User Interaction: Intro to Location

Asst. Professor Donald J. Patterson
INF 133 Fall 2010

Computing with Location

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

Tools for Navigation

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

Flickr:erica_marshall,darrenhester,maliciousmonkey

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?

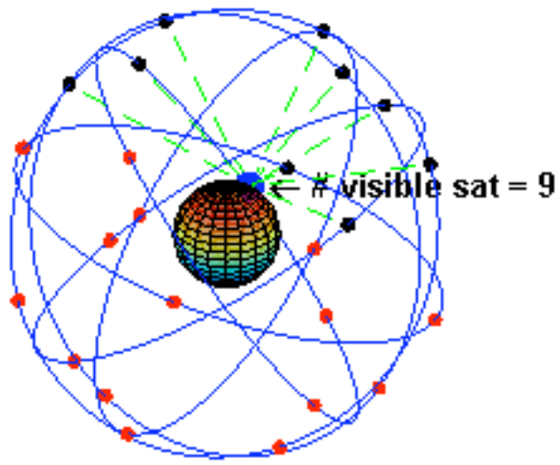
Global Location GPS

Flickr: akash_k

Global Location GPS

- Latitude and Longitude
  - What are they?
  - Datum

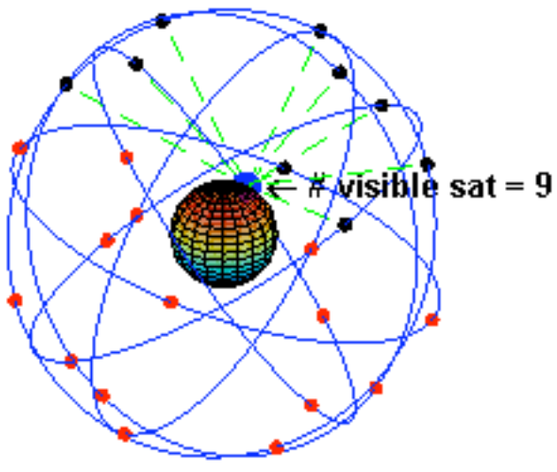
Global Location GPS



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

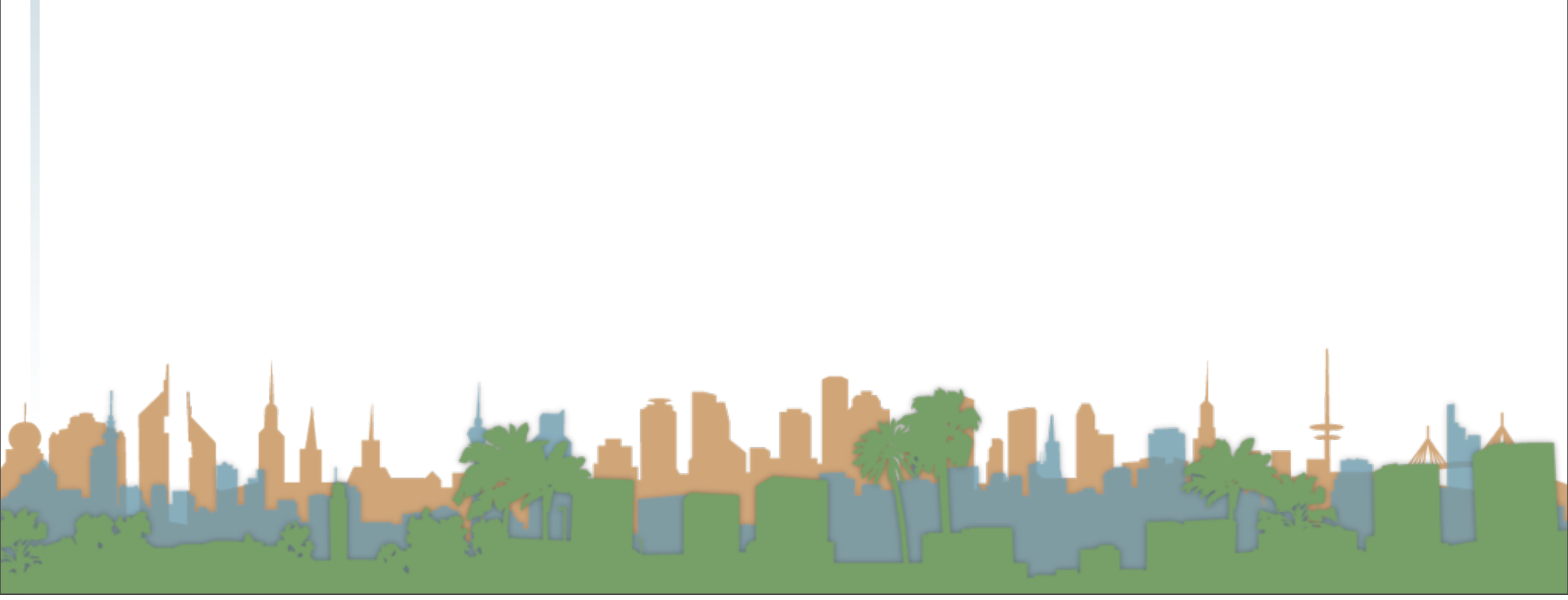
Global Location GPS

- 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

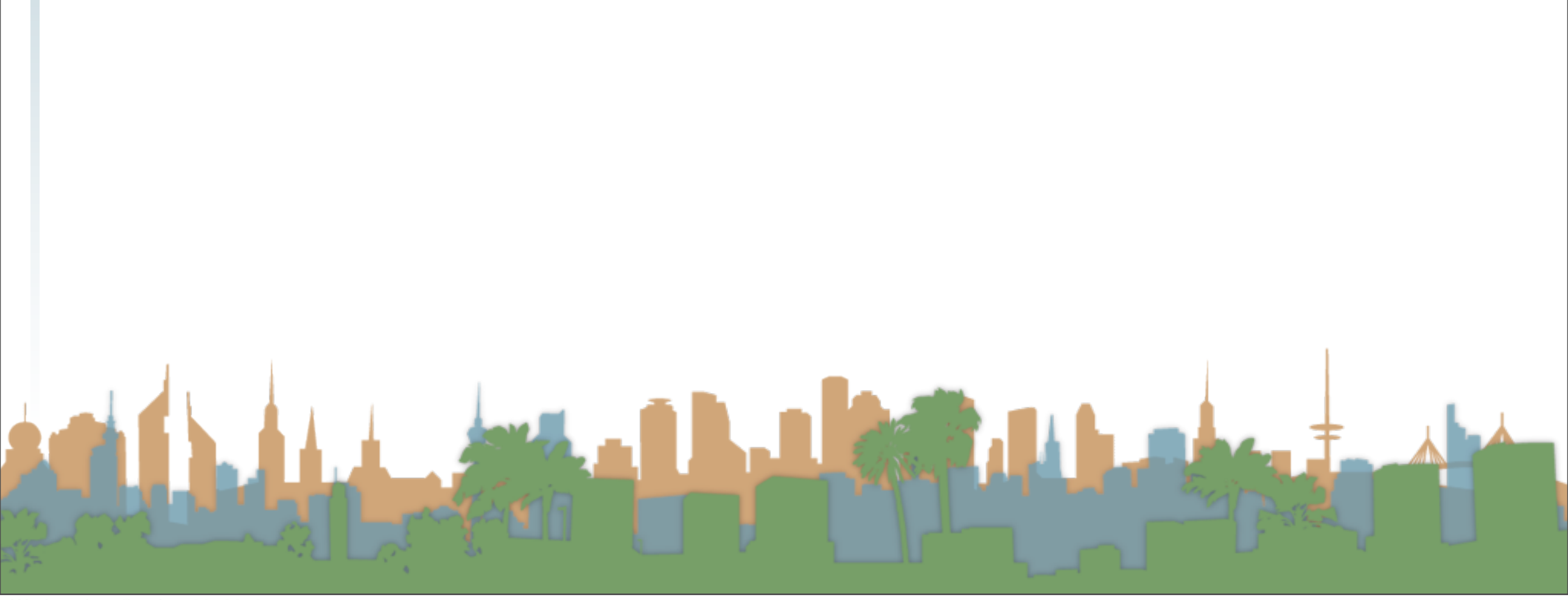
