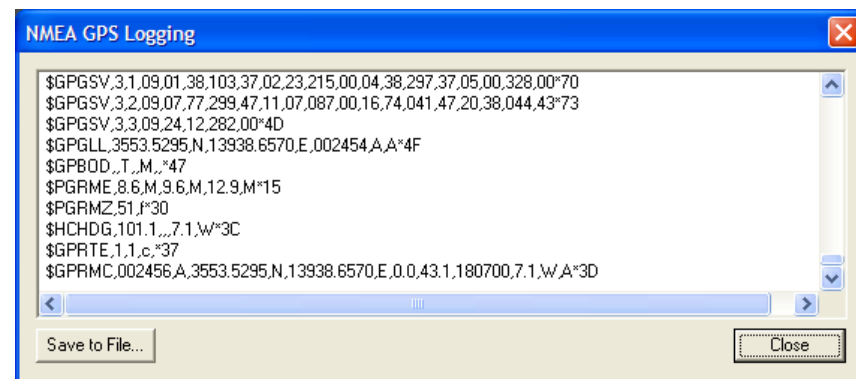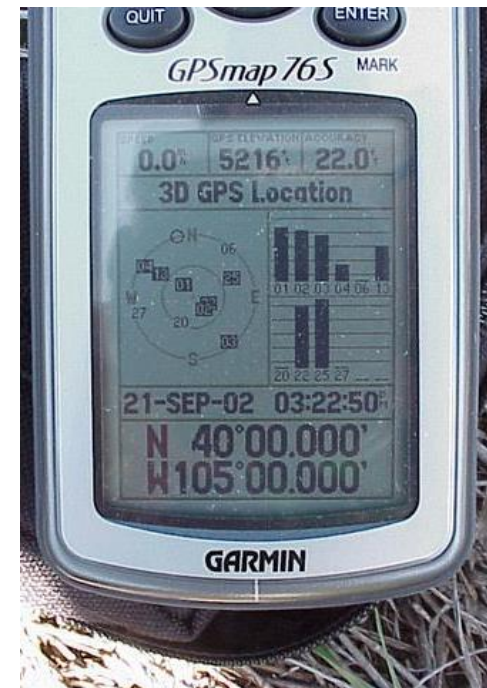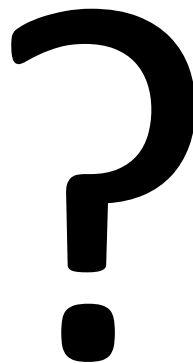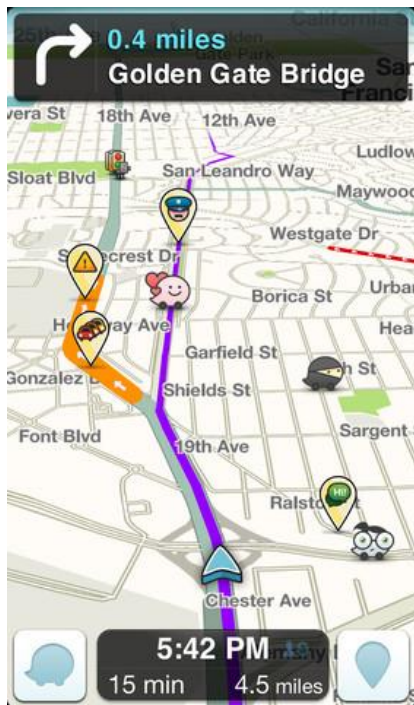# Intelligent Systems

GPS 1.

"GPS" (GNSS) vs. Navigation
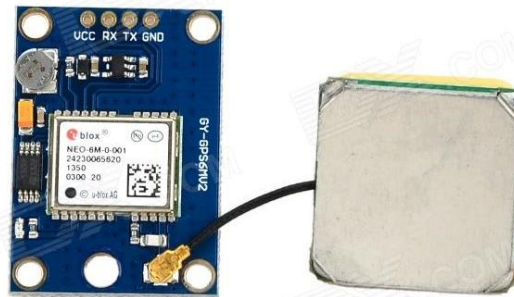

?

