

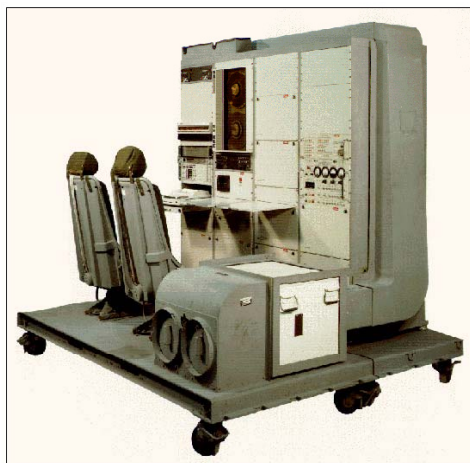


Invitational Workshop on Opportunistic Localization for the
Next Generation Wireless Devices, WPI, 16-17 June 2008

GPS and its Potential Competitors

Pratap Misra

First GPS Receiver



Rockwell Collins' Generalized Development Model
(1977)



Evolution of GPS Receivers

1981



2005



What if you could re-design GPS?

- Clean-slate start using the technology of 2005



What if you could re-design GPS?

- Clean-slate start using the technology of 2005
- It's being done!

PROGRAM OBJECTIVES

- Objectives of Galileo:
 - Increased overall performance
 - Civil system in contrast to GPS
 - Independent **and** interoperable with GPS
 - Better robustness
 - Certified quality of services
 - Qualified for safety critical applications
 - ...

24 June 2005

1



What if you could re-design GPS?

- Clean-slate start using the technology of 2005
- It's being done!

PROGRAM OBJECTIVES

- Objectives of Galileo:
 - Increased overall performance
 - Civil system in contrast to GPS
 - Independent **and** interoperable with GPS
 - Better robustness
 - Certified quality of services
 - Qualified for safety critical applications
 - ...

24 June 2005

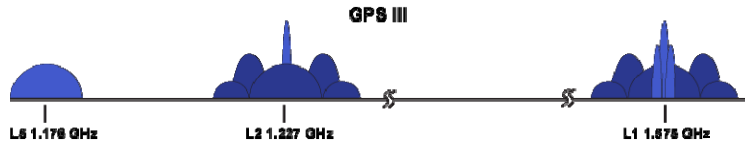
1



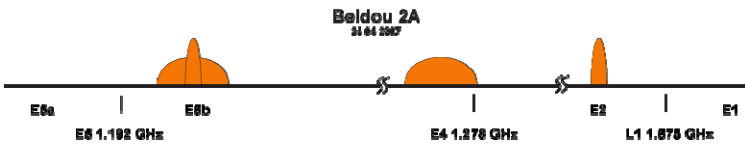
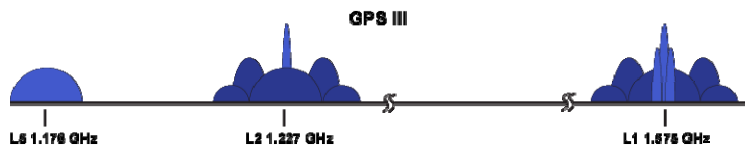
GPS was revolutionary; Galileo would be "just another" global navigation satellite system



Frequency Plans



Frequency Plans



Adapted from T. Grelier et al., Inside GNSS, May/June 2007

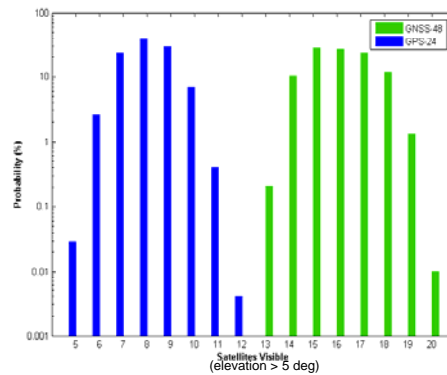


GPS created the mold

- Medium earth orbits (MEOs)
 - Orbital radius: ~25,000 km; period: ~12 hours
- ~24-satellite constellation
- CDMA ranging signals
- 10 MHz chipping rate
- Civil/Acquisition code: 1-ms period, 1-MHz chipping rate
- **Limitation: Signal strength**