Global Location GPS



Global Location GPS

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

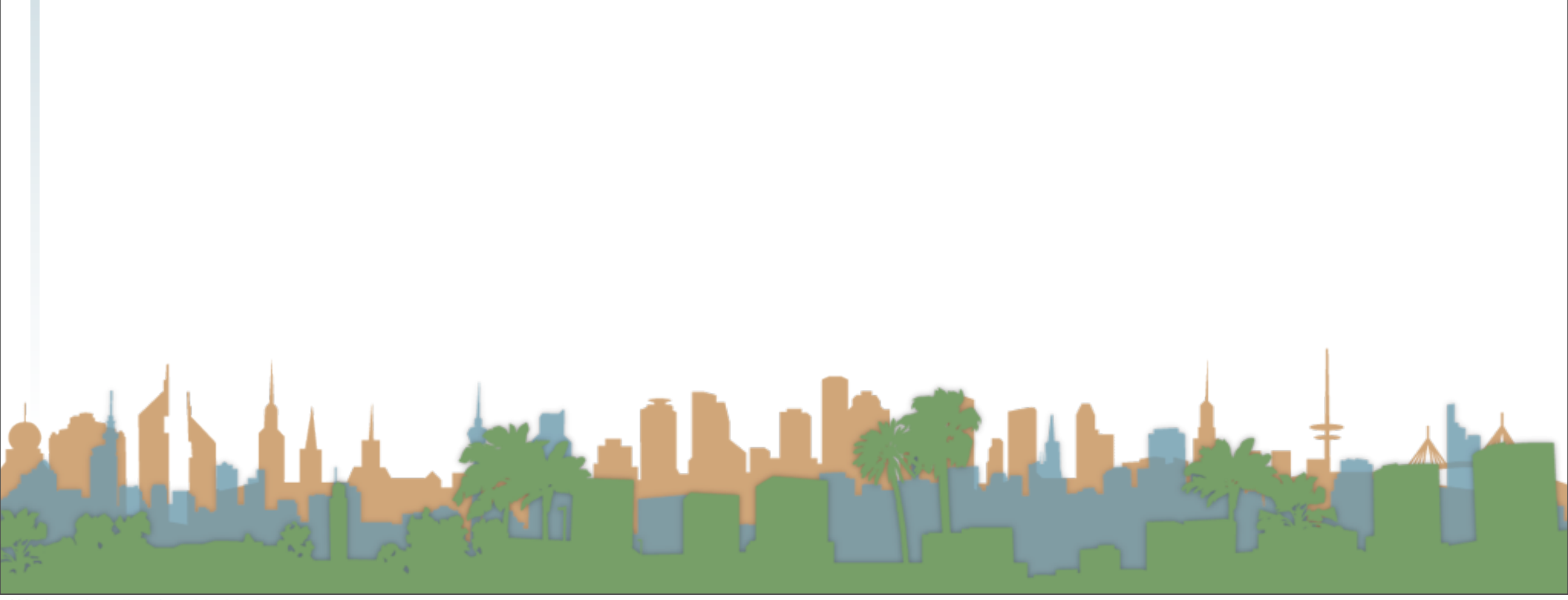
Global Location GPS



Global Location GPS

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

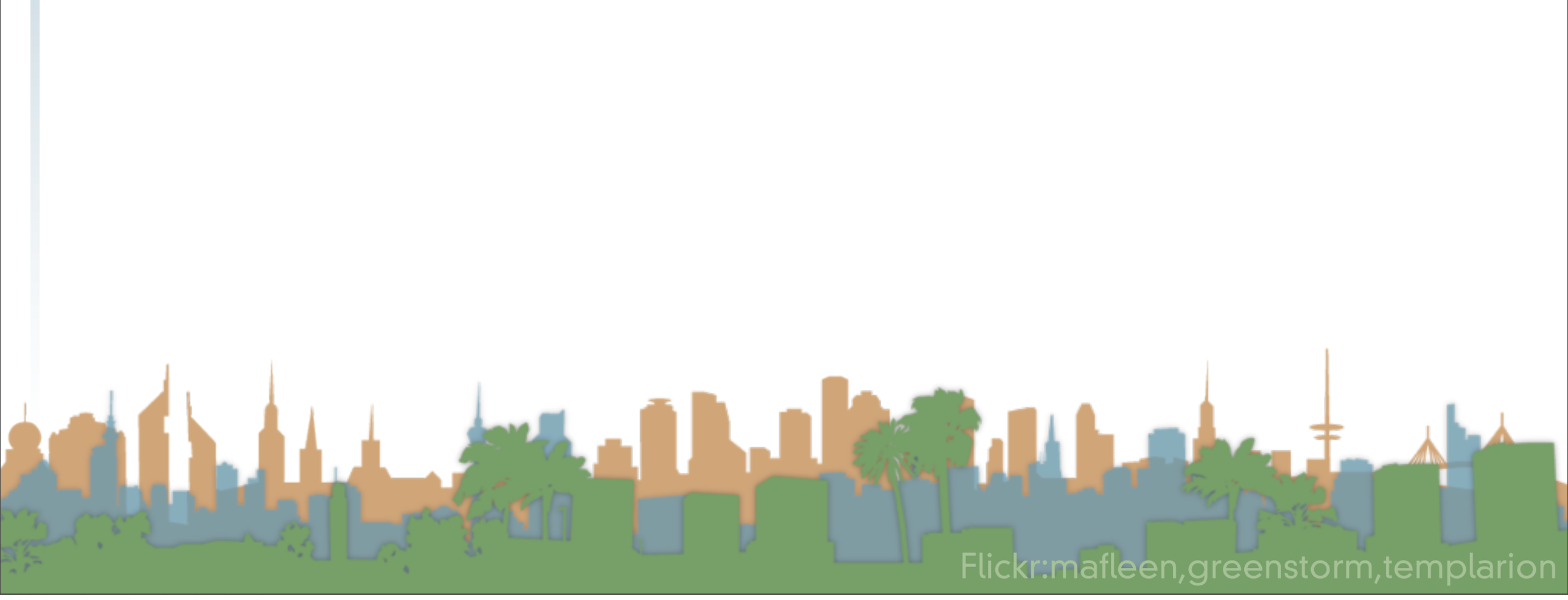
Global Location GPS



Global Location GPS

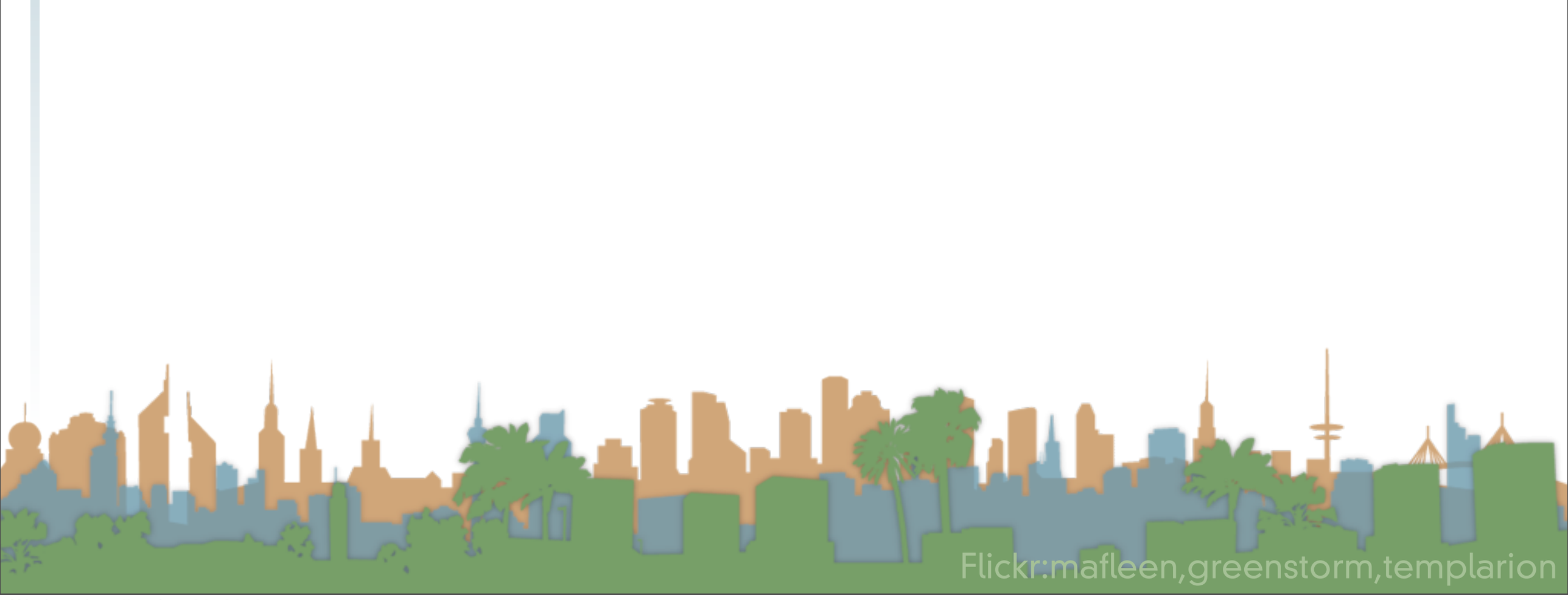
- Current GPS
  - Receiver requirements
