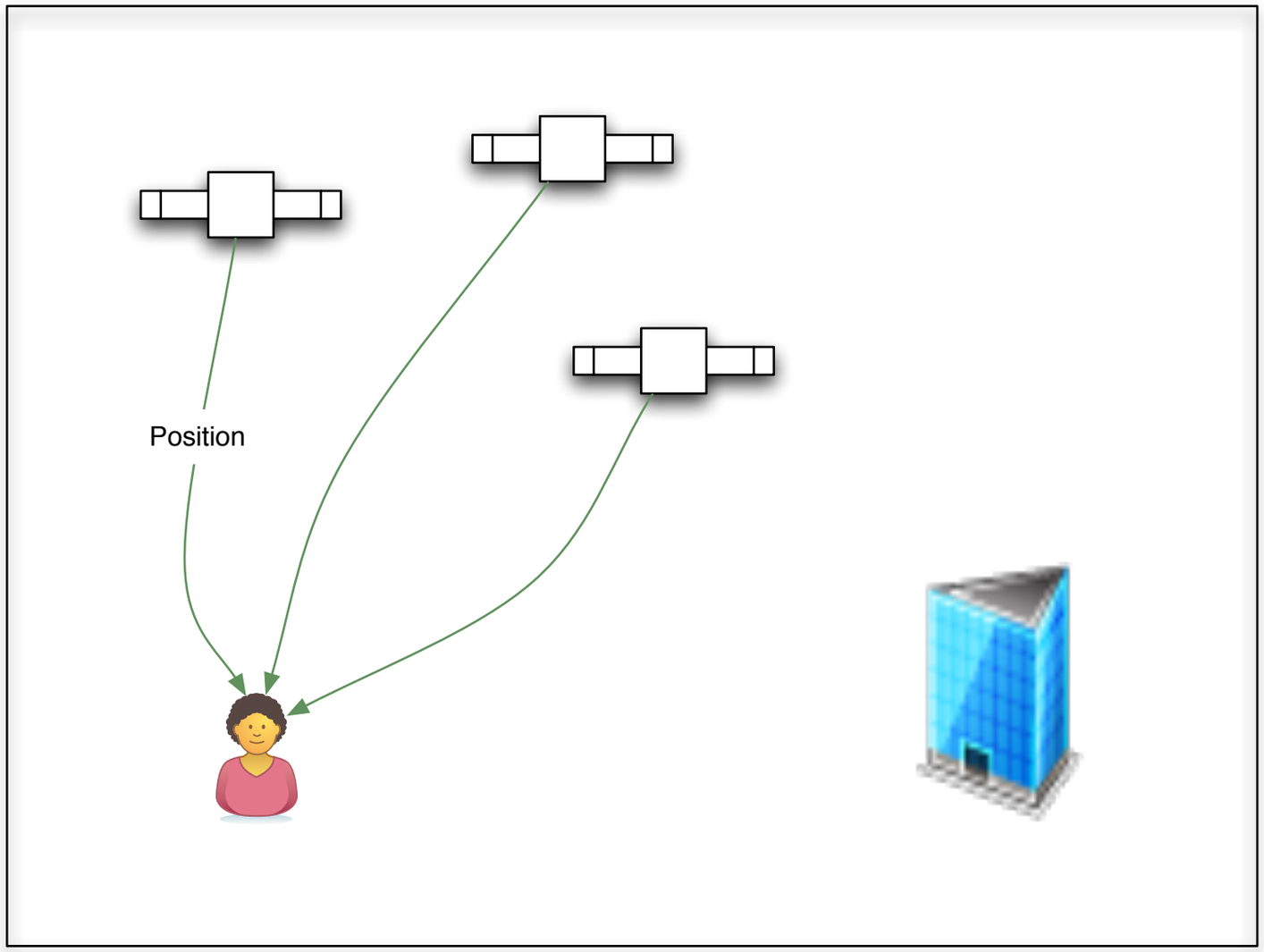

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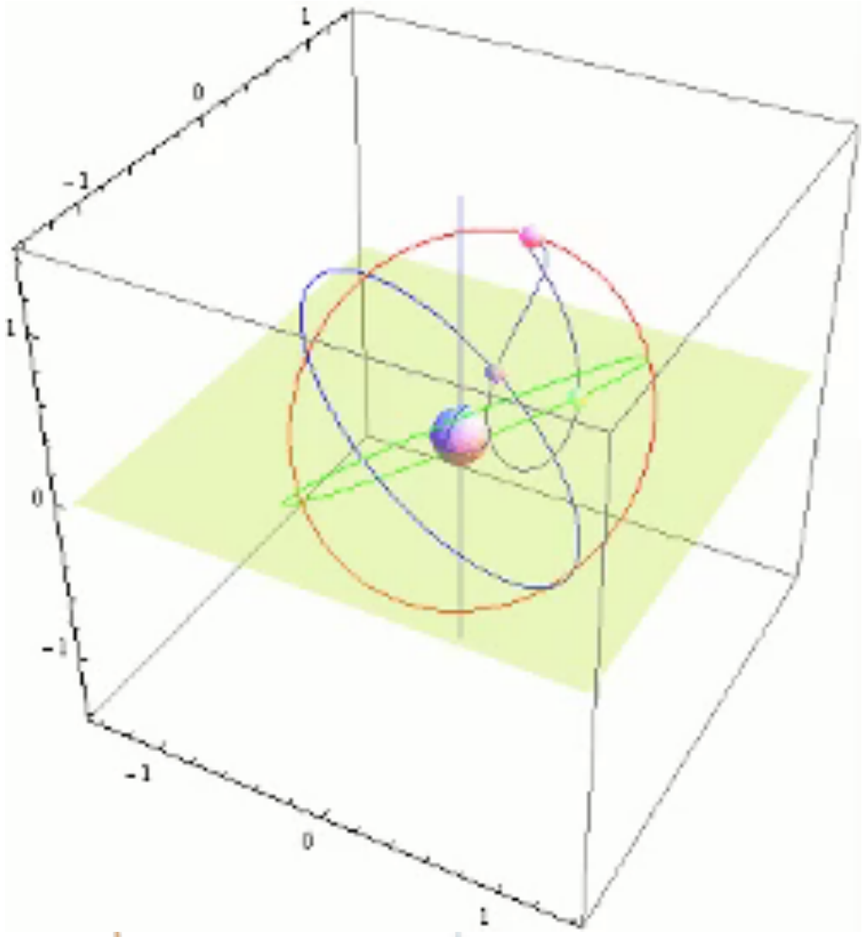
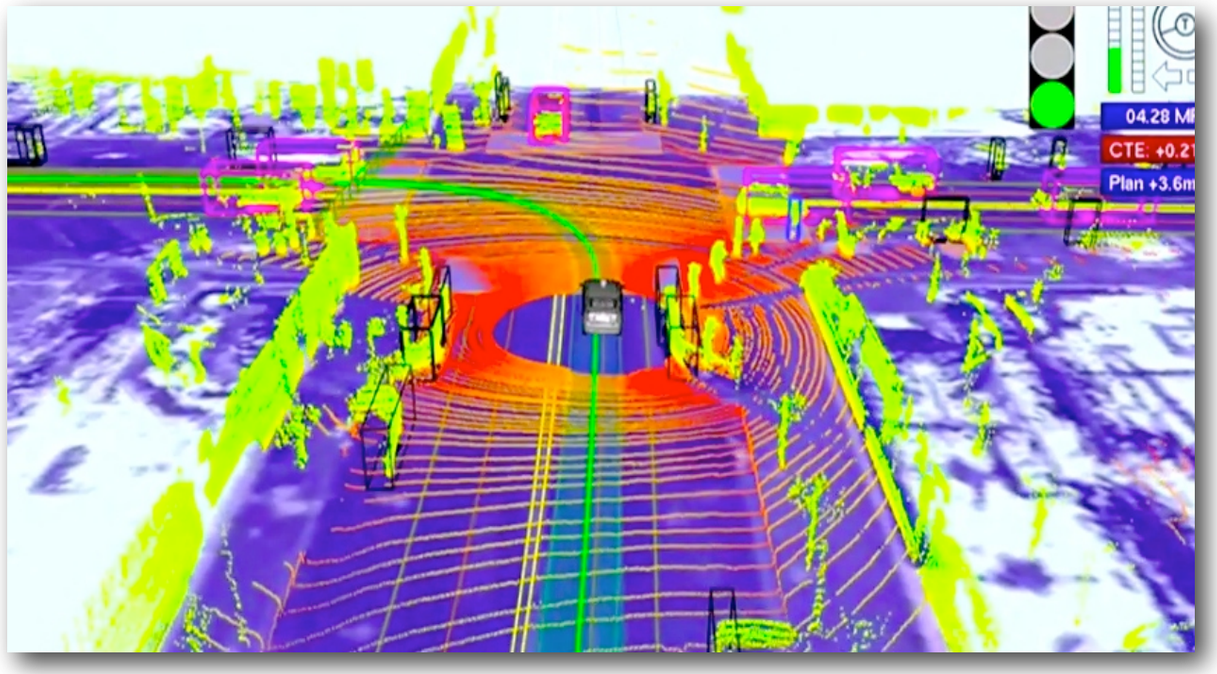
Global Location GPS

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



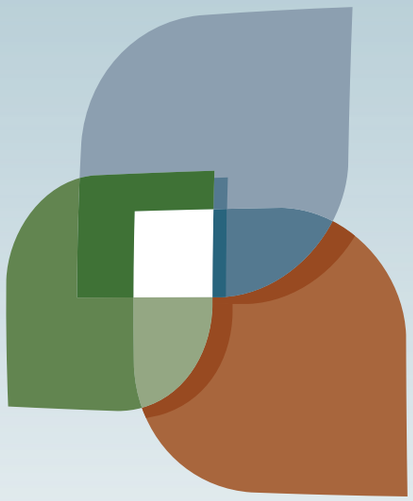
http://en.wikipedia.org/wiki/File:Qzss-45-0.09.jpg
http://en.wikipedia.org/wiki/File:Qzss-01-120s2.gif

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



LUCI