Some GPS receiver

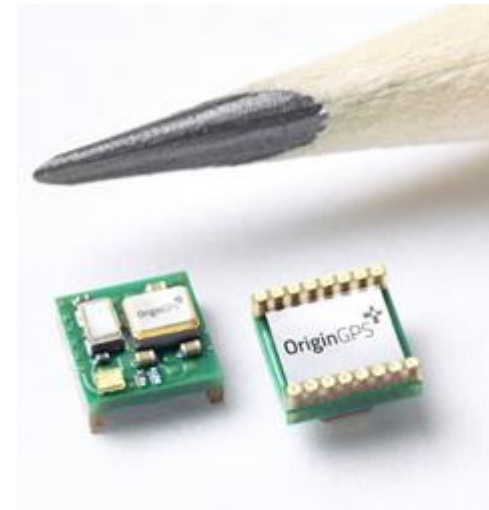GarminGPS 128 receiver

Magellan NAV 6500

Garmin GNS 530W

uBlox Lea6 (3DR)

uBlox LEO6

Global Navigation(GNSS)

- global navigation satellite system (GNSS)
  - Pl. GPS, Galileo, GLONASS, BeiDou …
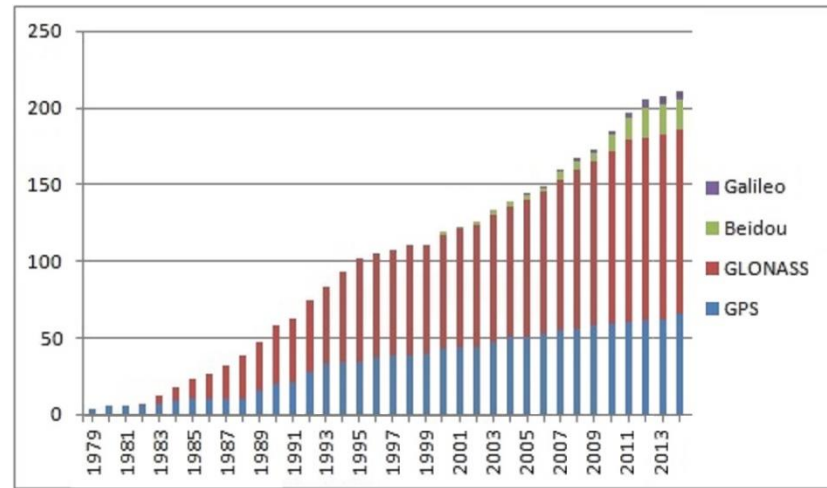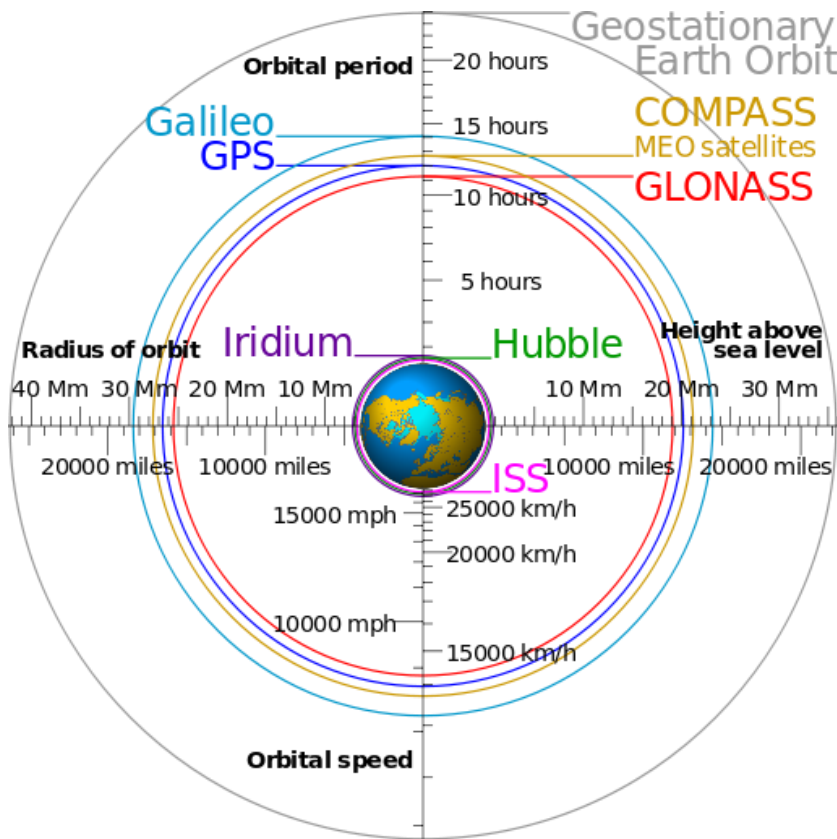
GNSS