    - Must have local clock
    - 3-D position requires four satellites
      - four unknowns (what are they?)
    - time or height reduces this

Global Location GPS



Global Location GPS

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



Global Location GPS

Global Location GPS

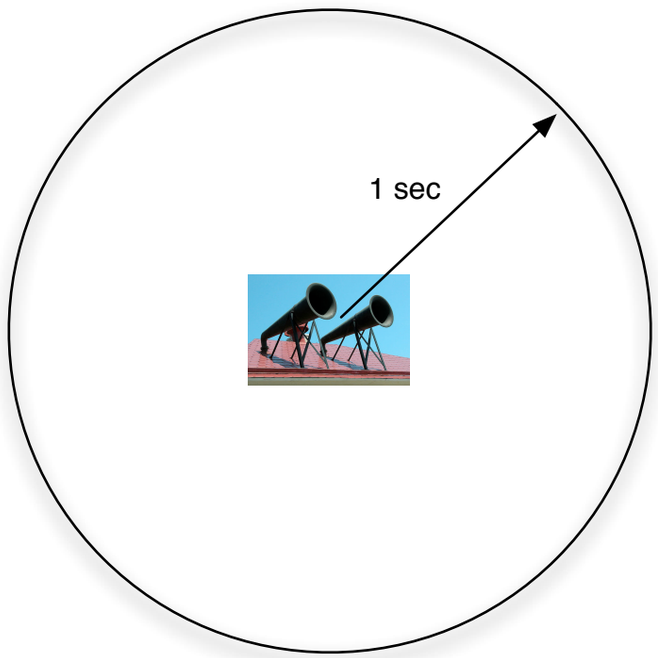
- Basic concept is based on the foghorn paradigm
  - but in 3-D

