

# User Interaction: Intro to Location

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INF 133 Fall 2012



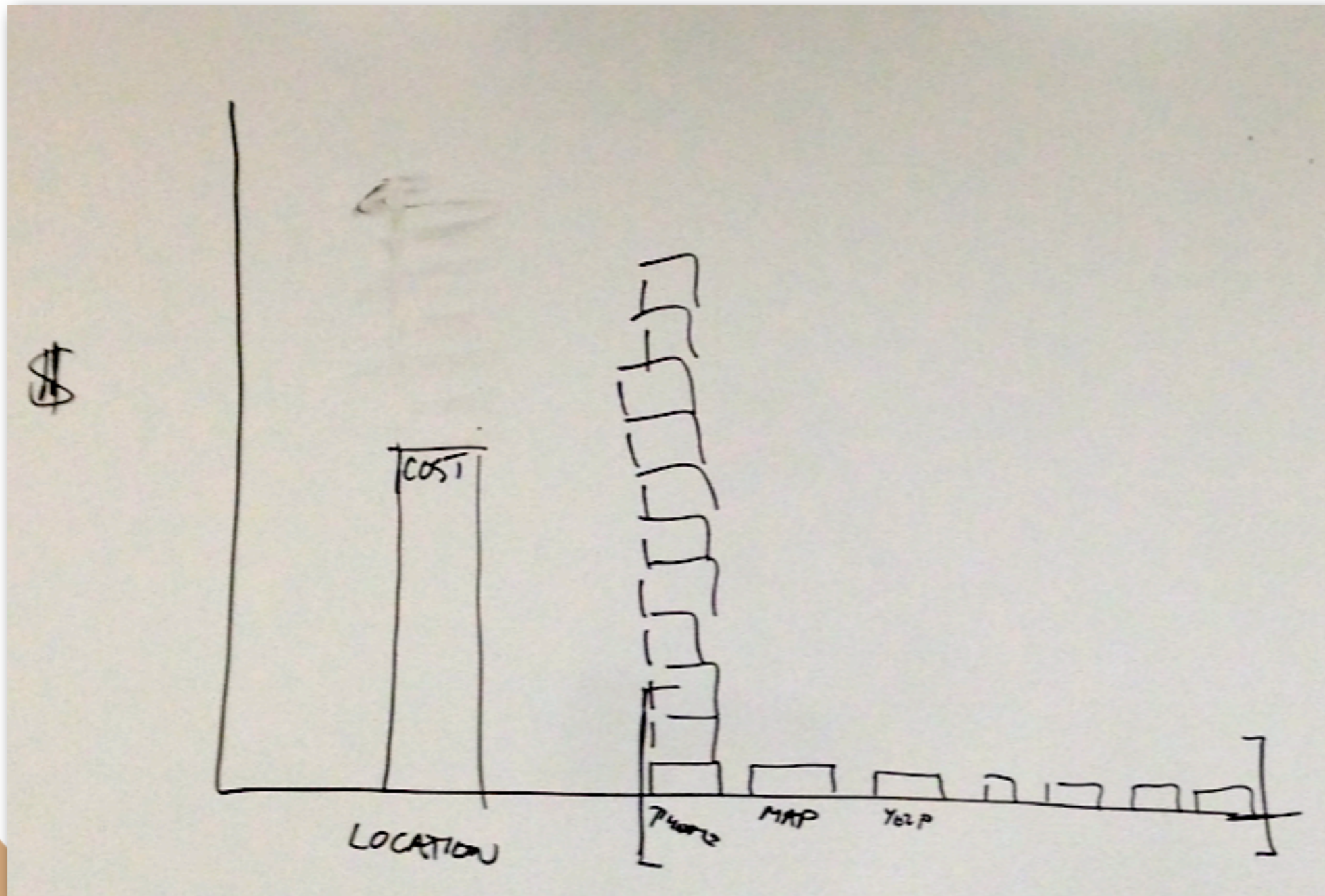
# Computing with Location

- Navigation
- Global Location
  - All things GPS
- Model-based localization vs. fingerprinting
  - Localization beyond GPS
- Beyond localization
  - Nomatic\*IM context



# Intro to Location

- The value of location vs the value of the killer app



## Tools for Navigation

- Navigation Tools
  - Clocks
  - Odometer
  - Electronic Aids
  - Radio navigation aids
    - ground-based
    - space-based



# Tools for Navigation



## Tools for Navigation

- Who calculates position?
  - User
  - 3rd party



# Tools for Navigation

- Who calculates position?
  - User
  - 3rd party
- What's the impact?



# Global Location GPS





# Global Location GPS

- Latitude and Longitude
  - What are they?
  - Datum

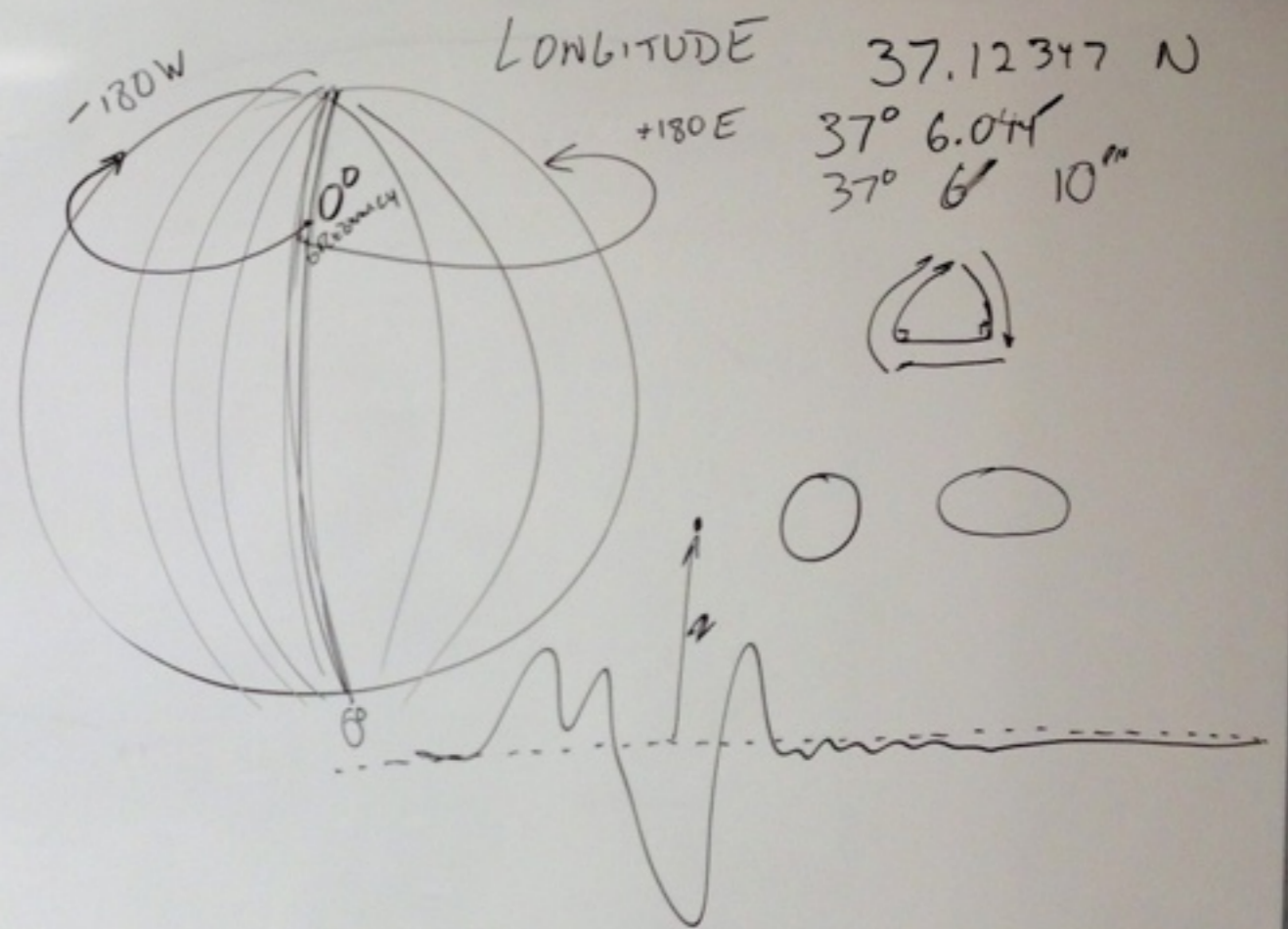
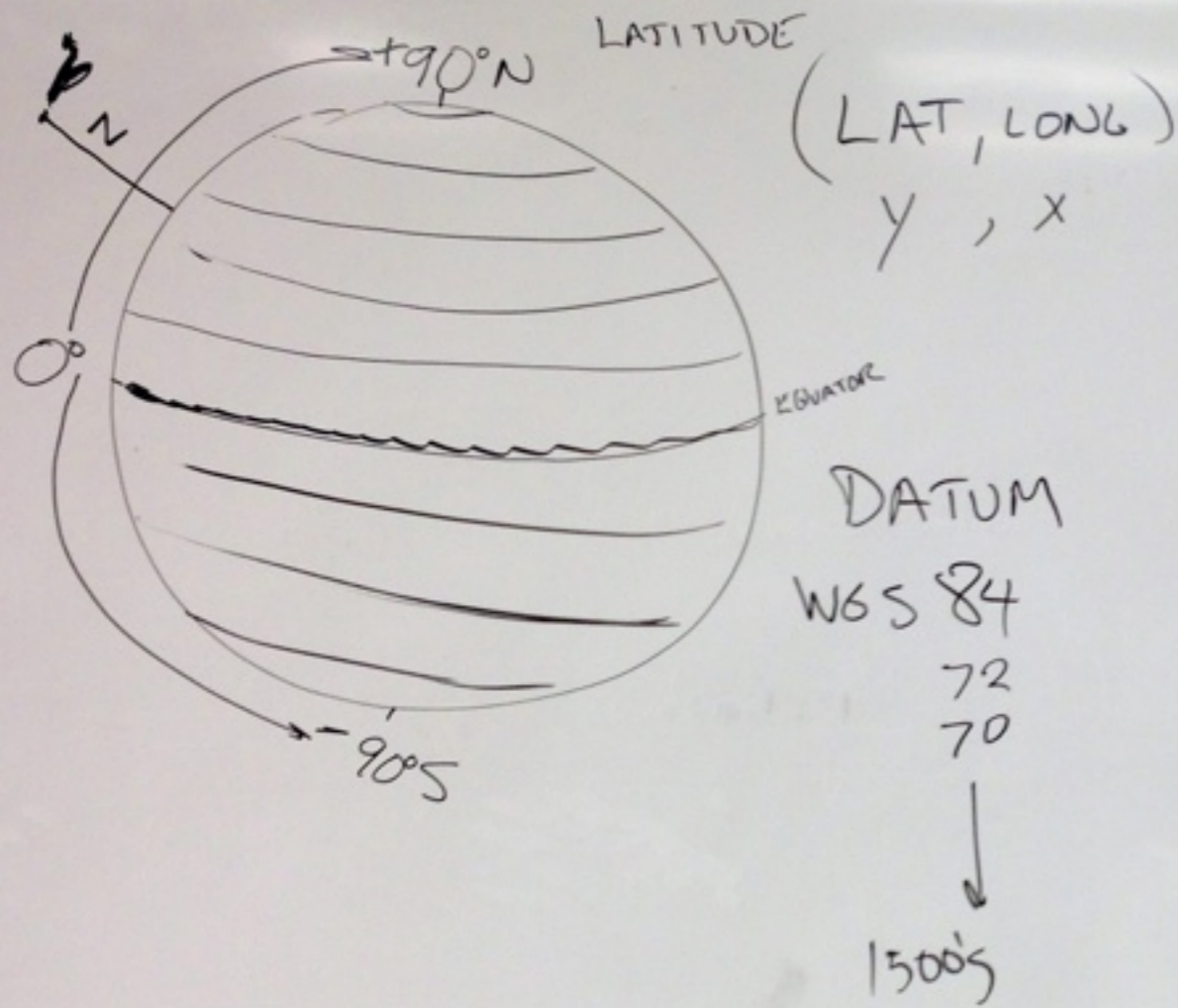