- GPS (USA)
  - Global Positioning System
- Galileo (EU)
- BeiDou (CN)
  - 北斗卫星导航系统 ☺
- GLONASS (RUS)
  - Globalnaya navigatsionnaya sputnikovaya sistema
    Глобальная навигационная спутниковая система
  - GLObal NAvigation Satellite System
- IRNSS (India)
  - Indian Regional Navigation Satellite System

Positioning (pre GPS)

- **Light house** ☺

- **Radio Location**
    - ILS (**I**nstrument**L**anding**S**ystem)
    - VOR (**V**HF **O**mnidirectional**R**ange)
    - DME (**D**istance **M**easuring **E**quippement).
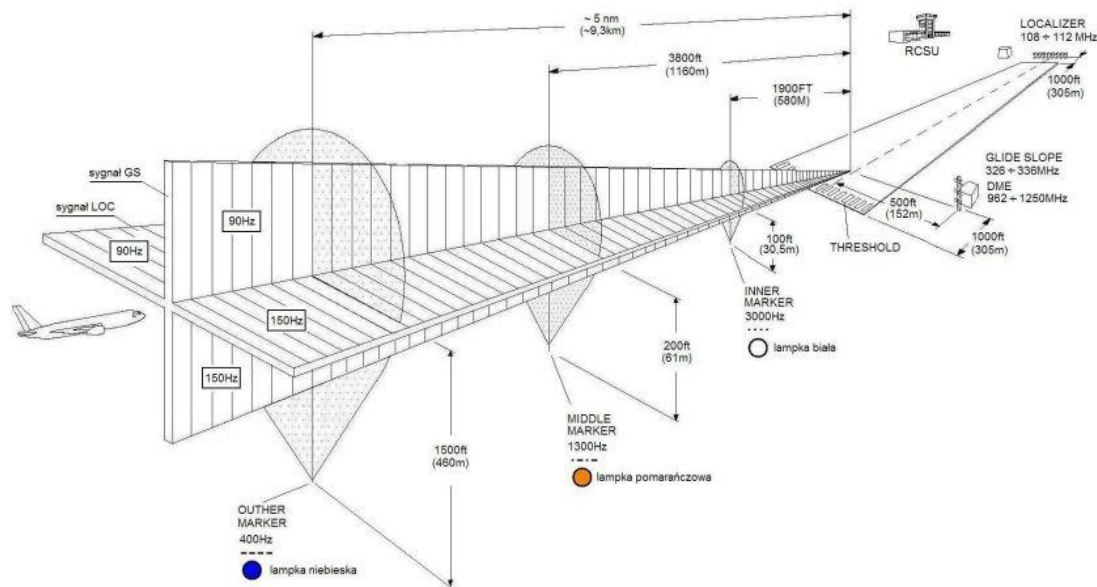
GPS

- U.S. Department of Defense
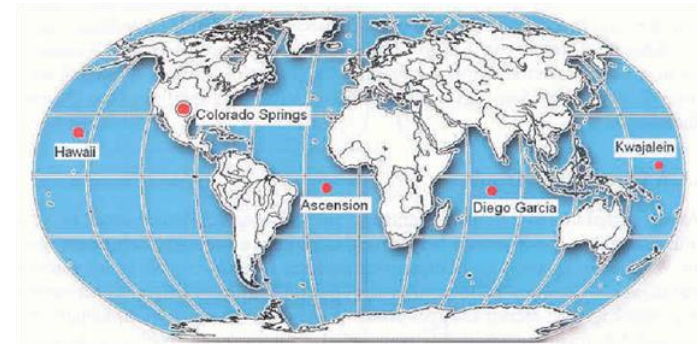
- **GPS satellites:**
  - NAVSTAR from Rockwell International
  - Alt: 20.240 km
  - Weight: 862 kg (az űrben mérve)
  - Size: 5,2 m w open solar panels