GPS+Galileo Compatible and Inter-operable

- 2 autonomous systems
 - Robustness
- 50+ satellites
 - Sky blockage less of a problem
- Mass market:
 - GPS/SPS + Galileo/OS
 - Low-cost, all-in-view receivers
- Integrity monitoring within the receiver
- Higher service availability



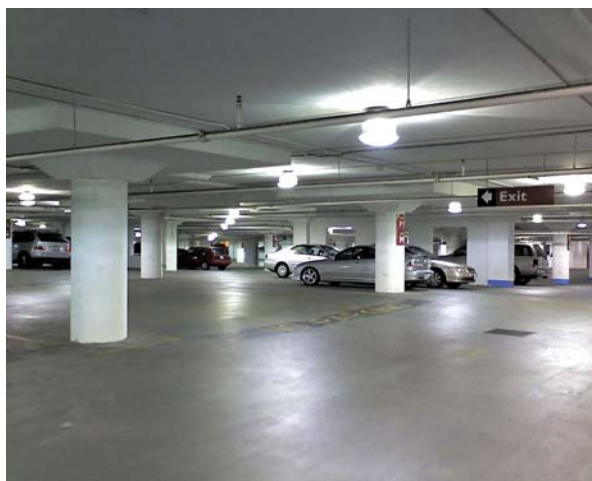


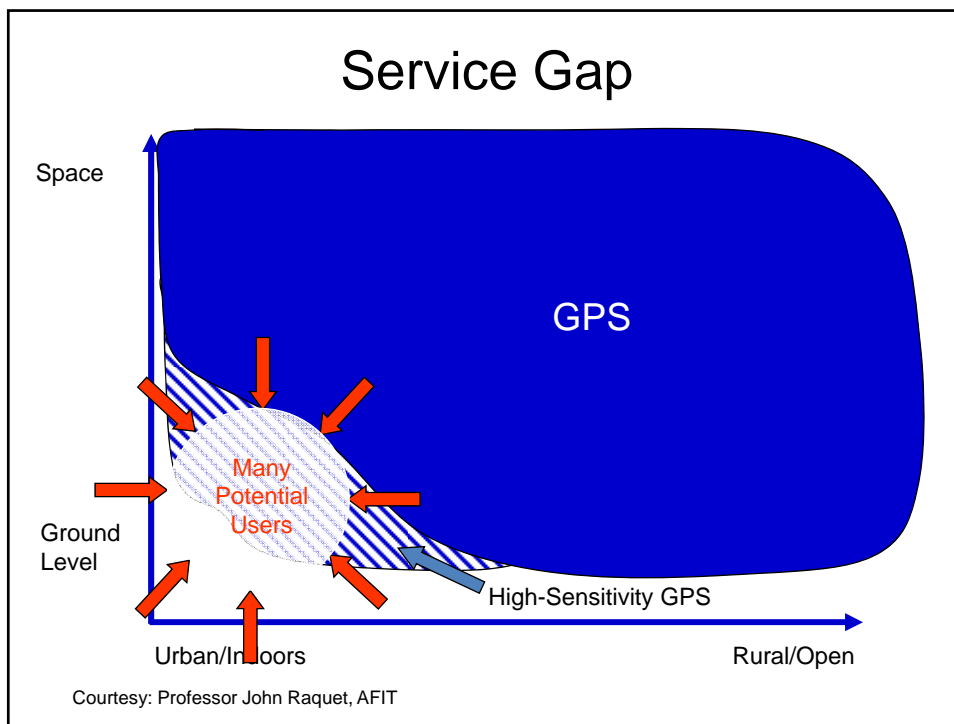
Hard for GPS, Little Help from Galileo et al.



Courtesy:
Professor Per Enge

Hard for GPS, Little Help from Galileo et al.





Invitational Workshop on Opportunistic Localization for the
Next Generation Wireless Devices, WPI, 16-17 June 2008

GPS and GLONASS and Galileo and BeiDou

Pratap Misra



Invitational Workshop on Opportunistic Localization for the
Next Generation Wireless Devices, WPI, 16-17 June 2008

GPS and GLONASS and Galileo and BeiDou, and still not enough!