# Intro to Location

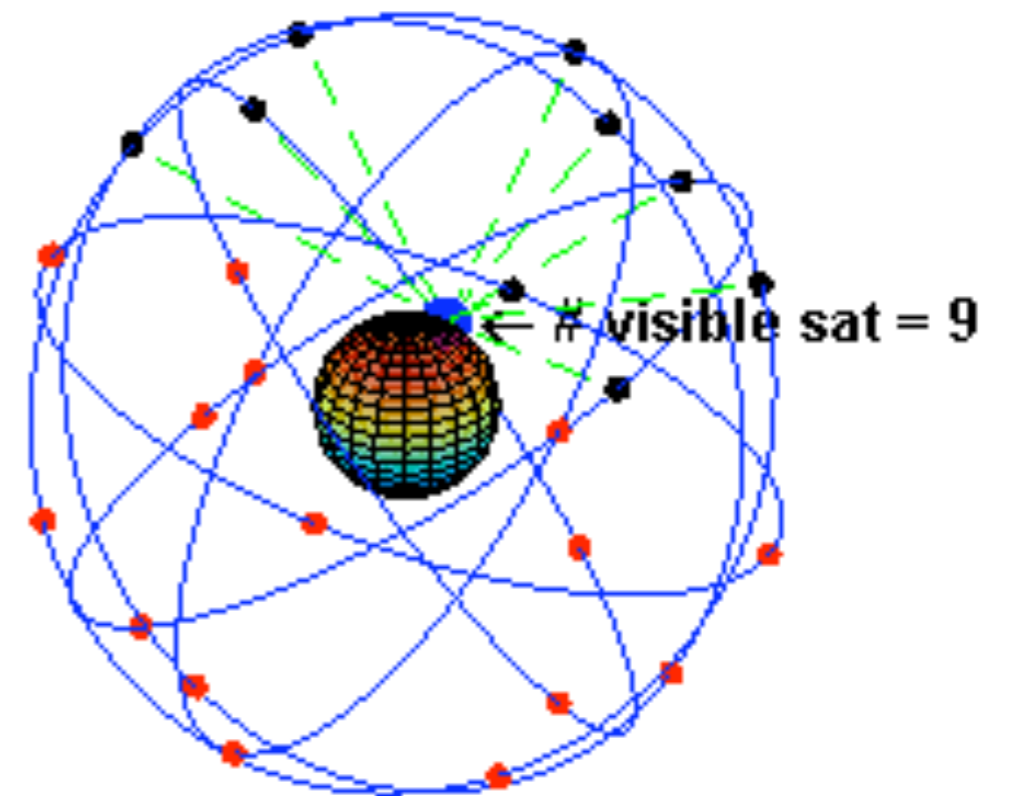
- Describe Lat,Long
  - $(x,y)$
- Datum
  - mean
  - earth models



## Global Location GPS

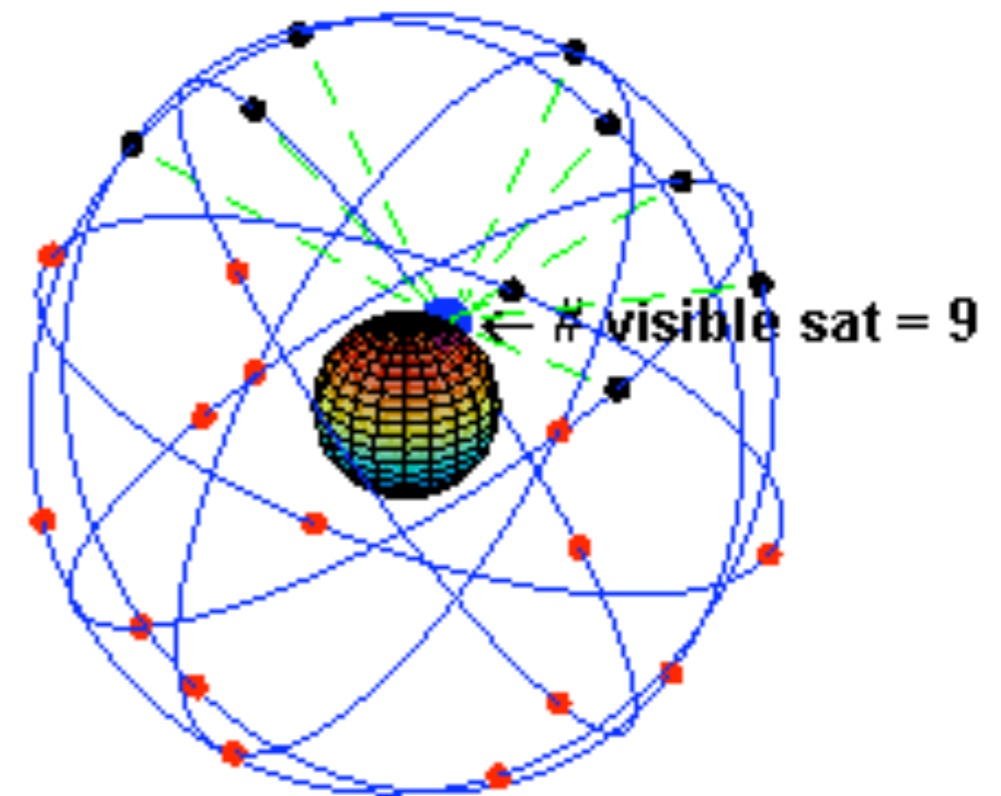


# Global Location GPS



## 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 planes
- 4 satellites per plane
- not geosynchronous
- world-wide monitoring stations