- **Base stations**
  - Hawaii, Ascension Island, Diego Garcia, Kwajalein és Colorado Springs.
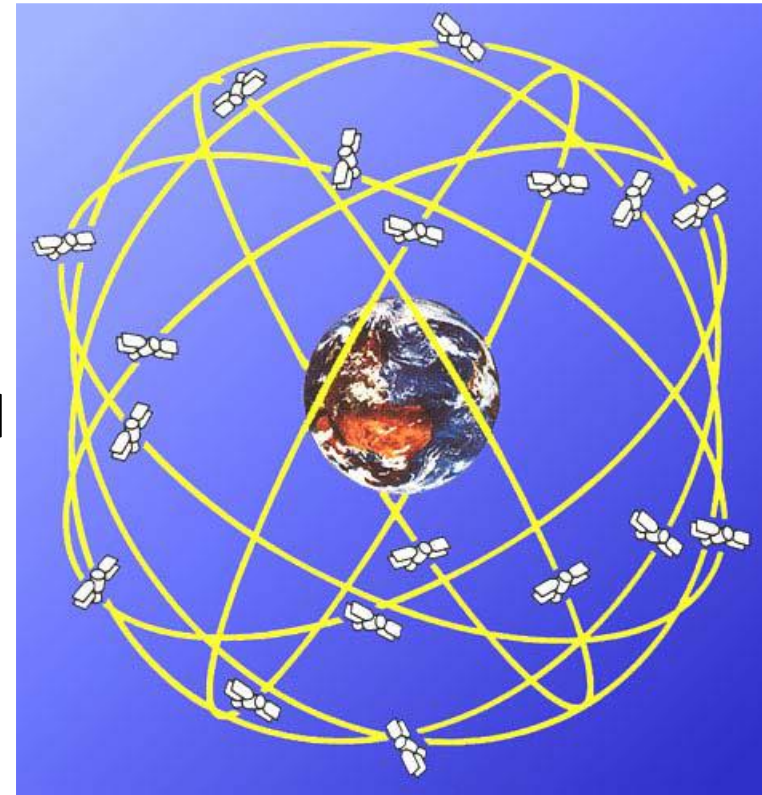
Satellite identification

