ELEMENTS OF ENGINEERING

(ENGG111)

Surveying

EDM and GPS

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After

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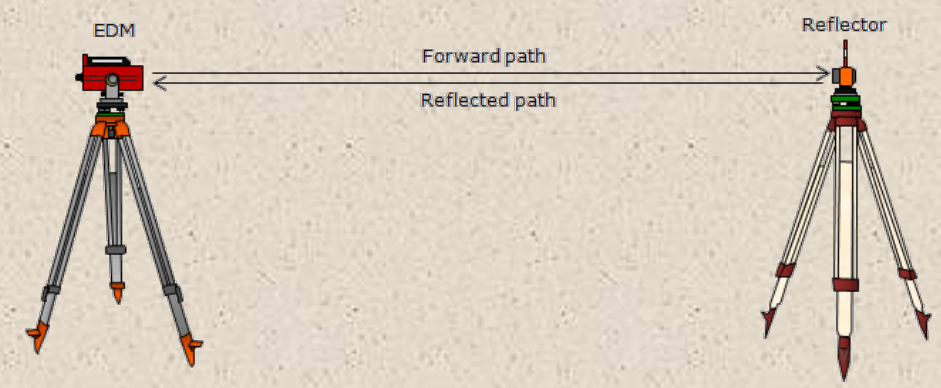
EDM

- Electromagnetic Distance Measurement
- Utilizes electromagnetic energy for measuring distances between two points
- The energy originates at an instrument at one end of a line and is transmitted to a "reflector" at the other end from where it is returned to the originating instrument.