# Global Location GPS



# 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





# Global Location GPS

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



# Global Location GPS



# 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



Flickr:mafleen,greenstorm,templarion

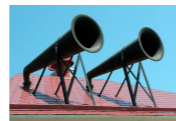
# Global Location GPS

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



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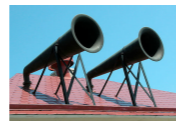
## Global Location GPS



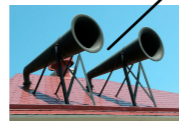
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## Global Location GPS



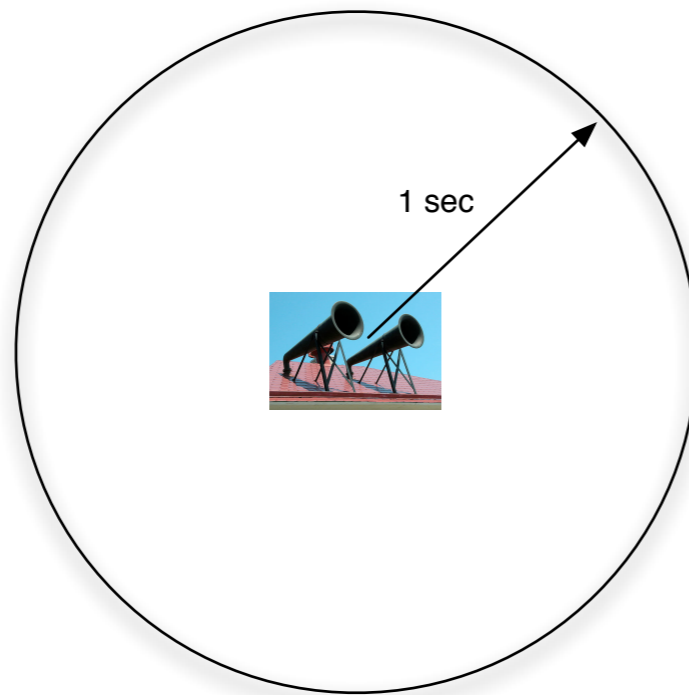
1 sec



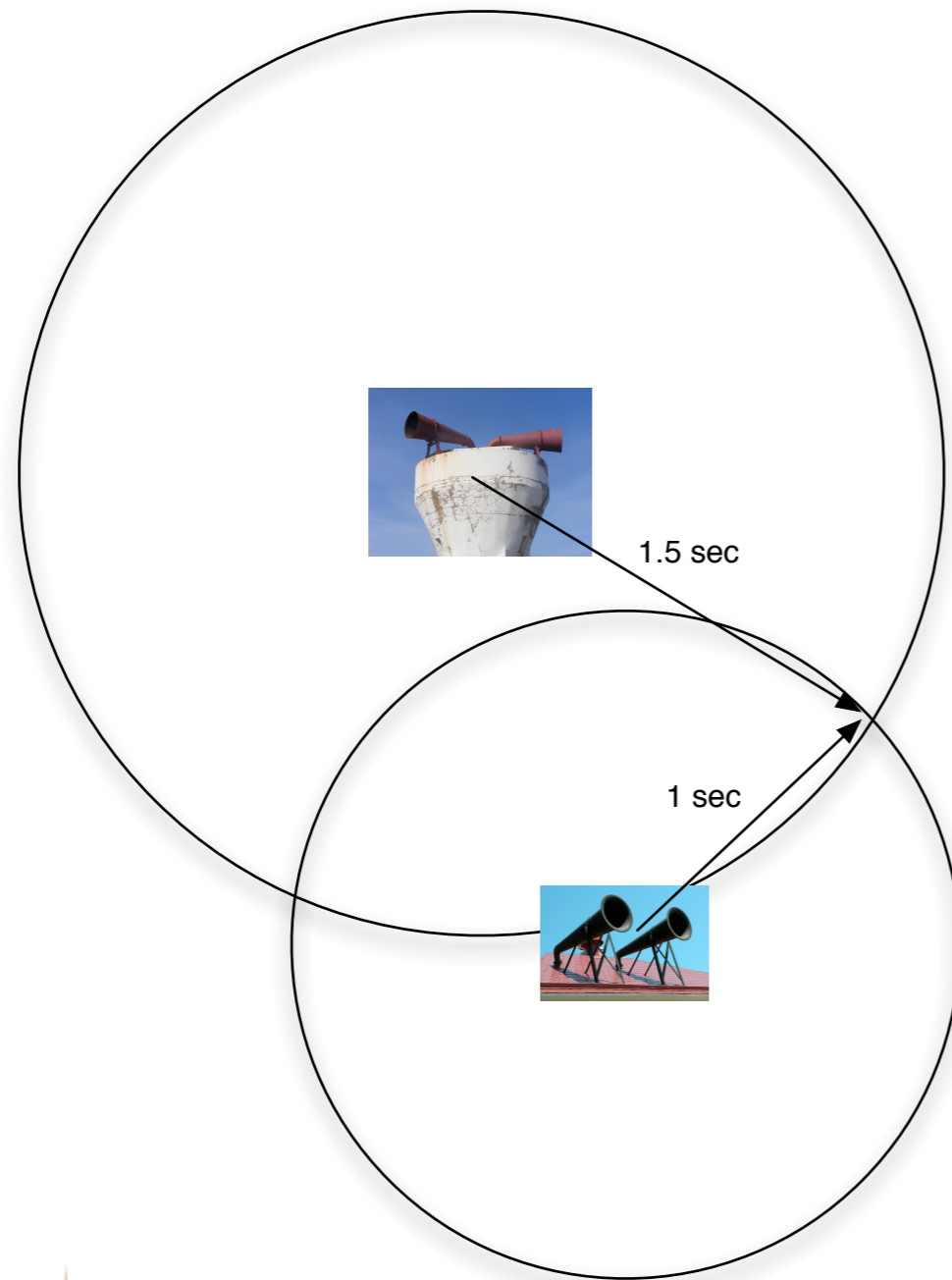
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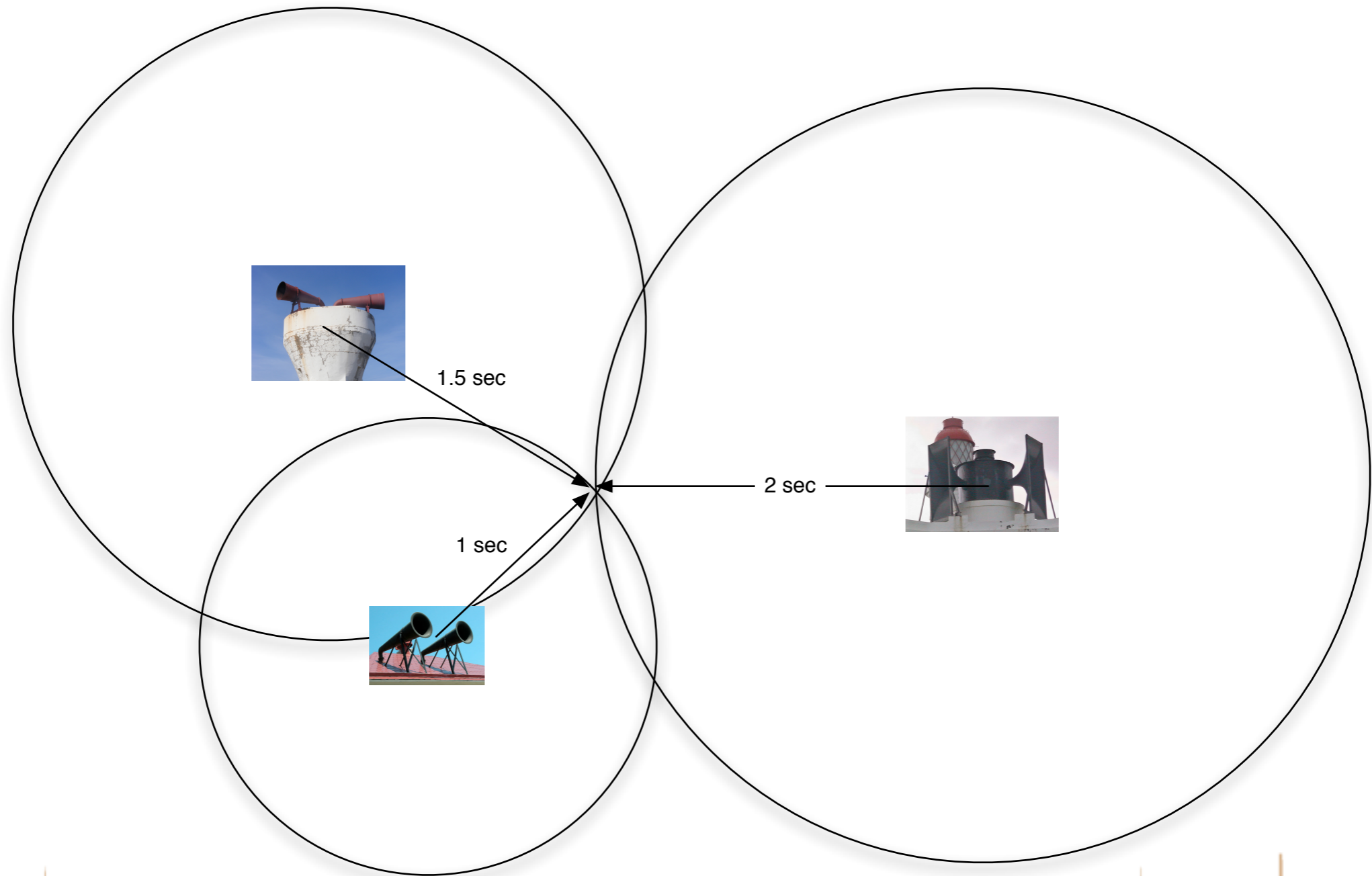
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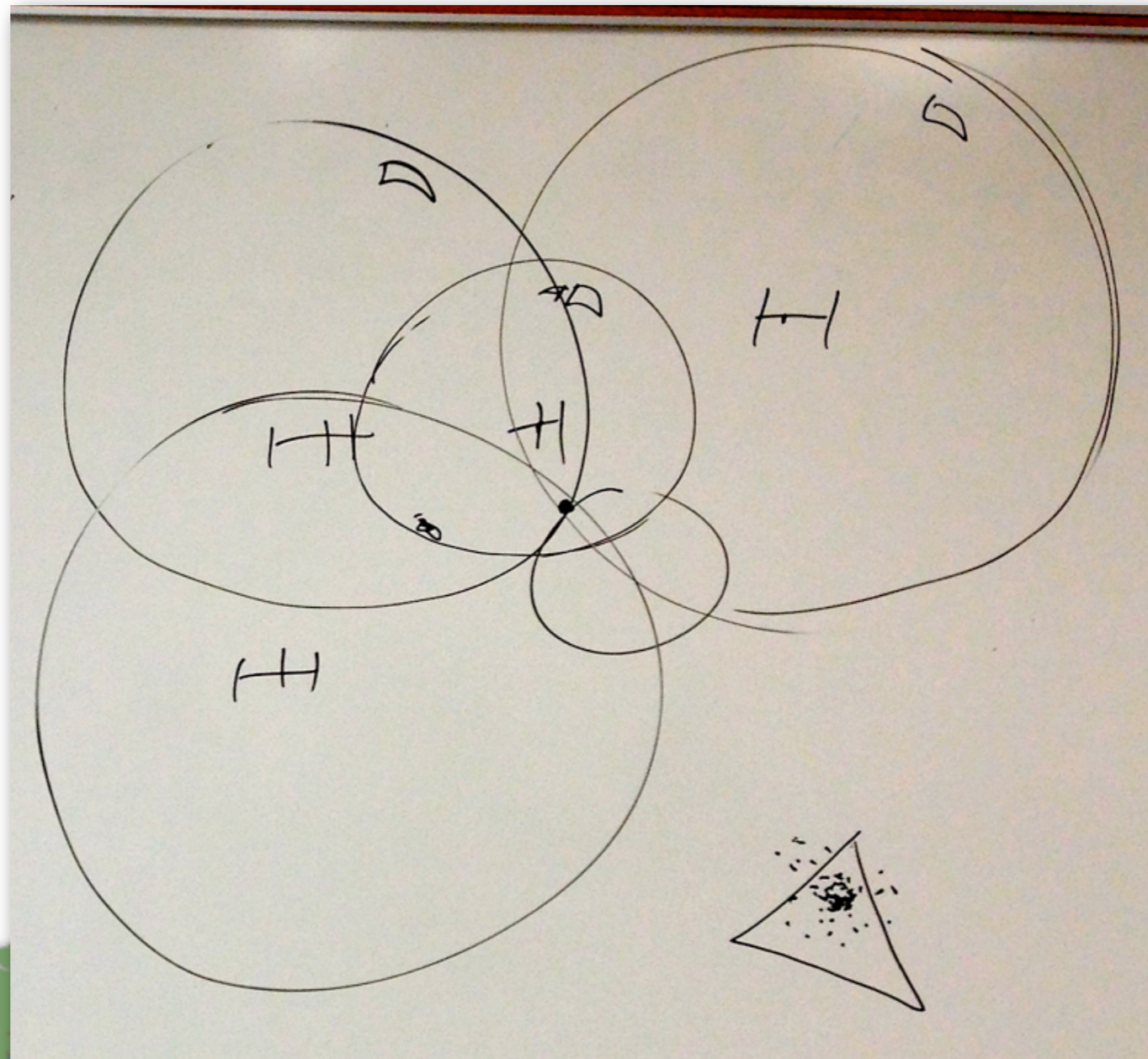
## Global Location GPS