- Pszeudo random signal
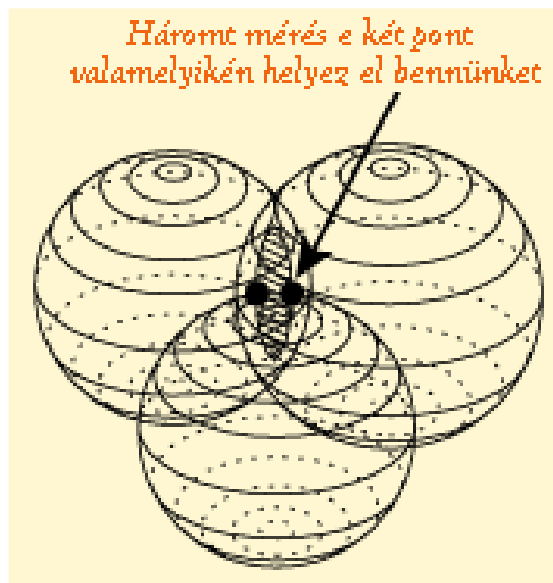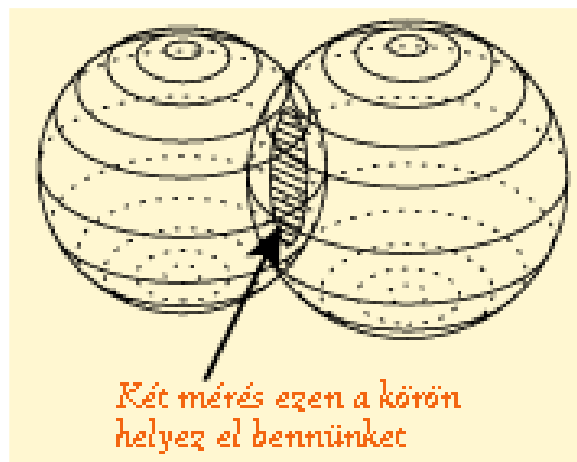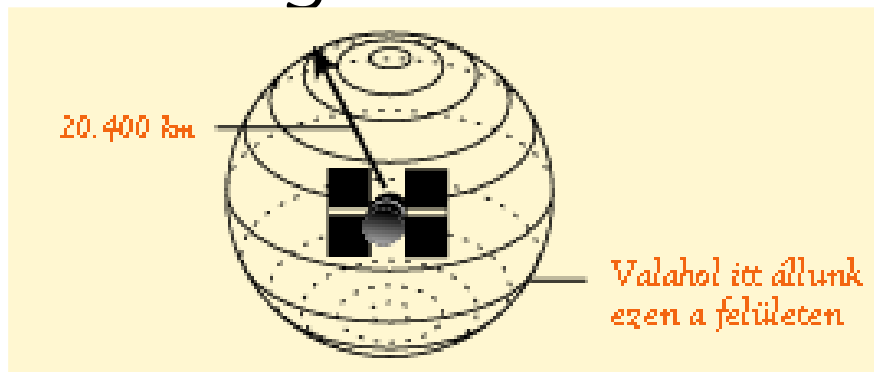- All satellites broadcast at the same two frequencies, 1.57542 GHz (L1 signal) and 1.2276 GHz (L2 signal).
- The satellite network uses a CDMA spread-spectrum technique where the low-bitrate message data is encoded with a high-rate pseudo-random (PRN) sequence that is different for each satellite.
- The receiver must be aware of the PRN codes for each satellite to reconstruct the actual message data.
- The C/A code, for civilian use, transmits data at 1.023 million chips per second, whereas the P code, for U.S. military use, transmits at 10.23 million chips per second.
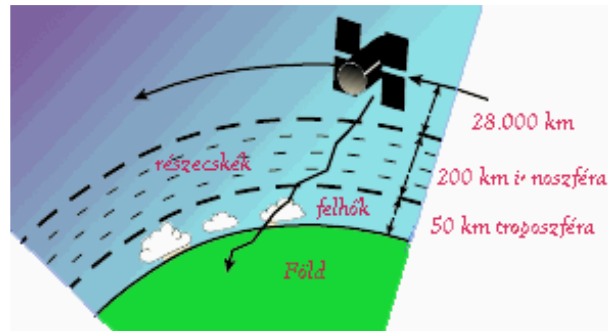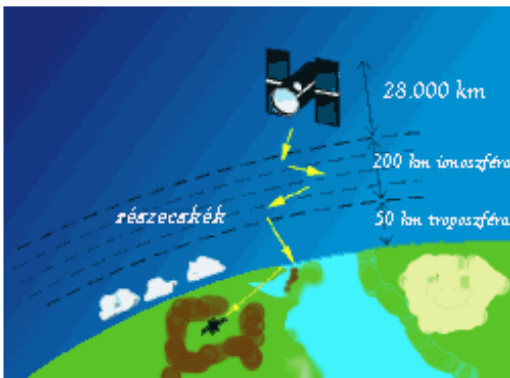
Distance measurement => position
~triangulation

20.400 km

Valahol itt állunk
ezen a felületen

Két mérés ezen a körön
helyez el bennünket

Háromt mérés e két pont
valamelyikén helyez el bennünket

GPS errors

| Error in [m]		
cause	standard GPS	Differential GPS
Satellite clock	1,5	0
GDOP	2,5	0
Ionosphere	5,0	0,4
Troposphere	0,5	0,2
Receiver noise	0,3	0,3
Multipath signal	0,6	0,6

GDOP

geometric dilution of precision (GDOP):