Basic Principle of EDM

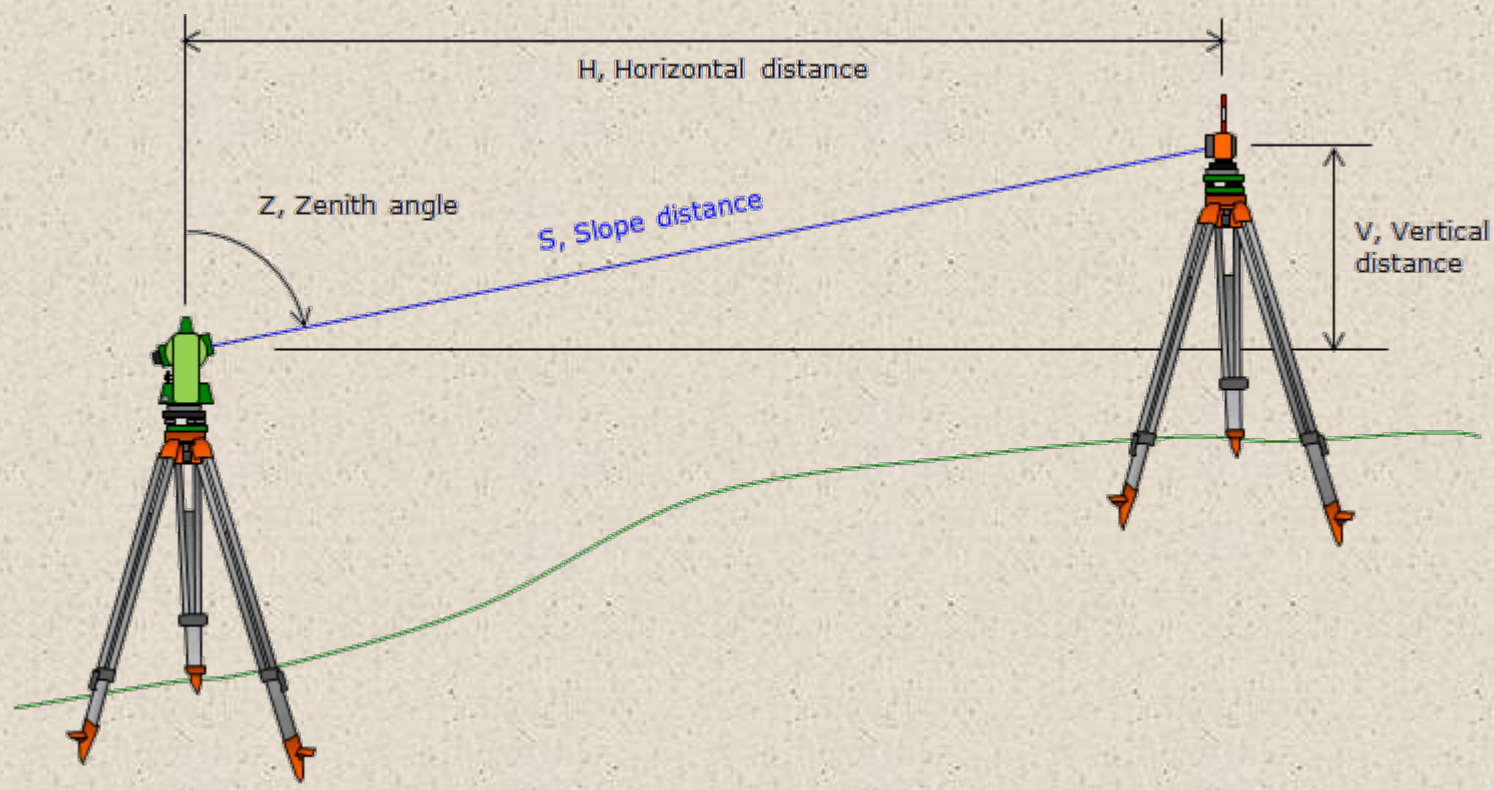


- EDM broadcast signals (EM radiation)
- Simple, distance calculation d = v*t
- Velocity = velocity of light 3*10E8 m/s
- Time is known (difference between sender and receiver)
- Distance is calculated

Total Station

- Modern surveying instrument
- Measure horizontal and vertical angles and slope distances in a single integrated unit.
- In operation total station is set up over the required point and its height over the survey station is measured.

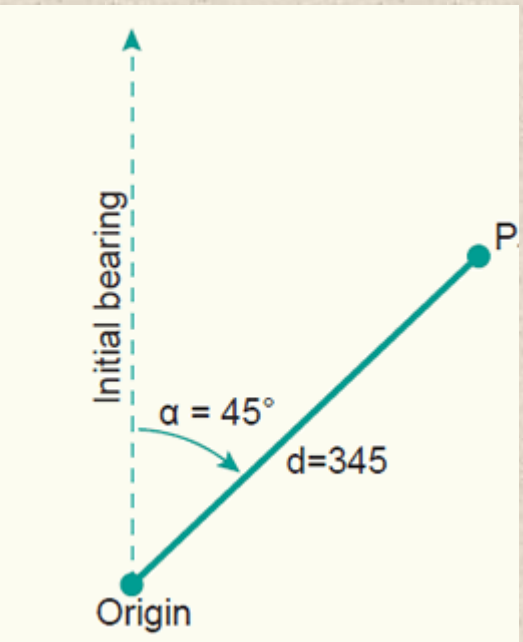
Distance measurement



From these two measurements, the Horizontal and Vertical distances are computed by the instrument:

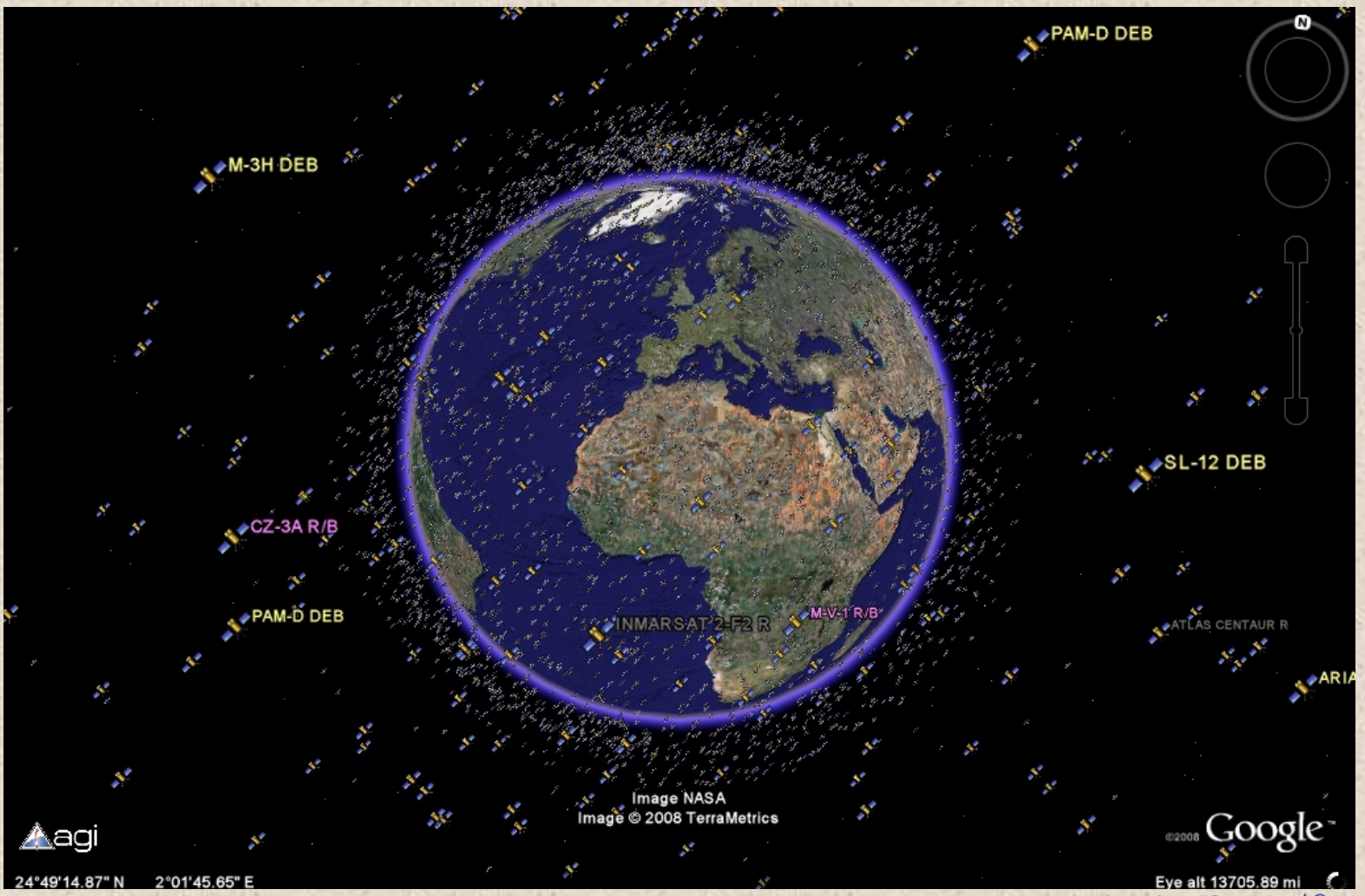
$$H = S \times \sin(Z) \qquad V = S \times \cos(Z)$$

Coordinate calculation



Easting = Distance* Sin(angle)
Northing = Distance*Cos(angle)

GPS


PAM-D DEB
M-3H DEB
SL-12 DEB
CZ-3A R/B
PAM-D DEB
INMARSAT 2-F2 R
M-V-1 R/B
ATLAS CENTAUR R
ARIA
Image NASA
Image © 2008 TerraMetrics
agi
©2008 Google
24°49'14.87" N 2°01'45.65" E
Eye alt 13705.89 mi