# Global Location GPS

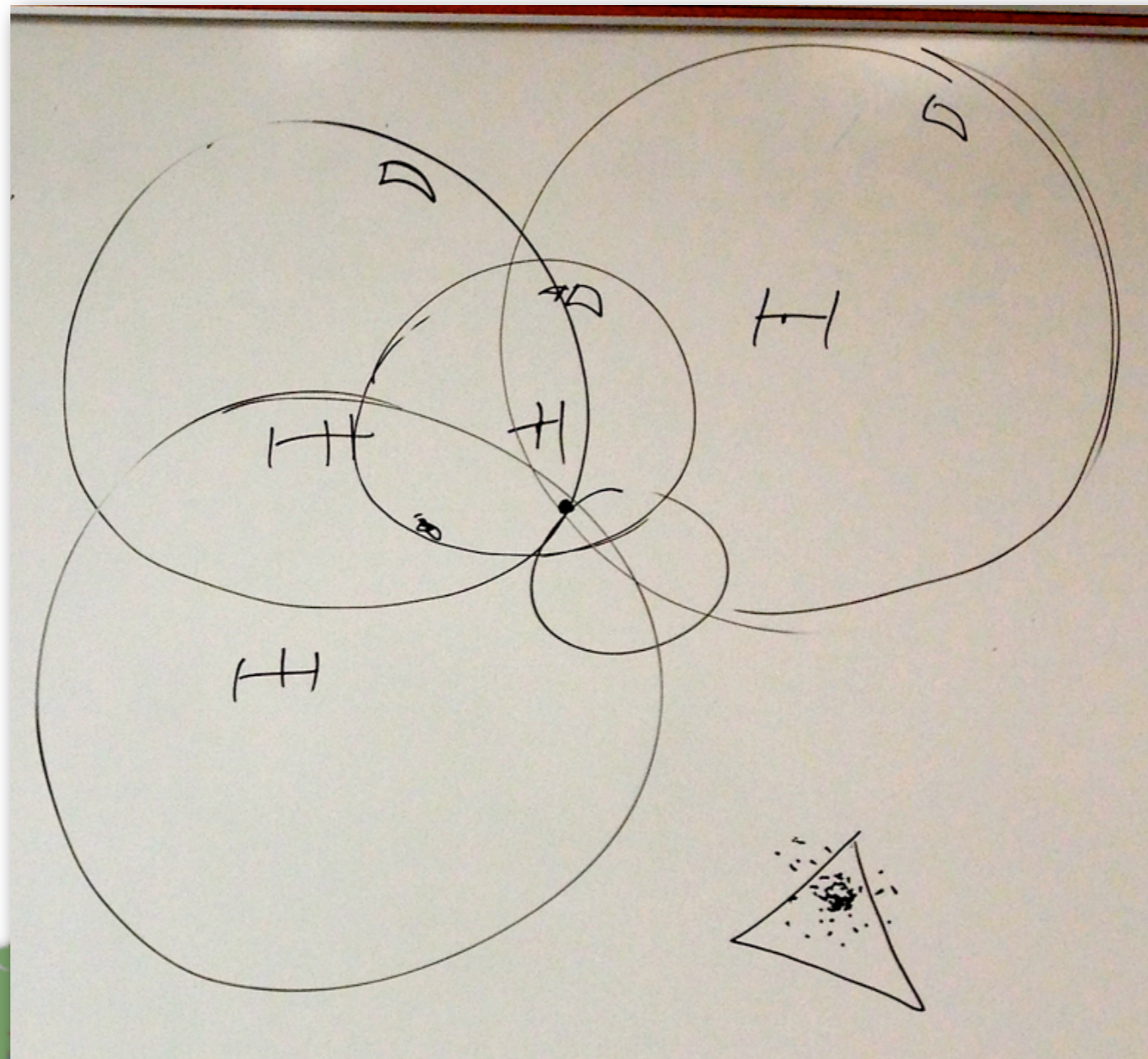


# Global Location GPS



## Global Location GPS

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  - but in 3-D



# Global Location GPS



# 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





# 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?

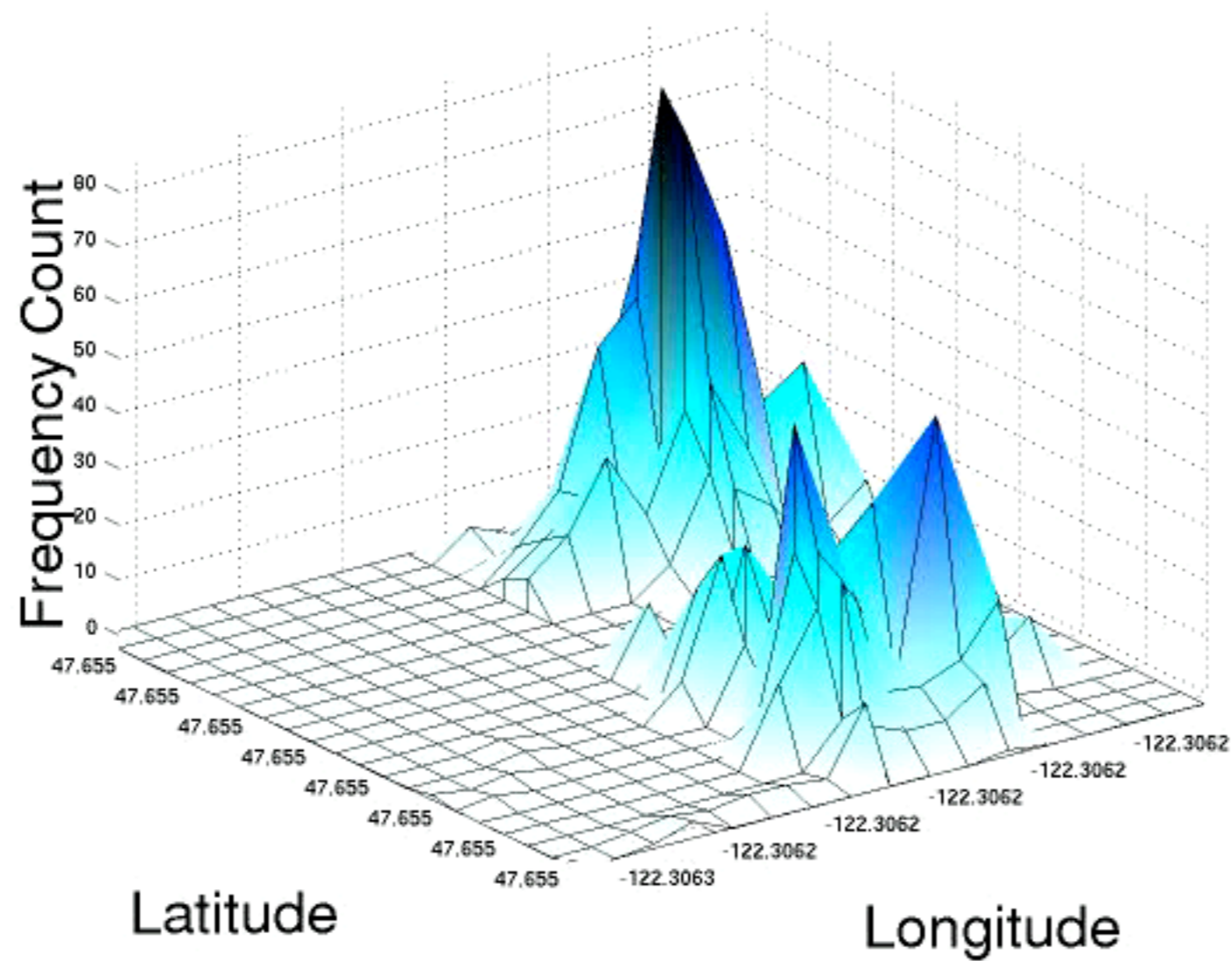


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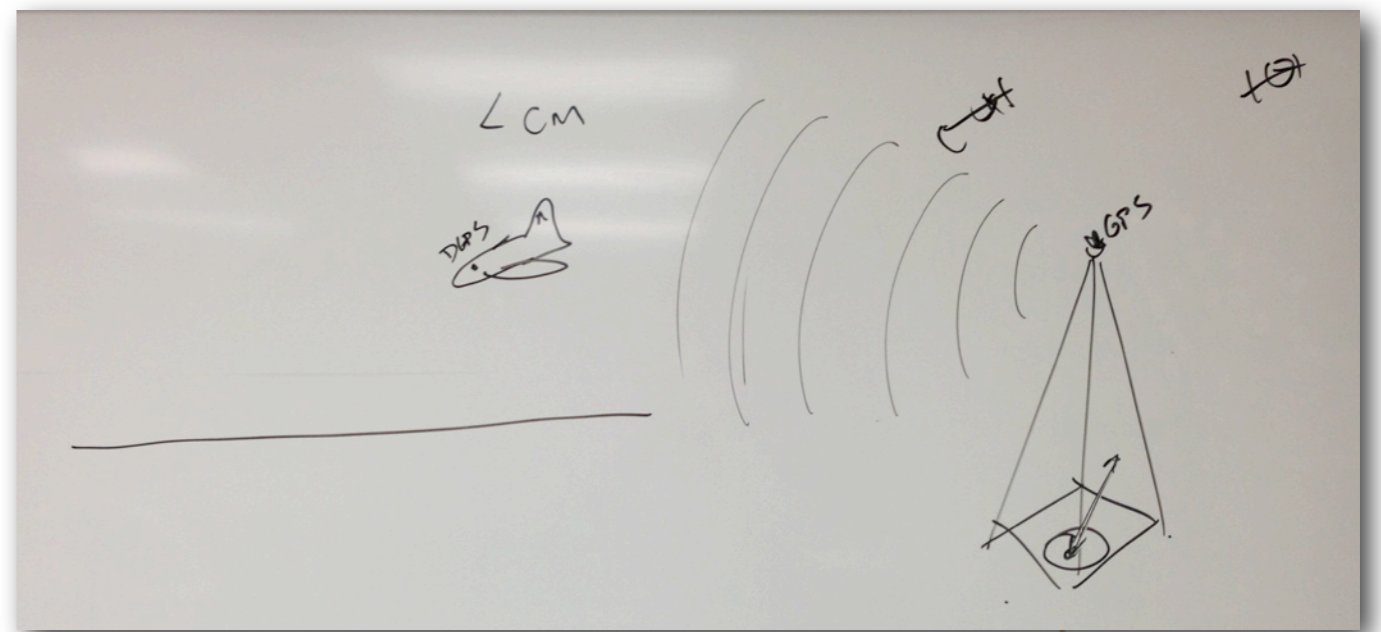
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  - 13 m 95% of the time horizontal
  - 22 m 95% of the time vertical system
  - 40 ns 95% of the time
  - How do you design for this?
- Urban canyons
  - What are they?
  - Japanese response, European response