- additional multiplicative effect of navigation satellite geometry on positional measurement precision.
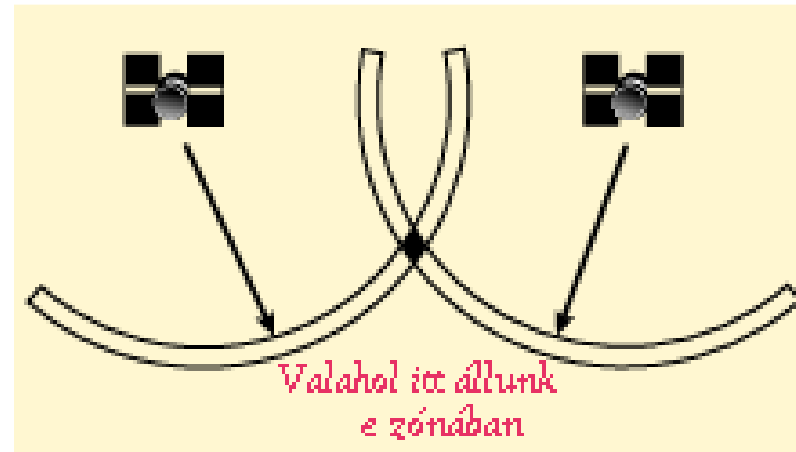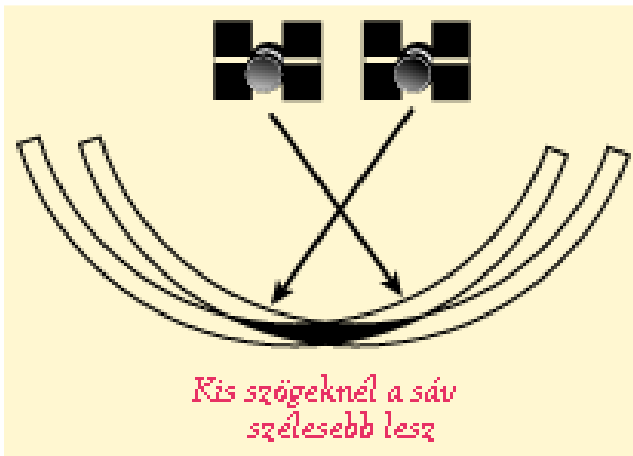
Selective Availability(SA)

- Selective Availability (SA) was an intentional degradation of public GPS signals implemented for national security reasons.

- In May 2000, at the direction of President Bill Clinton, the U.S government discontinued its use of Selective Availability in order to make GPS more responsive to civil and commercial users worldwide.

Selective Availability(SA)
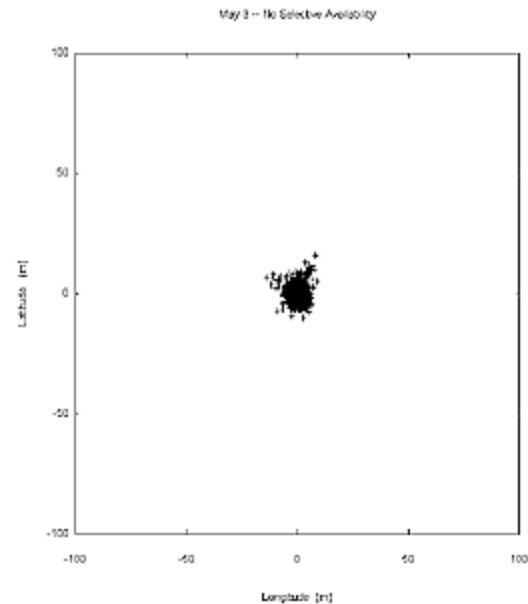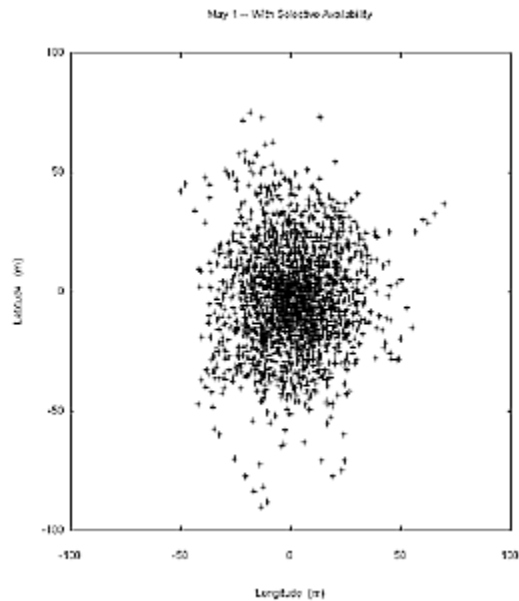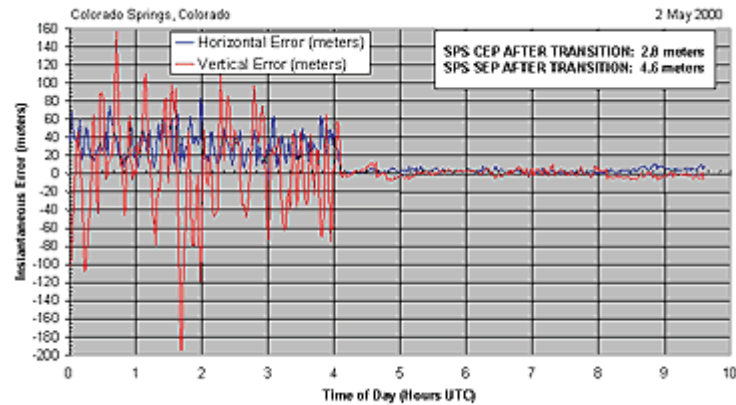
DGPS