GPS

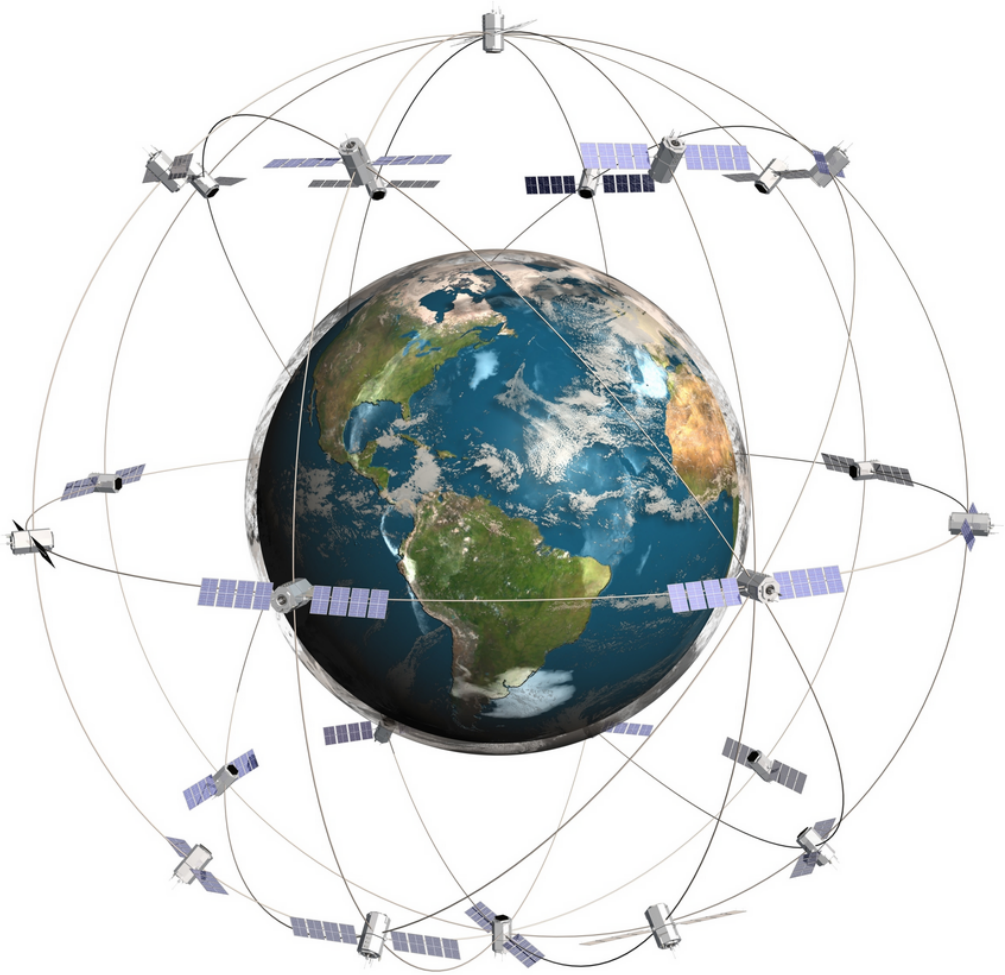
- Global Positioning System
- GPS is a satellite based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.
- GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use.
- GPS works in any weather conditions, anywhere in the world, 24 hours a day.

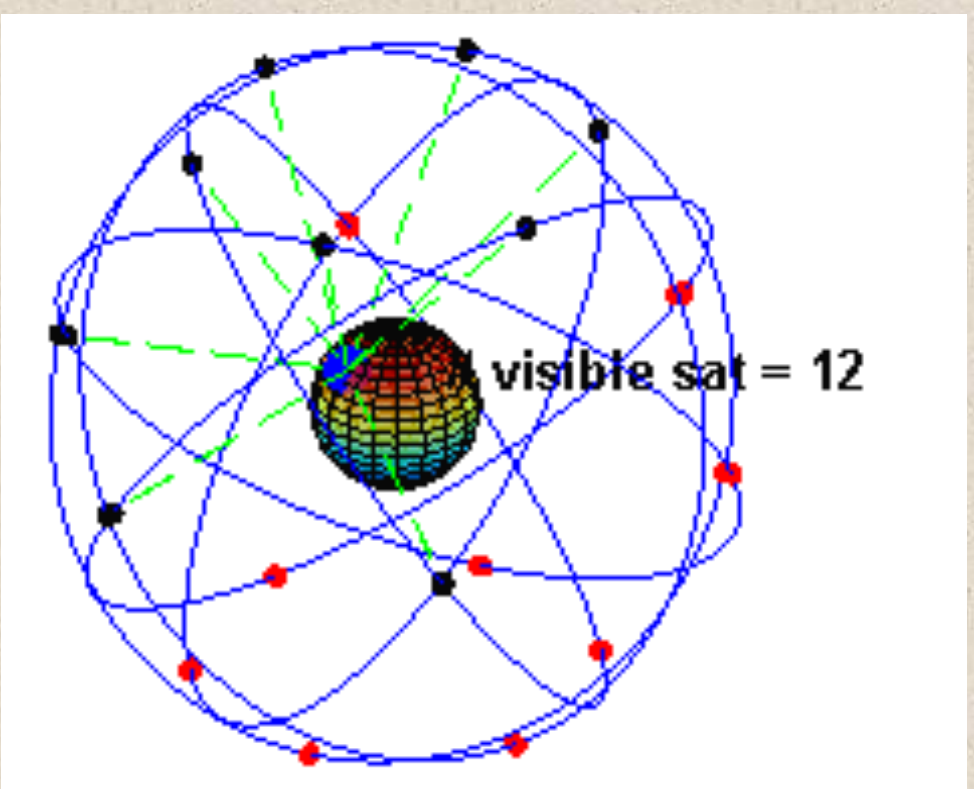
- GPS provides specially coded satellite signals that can be processed in a GPS receiver, enabling the receiver to compute position, velocity and time.
- Four GPS satellite signals are used to compute positions in three dimensions.
- Navigation in all three dimensions is the primary function of GPS.