# Global Location GPS

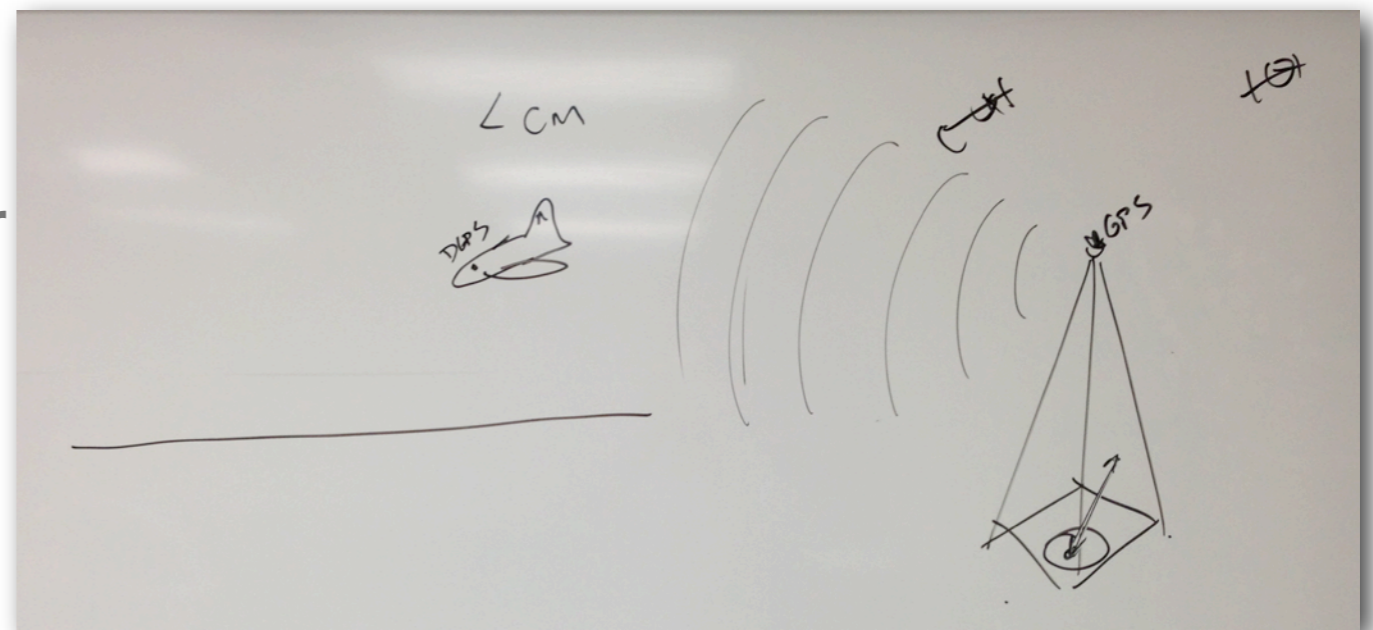


## Global Location GPS



## 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



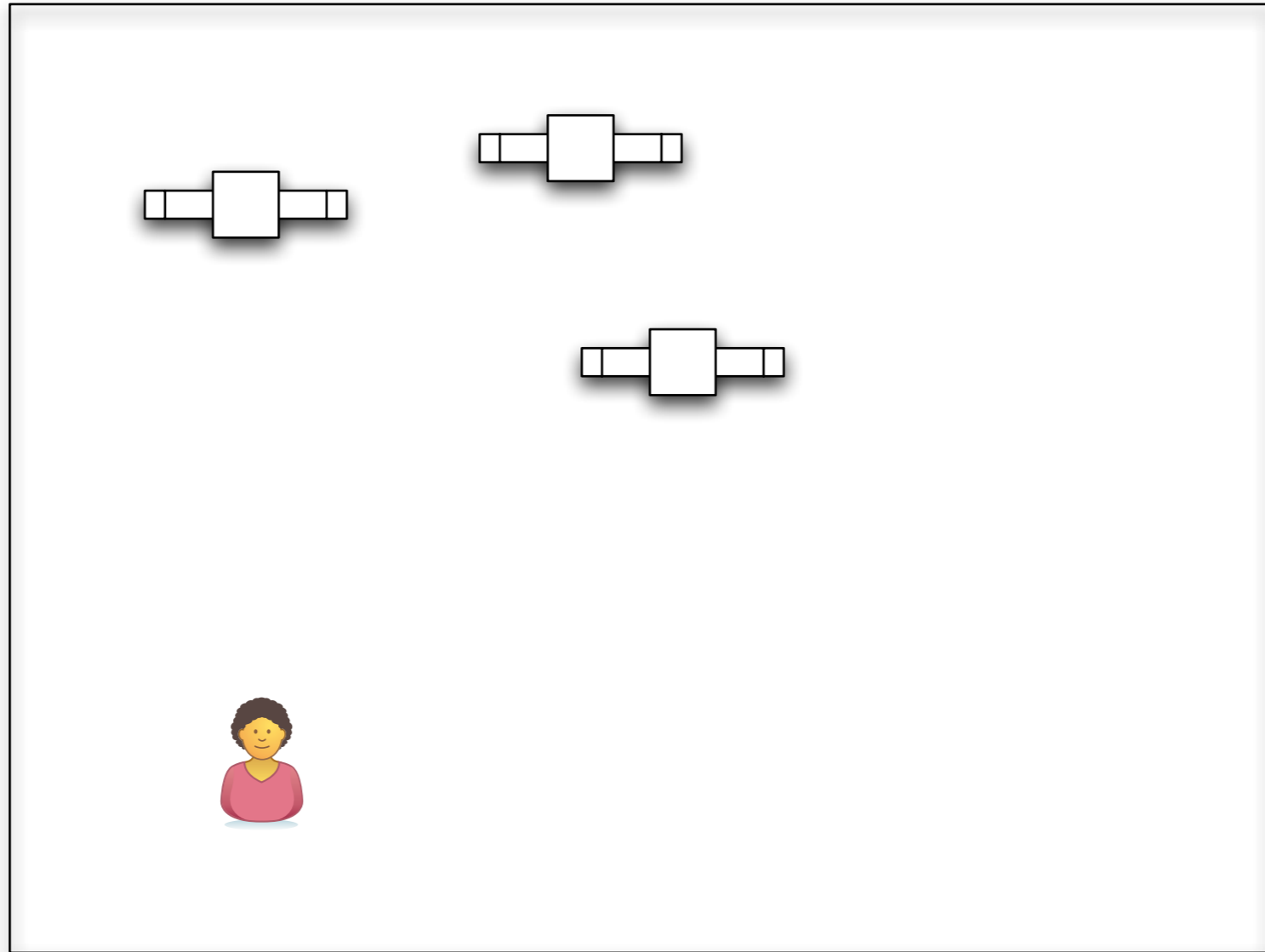
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