Flickr:mafleen,greenstorm,templarion

Global Location GPS

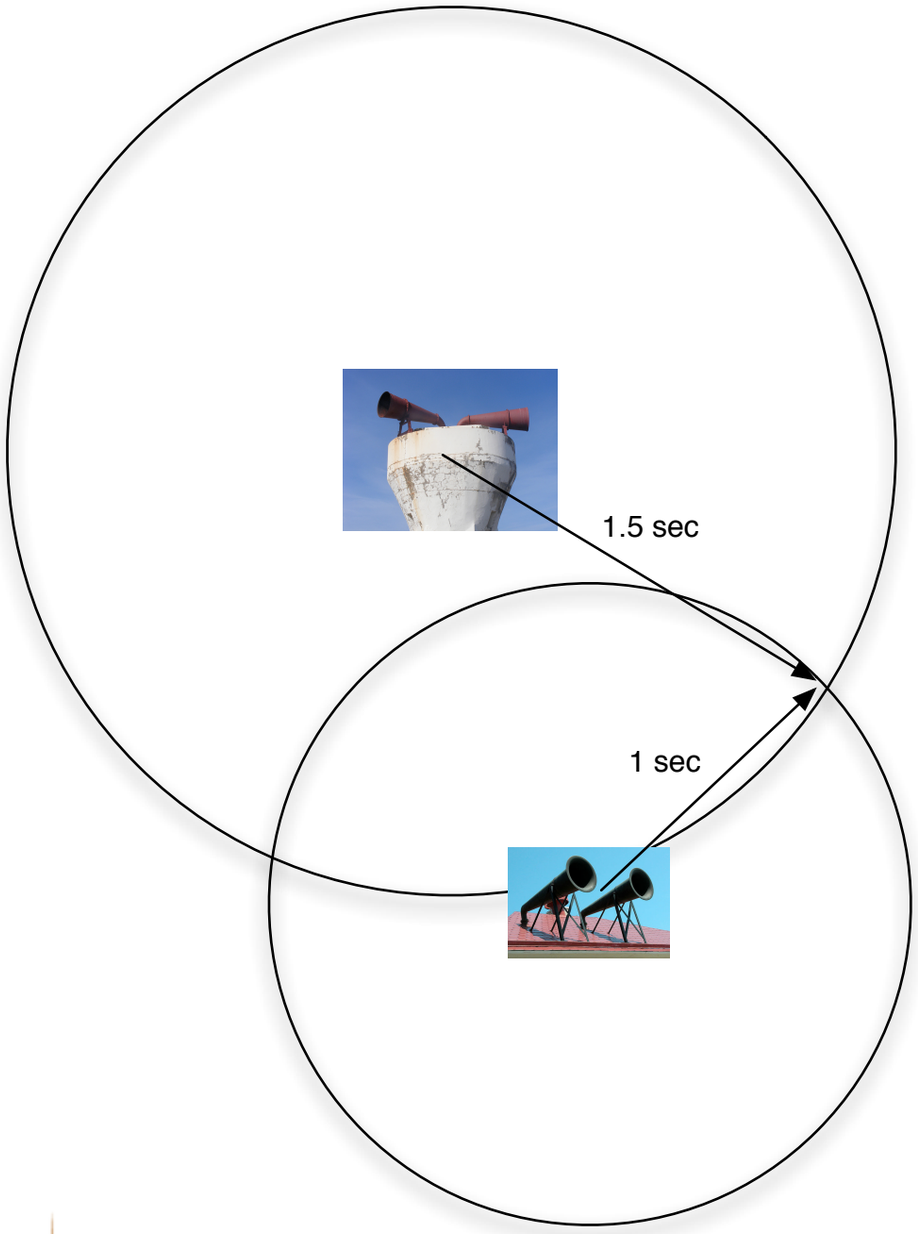
1 sec

Global Location GPS

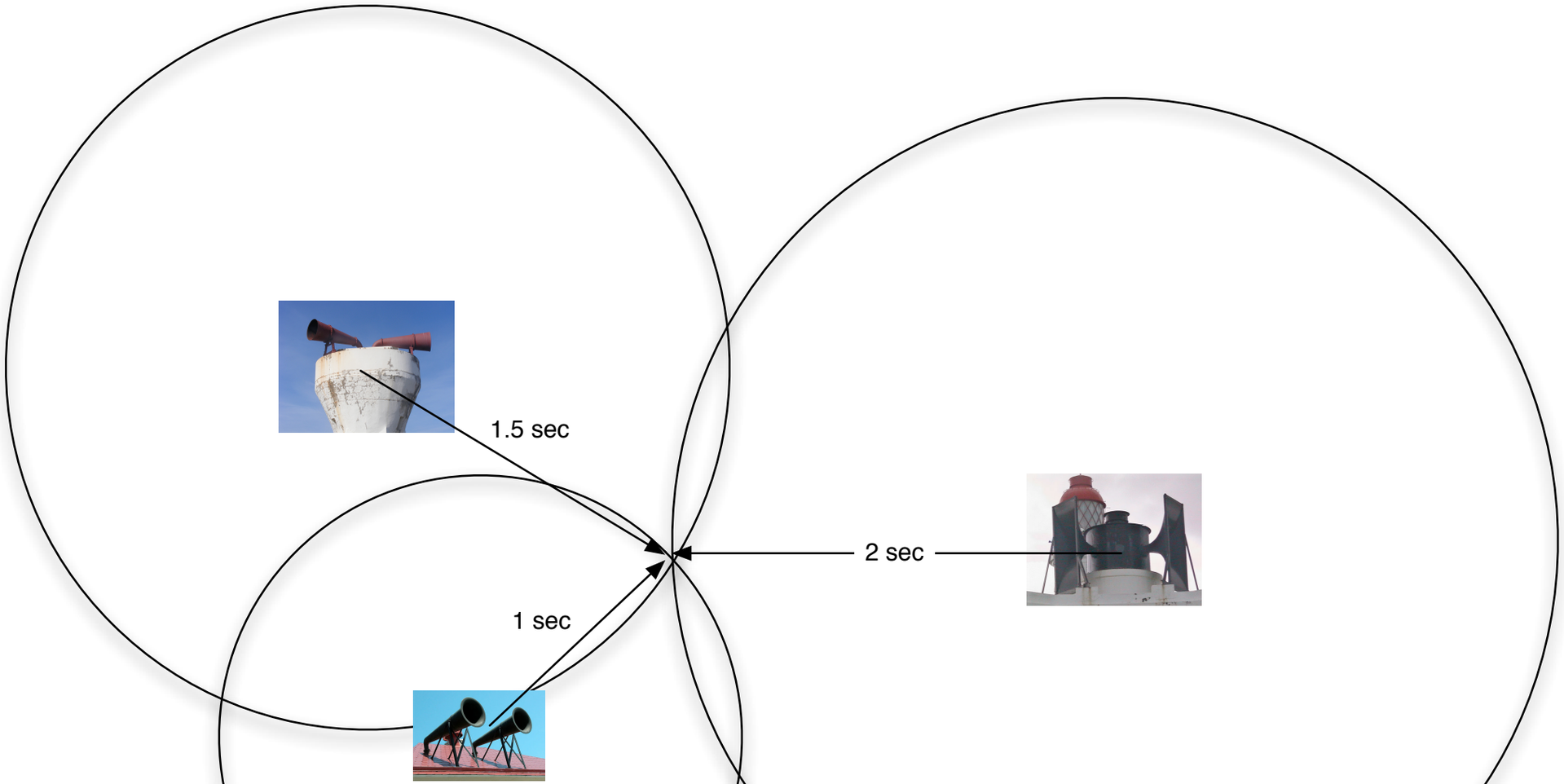


Flickr:mafleen,greenstorm,templarion

Global Location GPS