- Differential GPS

- DGPS uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the GPS satellite systems and the known fixed positions. These stations broadcast the difference between the measured satellite pseudoranges and actual (internally computed) pseudoranges, and receiver stations may correct their pseudoranges by the same amount. The digital correction signal is typically broadcast locally over ground-based transmitters of shorter range.

GPS SATELLITES

ERROR CORRECTIONS

REFERENCE
STATION

NAVIGATOR
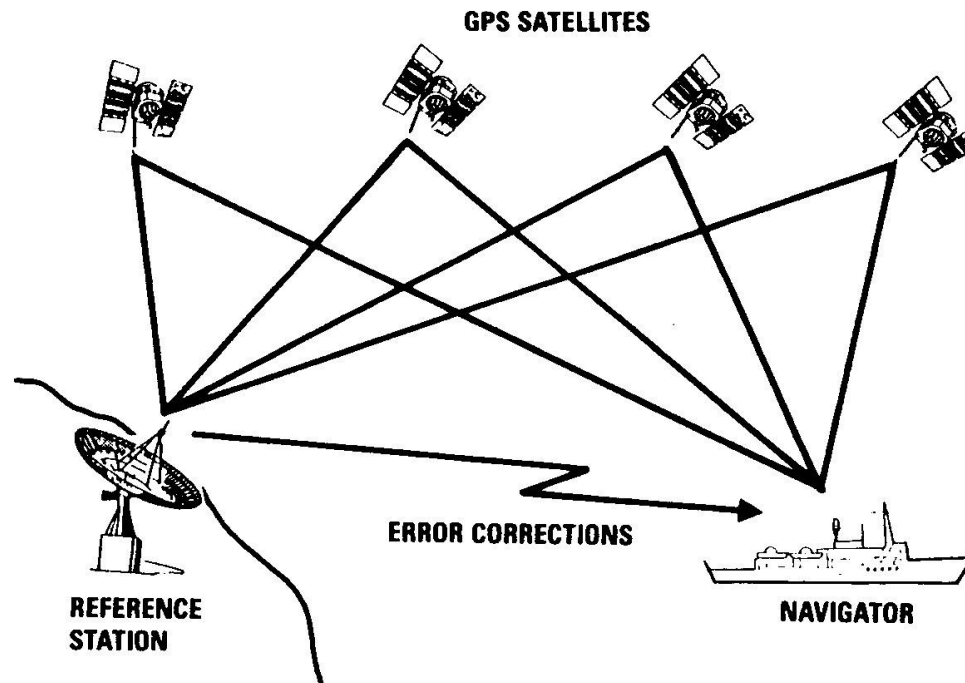
Message formats

- NMEA 0183
  - Character based
  - General sentences:
    GGA, RMC, GSV, GLL…
- SiRF
  - Binary format

http://www.gpsinformation.org/dale/nmea.htm