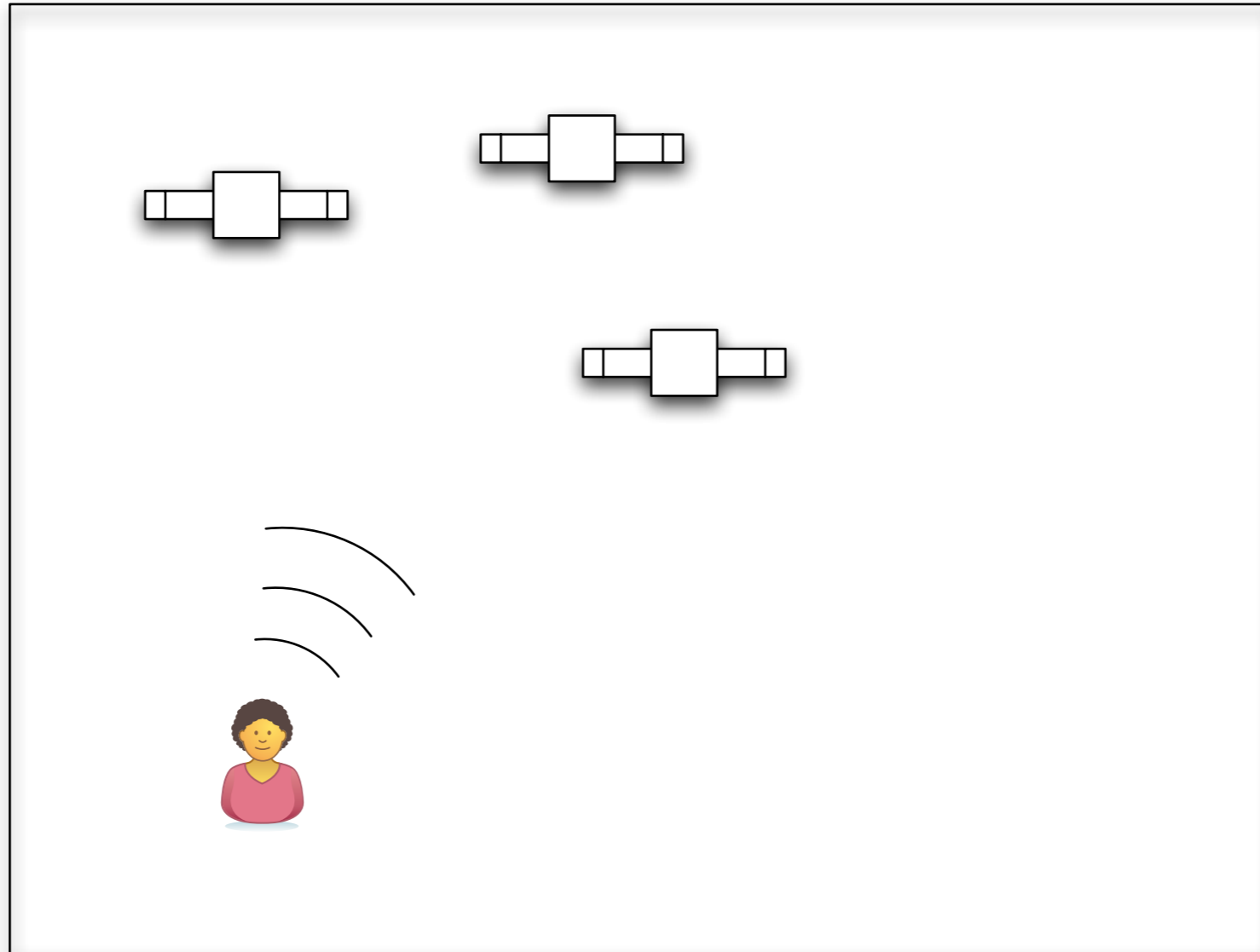
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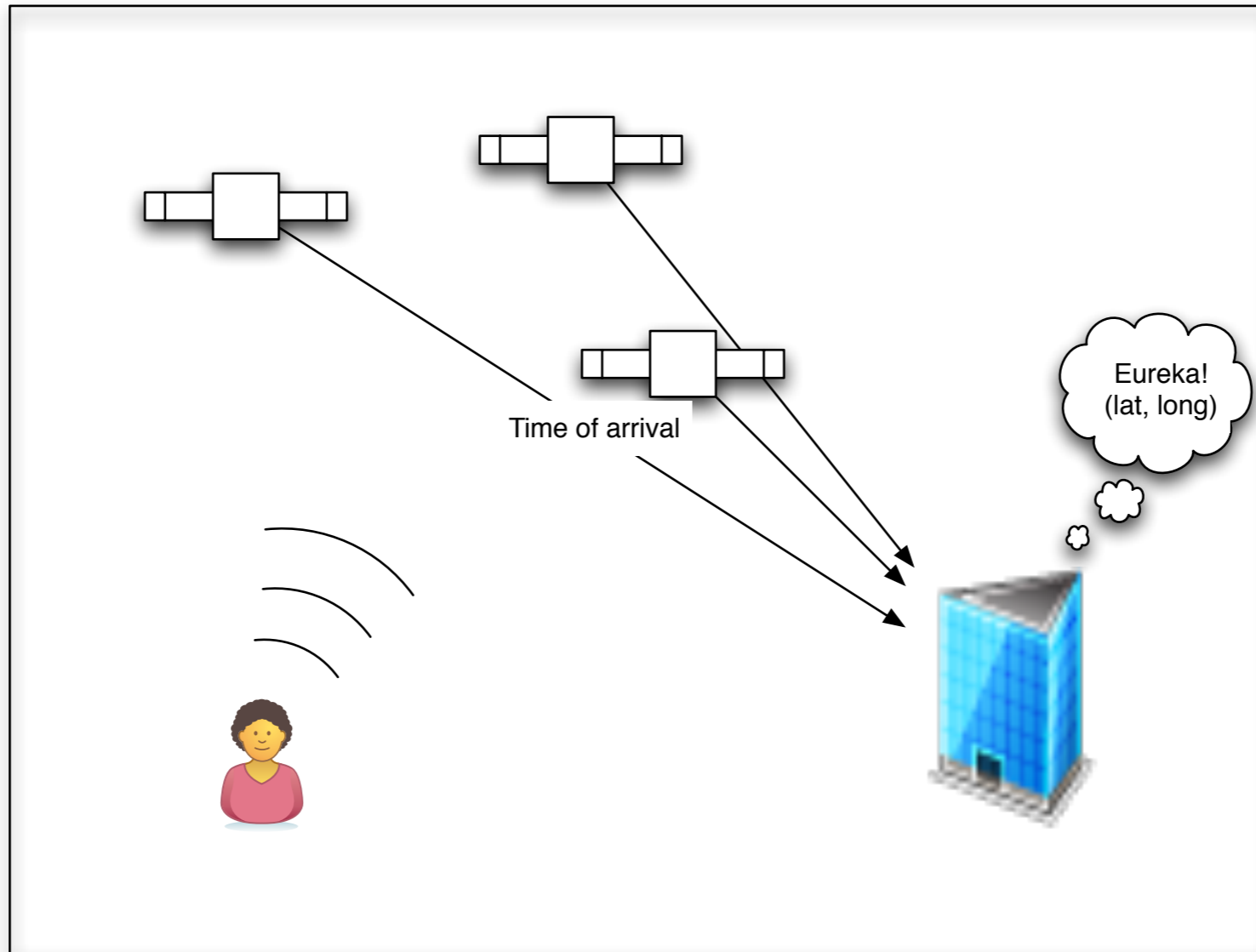
- The current and future of GPS
  - BeiDou
    - Chinese competitor
    - centralized system