Pratap Misra

Back up slides



BeiDou/Compass

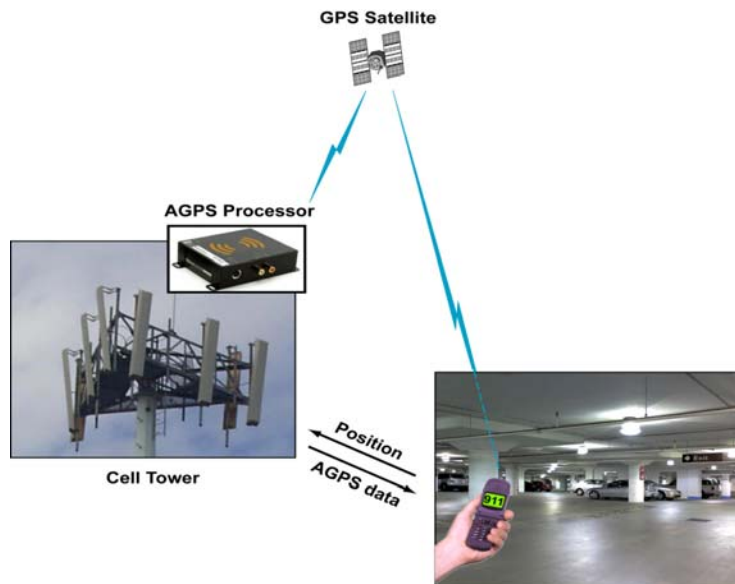
- Chinese
- Active system
 - 2 - 3 geostationary satellites orbited in 2000 – 2003
 - 1 MEO launched in 2007
- Mission: unclear