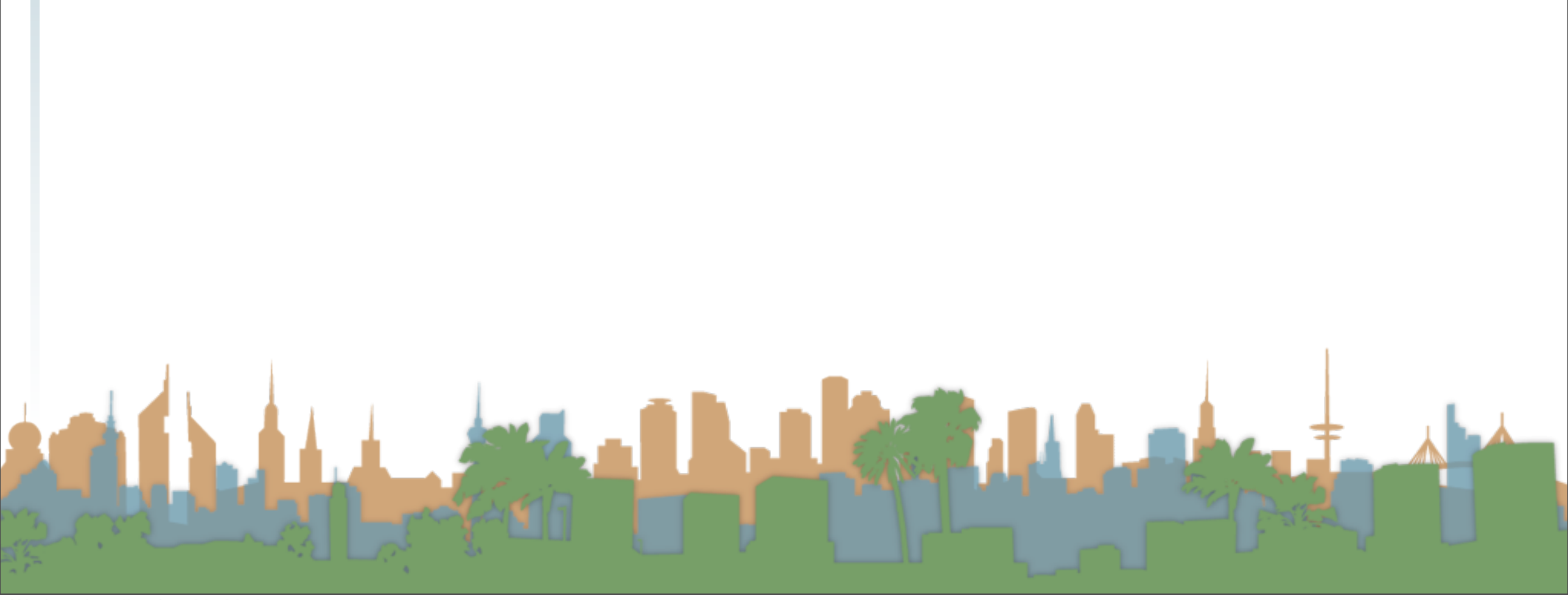


Global Location GPS



Flickr:mafleen,greenstorm,templarion

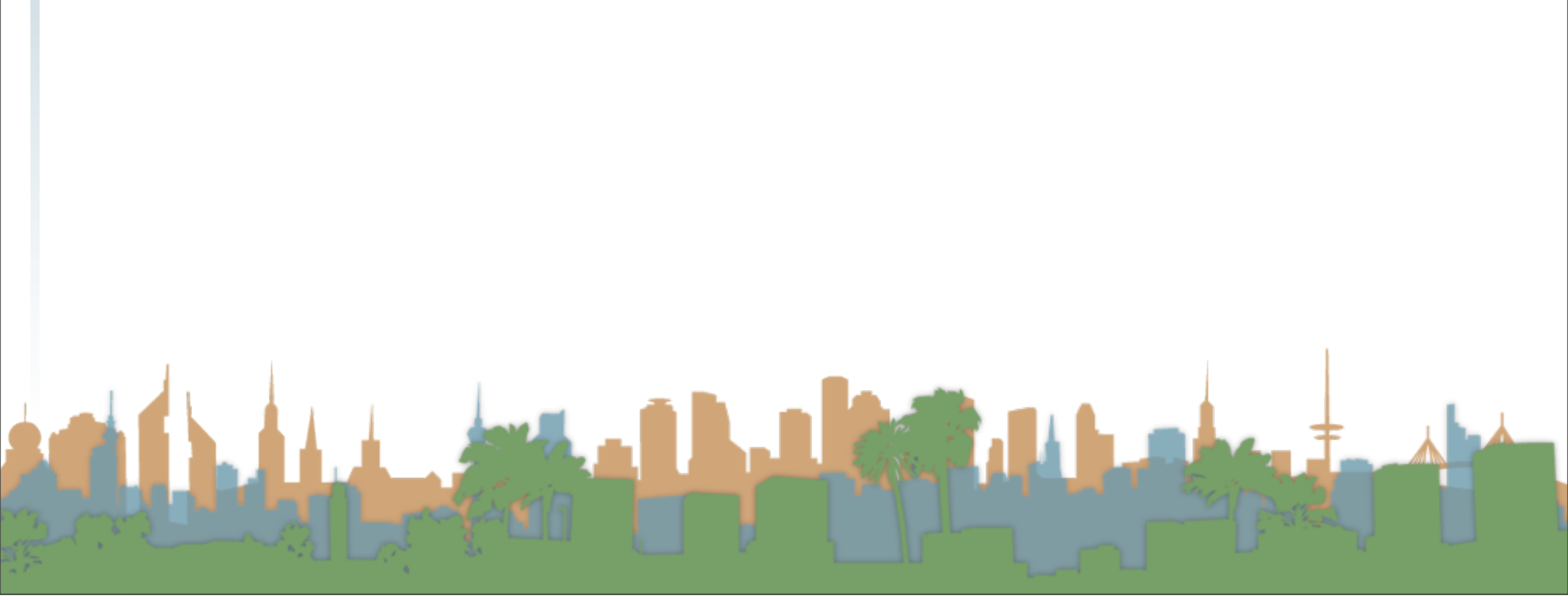
Global Location GPS



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