Other satellite systems

Other satellite navigation systems in use or various states of development include:

- GLONASS – Russia's global navigation system. Fully operational worldwide.
- Galileo – a global system being developed by the European Union and other partner countries, planned to be operational by 2014 (and fully deployed by 2019)
- Beidou – People's Republic of China's regional system, currently limited to Asia and the West Pacific
- COMPASS – People's Republic of China's global system, planned to be operational by 2020
- IRNSS – India's regional navigation system, planned to be operational by 2015, covering India and Northern Indian Ocean
- QZSS – Japanese regional system covering Asia and Oceania

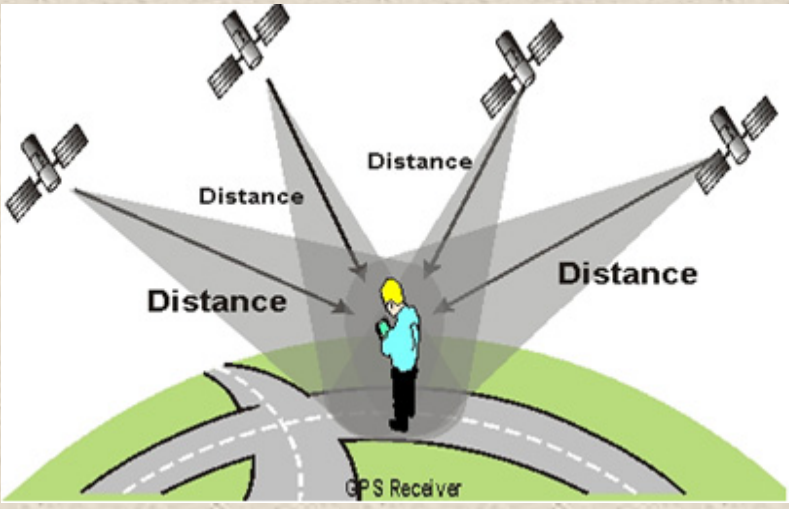


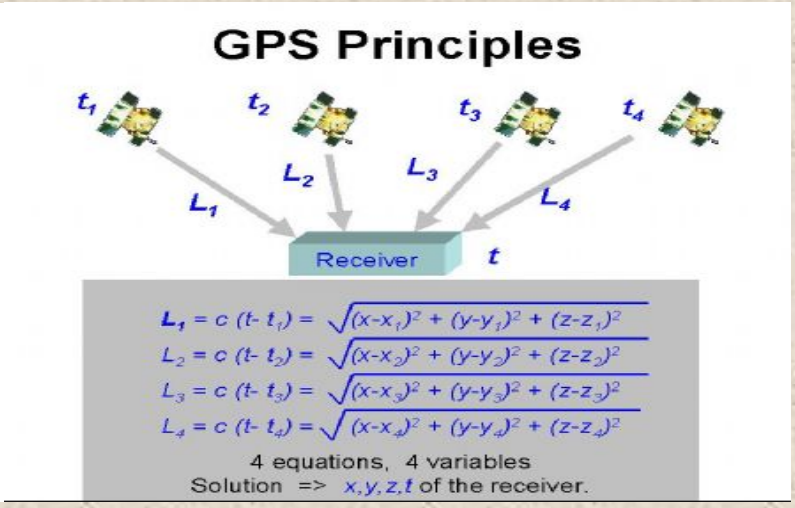

visible sat = 12

Working principle of GPS

- Each of the 24 satellites emits signals to receivers that determine their location or range by computing the difference between the time that a signal is sent and the time it is received.
  The signal contains data that a receiver uses to compute the locations of the satellites needed for accurate positioning.
- GPS satellites carry atomic clocks that provide extremely accurate time. The time information is placed in the codes broadcast by the satellite so that a receiver can continuously determine the time the signal was broadcast. With information about the ranges to three satellites and the location of the satellite when the signal was sent, the receiver can compute its own three-dimensional position.