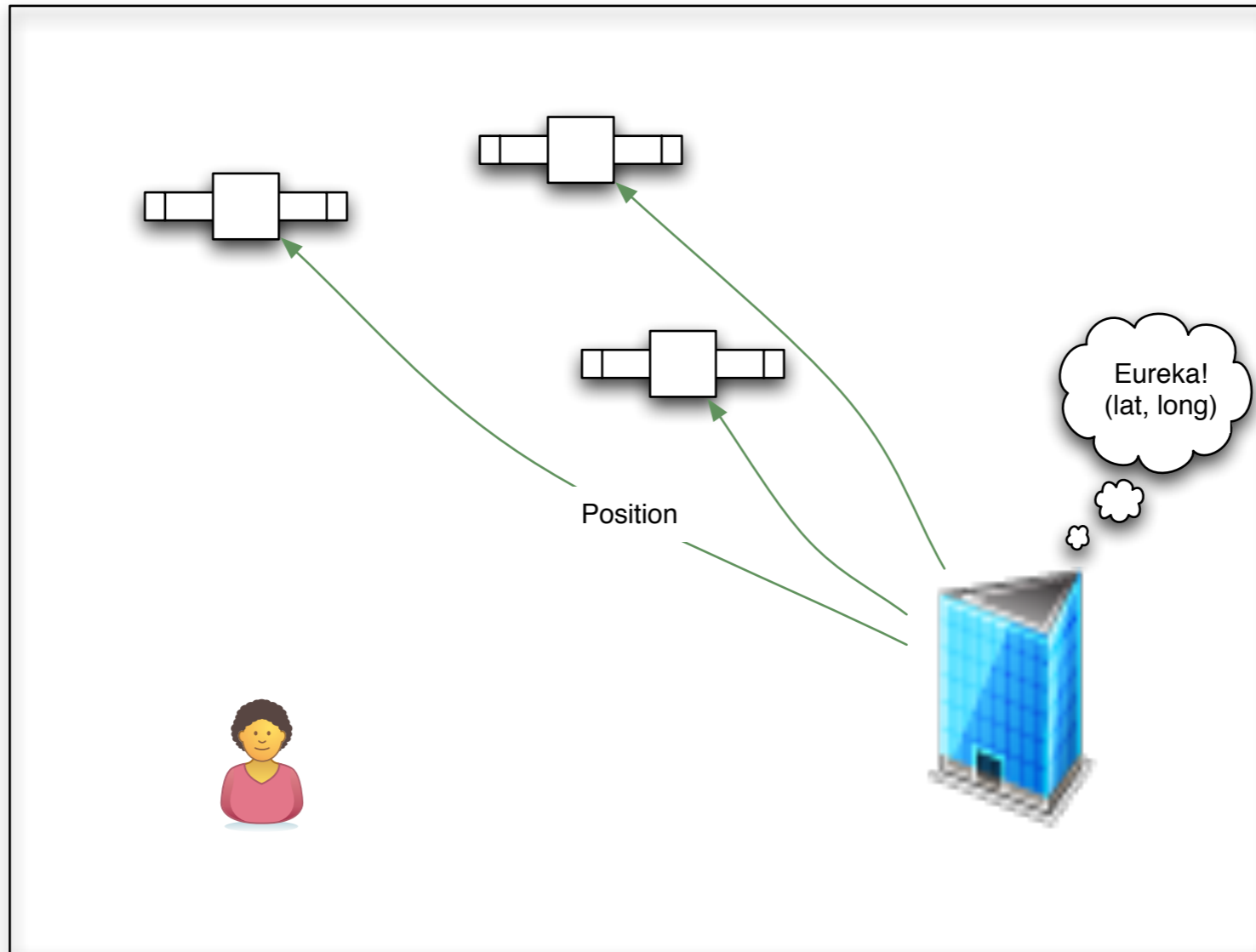


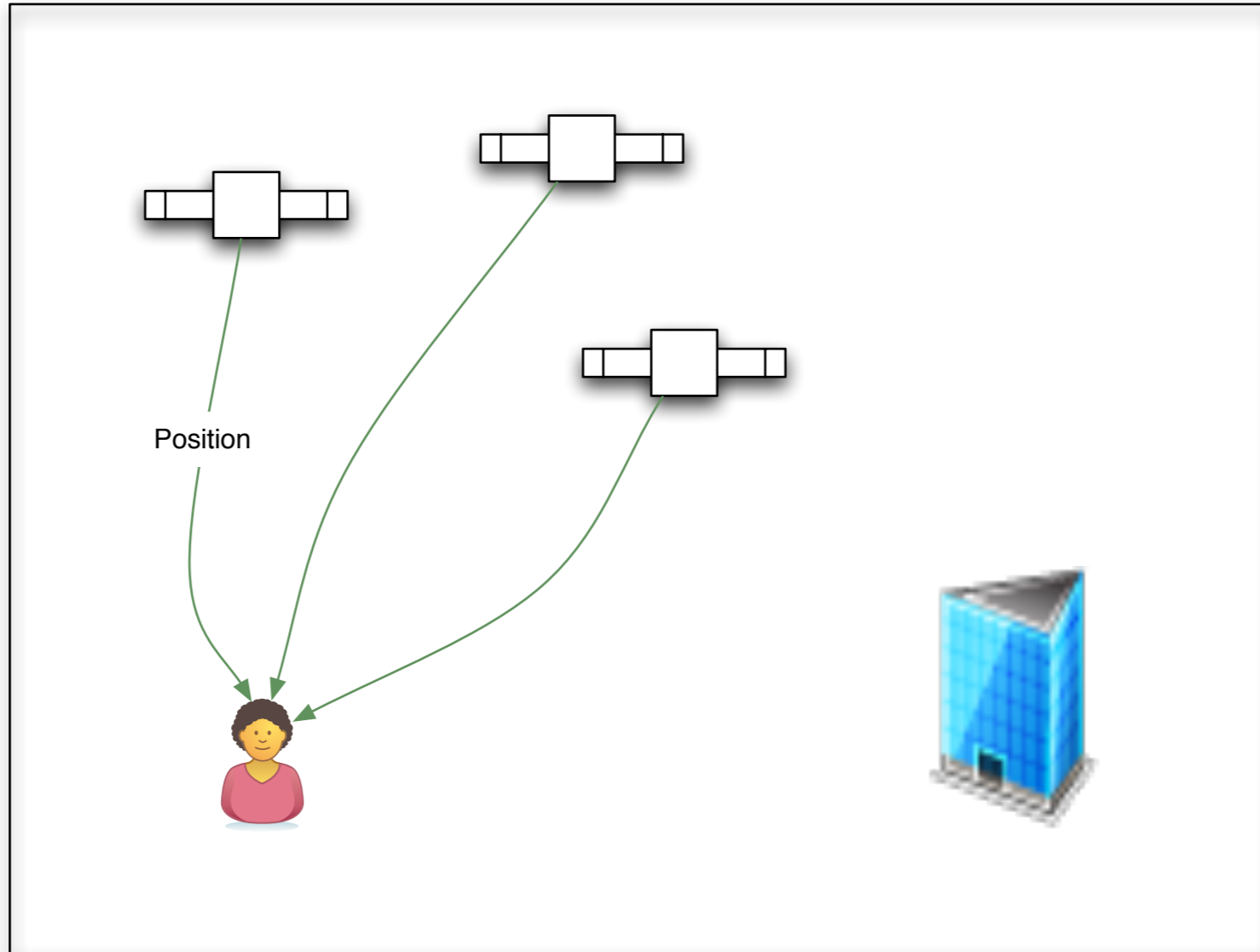












# Intro to Location



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  - security of users?
  - reliability?
  - implications on device?



# Global Location GPS



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

# Global Location GPS

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