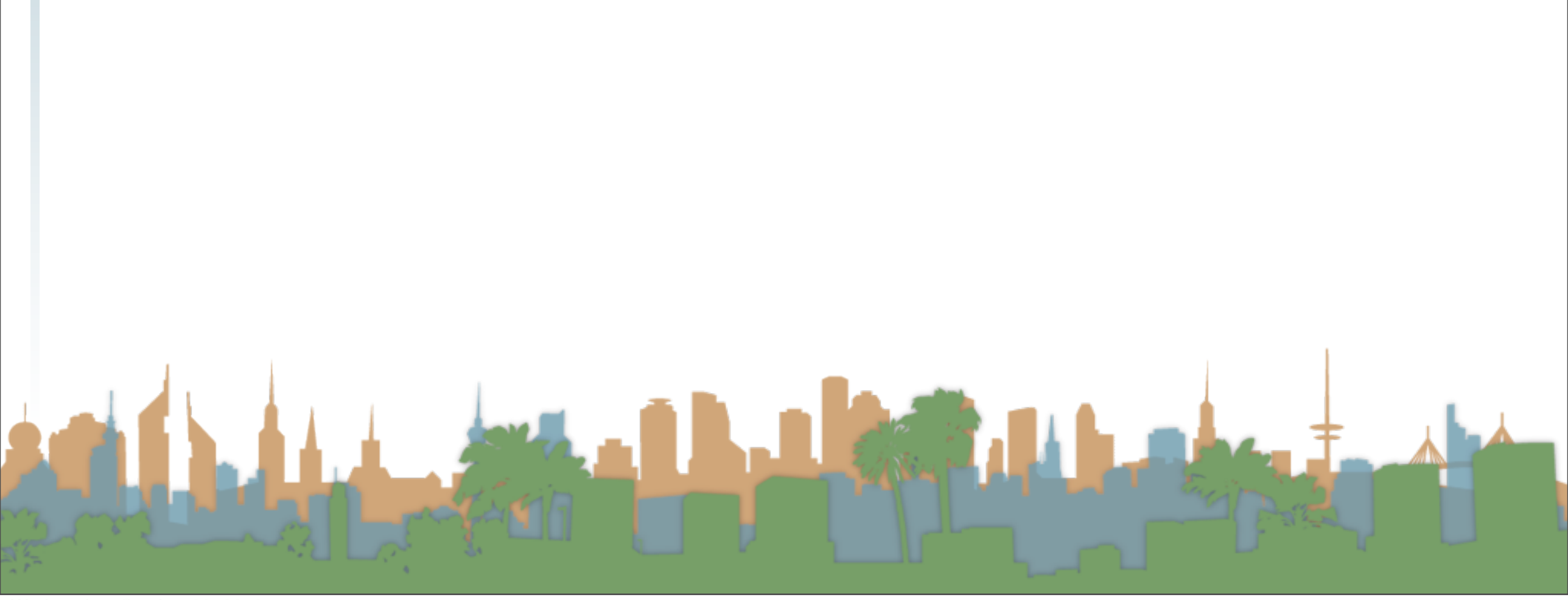
Global Location GPS



Global Location GPS

- The current and future of GPS
  - BeiDou
    - Chinese competitor
    - centralized system
  - Japanese Quasi-Zenith System