from BeiDou official website

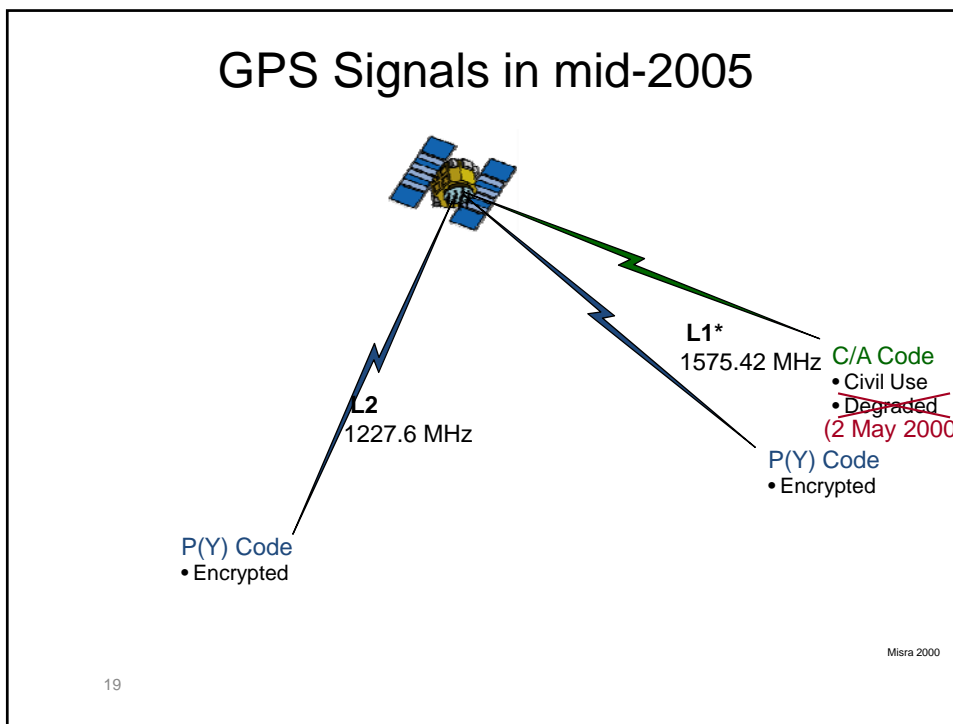
17

GPS Augmentation

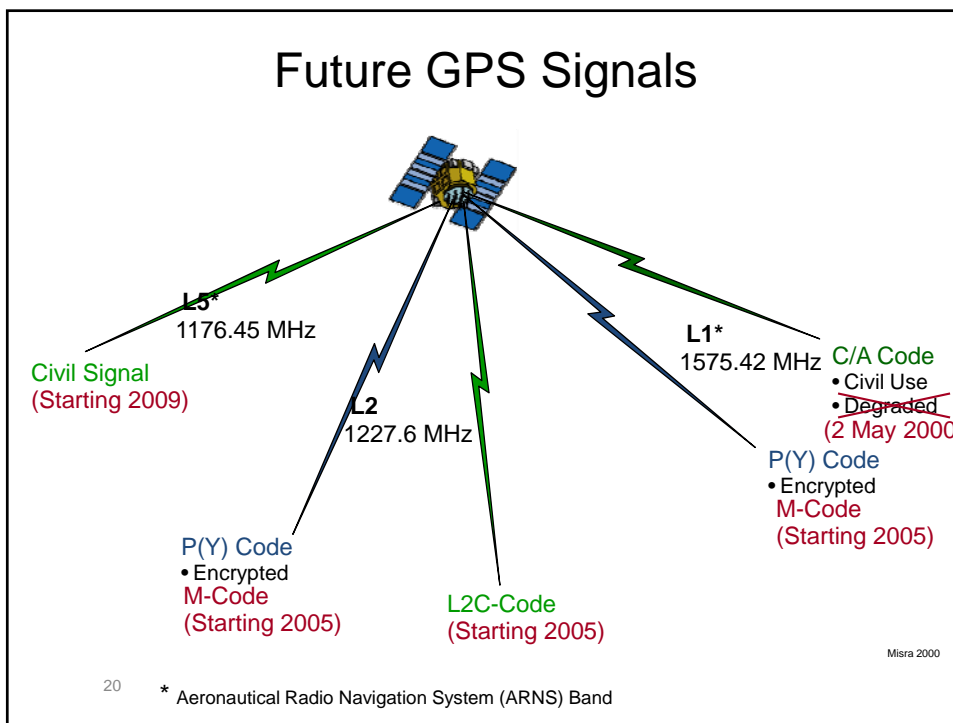




GPS Signals in mid-2005



Future GPS Signals





Soviet-built GLONASS Aviation Receiver & Tool box (circa 1990)*



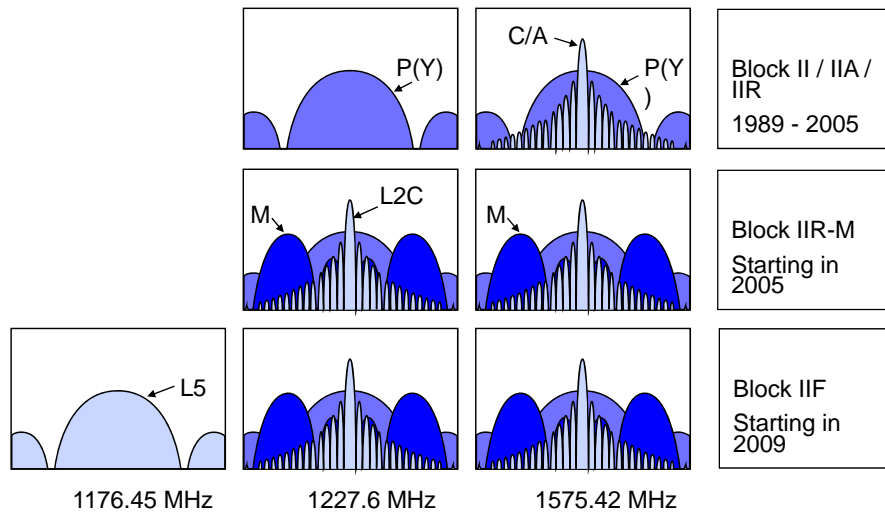
ASN-16



* Source: MIT Lincoln Laboratory

21

Evolution of GPS Signals



22