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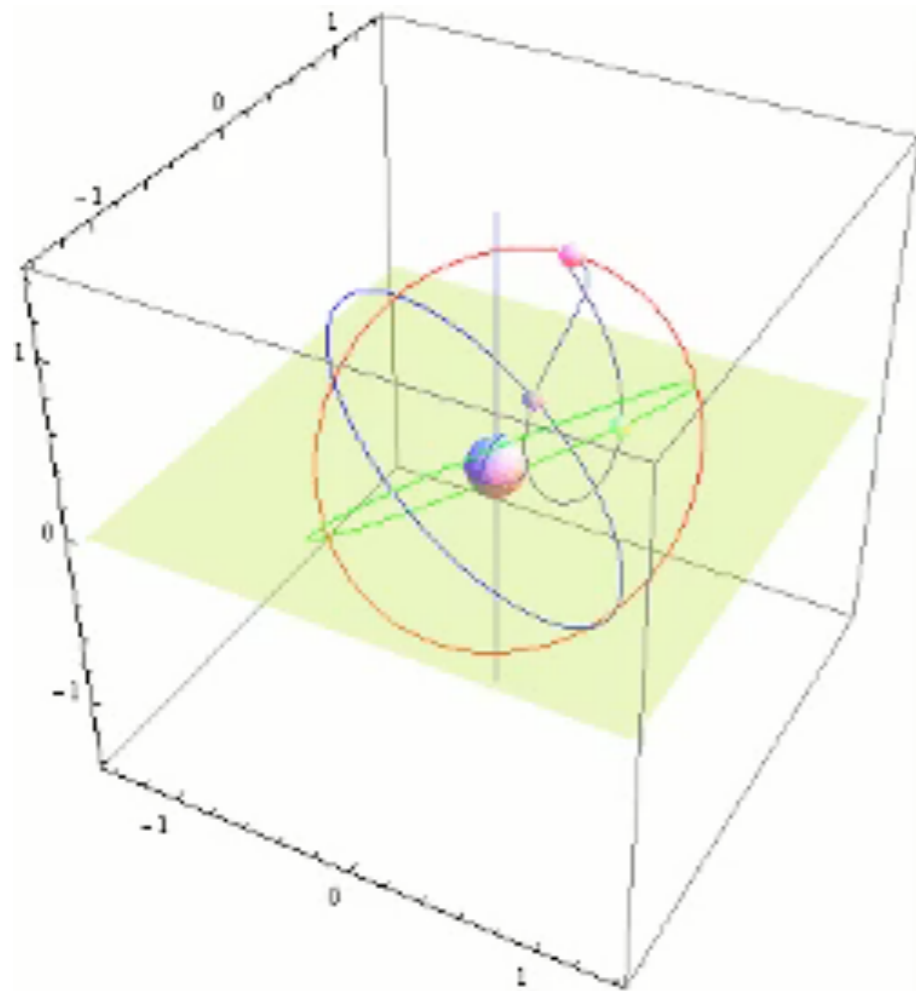
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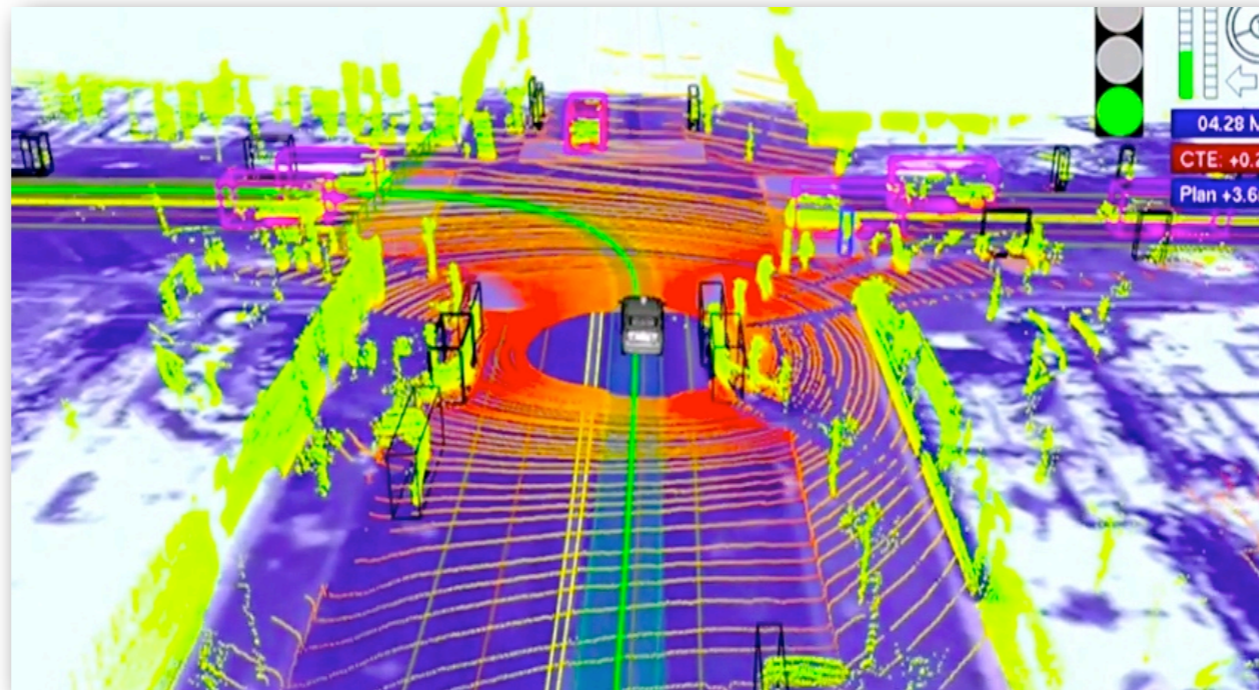


## Global Location GPS

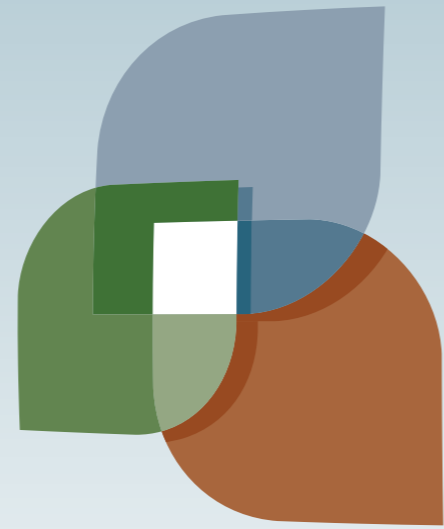
- The current and future of GPS
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# Google's self-driving car



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.



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