Global Location GPS



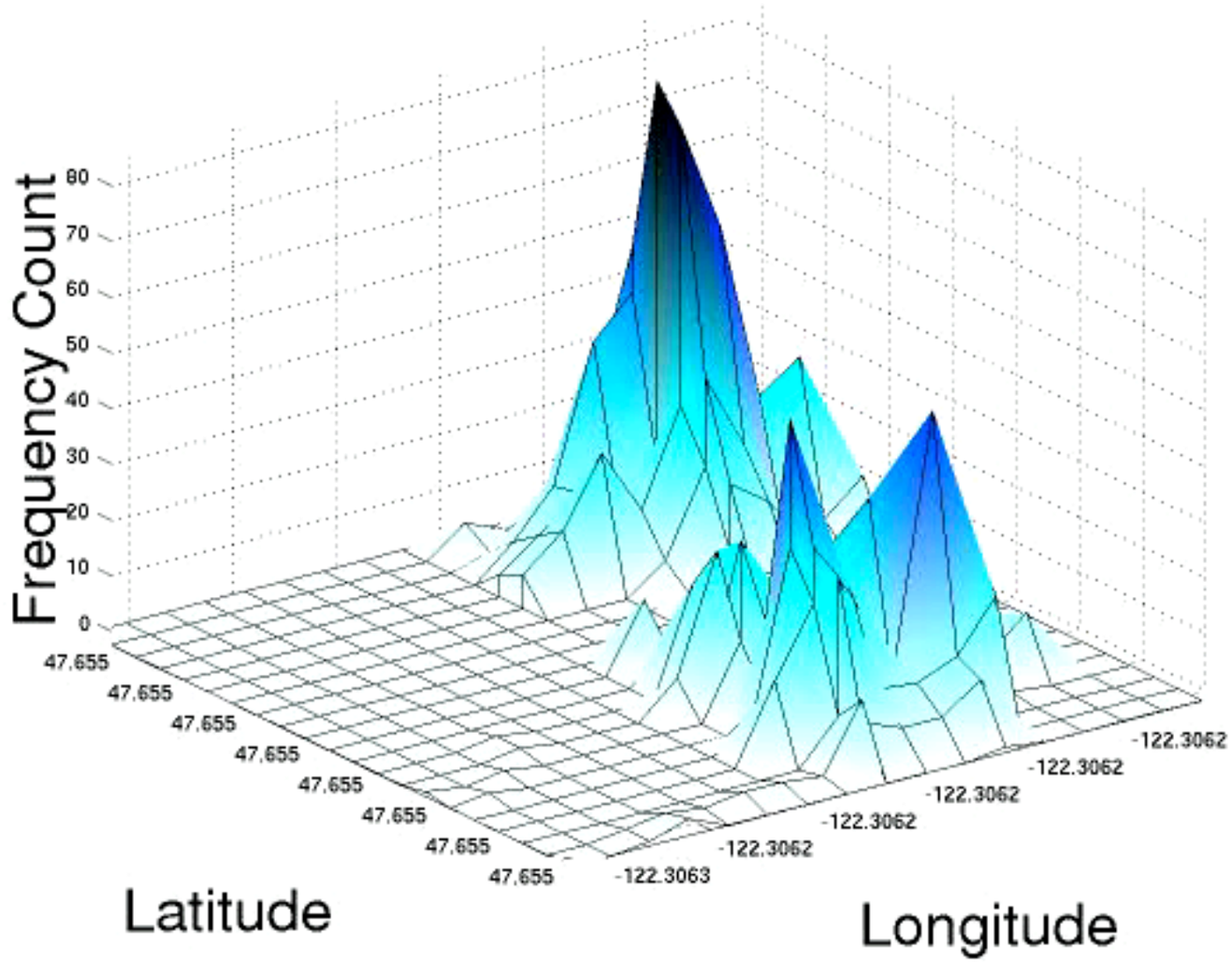
Global Location GPS

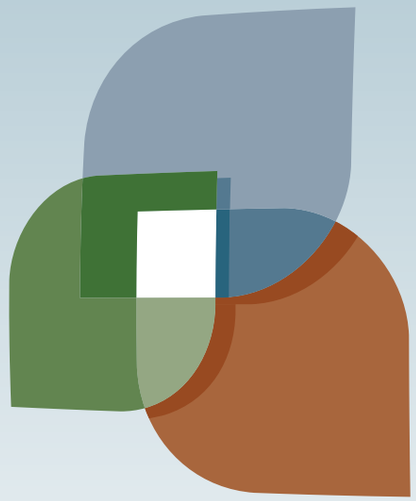
- GPS accuracy
  - 13 m 95% of the time horizontal
  - 22 m 95% of the time vertical system
  - 40 ns 95% of the time
  - How do you design for this?

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





LUCI

Wednesday, October 20, 2010