Coordinate calculation





Very famous *resection* principle in Surveying

C(ts-to) =

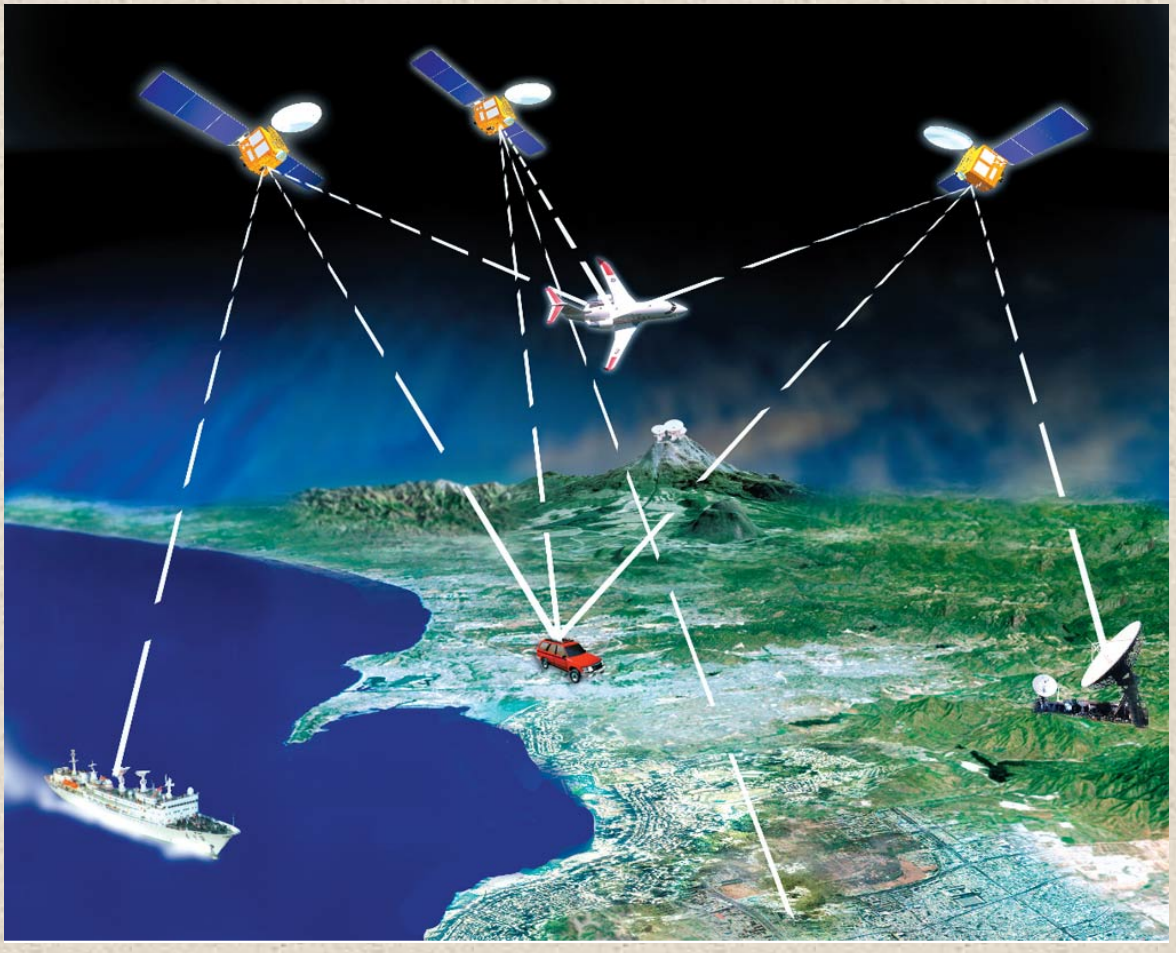
$$\sqrt{(xs - xo)^2 + (ys - yo)^2 + (zs - zo)^2}$$

Segments of GPS

THREE SEGMENTS

- *Space Segment*
  - *Minimum of 24 satellites (currently 30) in orbit around Earth at altitude 20,000 km*
- *Control Segment*
  - *Satellites are tracked by ground stations*
  - *Navigation updates sent to satellites*
  - *Updates ephemeris data (position) and atomic clocks*
- *User Segment*
  - *GPS Receiver*
  - *Uses data from satellites to calculate user's position, altitude and other data*

Segments of GPS



Distance measurement by GPS

- Satellites broadcast radio signals (EM radiation)
- Simple, distance calculation d = v*t
- Velocity = velocity of light 3*10E8 m/s
- Time is known (difference between sender and receiver)
- Distance is calculated

Uses of GPS

Location - determining a position
Navigation - getting from one location to another
Tracking - monitoring object or personal movement
Mapping - creating maps of the world
Timing - bringing precise timing to the world

Any Queries?


THANK YOU
for your attention!