User Interaction: Intro to Location

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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
Intro to Location

Tools for Navigation

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

- Who calculates position?
  - User
  - 3rd party
- What’s the impact?
Intro to Location

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

- Latitude:
  - 0° (equator)
  - 90° N (North Pole)
  - 90° S (South Pole)
- Longitude:
  - 0° (Greenwich Meridian)
  - 180° W (International Date Line)

- Latitude is fat!
Global Location GPS

Mathematical Model

Datum

WGS-84

100's of them

WGS-72

(Latitude, Longitude)

(x, y)
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

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
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

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

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Global Location GPS

1 sec
Global Location GPS
Global Location GPS

1 sec

1.5 sec
Global Location GPS

Intro to Location

Flickr: mafleen, greenstorm, templarion
Global Location GPS

- Basic concept is based on the foghorn paradigm
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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
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