User Interaction: Intro to Location

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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

Frequency Count

Latitude

Longitude
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

Intro to Location

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2cm

Differential
## Apple iPhone 6

### General
- **2G Network**: GSM 850 / 900 / 1800 / 1900 - A1549 (GSM), A1549 (CDMA), A1586
  - CDMA 800 / 1700 / 1900 / 2100 - A1549 (CDMA), A1586
- **3G Network**: HSDPA 850 / 900 / 1700 / 1900 / 2100 - A1549 (GSM), A1549 (CDMA), A1586
  - CDMA2000 1xEV-DO - A1549 (CDMA), A1586
  - TD-SCDMA 1900 / 2000 - A1586
- **4G Network**: LTE 700/800/850/900/1700/1800/1900/2100/2600 (1/2/3/4/5/7/8/13/17/18/19/20/25/26/28/29/39/40/41) - A1549 (GSM), A1549 (CDMA)
  - LTE 700/800/850/900/1800/1900/2100/2600 TD-LTE 1900/2300/2500/2600 (1/2/3/4/5/7/8/13/17/18/19/20/25/26/28/29/38/39/40/41) - A1586

- **SIM**: Nano-SIM
- **Announced**: 2014, September
- **Status**: Available. Released 2014, September

### Body
- **Dimensions**: 138.1 x 67 x 6.9 mm (5.44 x 2.64 x 0.27 in)
- **Weight**: 129 g (4.55 oz)
  - Fingerprint sensor (Touch ID)
  - Apple Pay (Visa, MasterCard, AMEX certified)

### Display
- **Type**: LED-backlit IPS LCD, capacitive touchscreen, 16M colors
- **Size**: 750 x 1334 pixels, 4.7 inches (~326 ppi pixel density)
- **Multitouch**: Yes
- **Protection**: Shatter proof glass, oleophobic coating
  - Display Zoom

### Sound
- **Alert types**: Vibration, proprietary ringtones
- **Loudspeaker**: Yes
- **3.5mm jack**: Yes

### Memory
- **Card slot**: No
Global Location GPS

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

Eureka!

(lat, long)

Position

Eureka!
(lat, long)
• What are the implications of this design on
  • scalability of the system?
  • privacy of users?
  • security of users?
  • reliability?
  • implications on device?
Intro to Location

Global Location GPS

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

http://en.wikipedia.org/wiki/File:Qzss-45-0.09.jpg
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.
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?
Global Location GPS

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NO GPS RELIES ON TELECOM
What’s the difference between DGPS and A-GPS?

- **DGPS**
  - Requires a special receiver, a compatible tower, calculates position on receiver, provides very high accuracy

- **Cell-tower positioning**
  - Doesn’t require GPS on phone, requires a cooperating cell-tower, position is calculated on tower, sent to phone

- **A-GPS**
  - Requires GPS on phone, Uses cell-tower to hot-start receiver GPS, requires cooperating tower, requires cooperating phone, standard accuracy

- All require tower to know where it is