

Unit-8  
GLOBAL POSITIONING SYSTEM  
(GPS)

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# Global Positioning System(GPS)



- GPS is a global radio-navigation system formed from a constellation of 24 satellites and their ground stations.
- GPS is a product of Strategic Defense Initiative (SDI) (also known as “*Star Wars*” of Ronald Reagan)
- During the development of the GPS system, the emphasis was placed on the following three aspects:
  1. *It had to provide users with the capability of determining position, speed and time, whether in motion or at rest.*
  2. *It had to have a continuous, global, all-weather 3-dimensional positioning capability with a high degree of accuracy.*
  3. *It had to offer potential for civilian use.*

# Uses of GPS:

- **Though, GPS is funded and *controlled* by the U. S. Department of Defense (DOD) however, it is being used by civilians for:**
  - *positioning*
  - *georeferencing*
  - *navigation*
  - *time*
  - *frequency calibrations*
  - ...

*Based on the number of GPS receivers sold globally, road transport applications are the majority users of GPS positioning – for commercial fleet management and flight tracking, taxi services, public transport monitoring and passenger information, and emergency vehicle location, dispatch and navigation.*

## Characteristics of GPS:

- *Accurate Navigation (10 - 20 m)*
  - *Worldwide Coverage*
  - *24 hour access*
  - *Common Coordinate System*
- Accessible by Military and Civil
- GPS satellites circle the earth twice a day, 20,200 km above the earth a speed of about 14000 km/hr (3.9 km/second).
- Signals available anywhere on the earth, day and night.

# Component of GPS:

- **Space segment:**

24 satellites in 6 orbital planes (4 in each plane)

- equally spaced (60 deg. apart)

- inclined at about 55 deg. with respect to the equatorial plane

- Orbits in this height are referred to as MEO – medium earth orbit.

- The satellites have a speed of 3.9 km per

second and a nominal period of 12 h sidereal time (11 h 58m 2s),

repeating the geometry each sidereal day.

- GPS control segment:

*Control Segment: The Master Control Station and the globally dispersed Reference Stations used to manage the GNSS satellites, determine their precise orbital parameters and synchronize their clocks.*

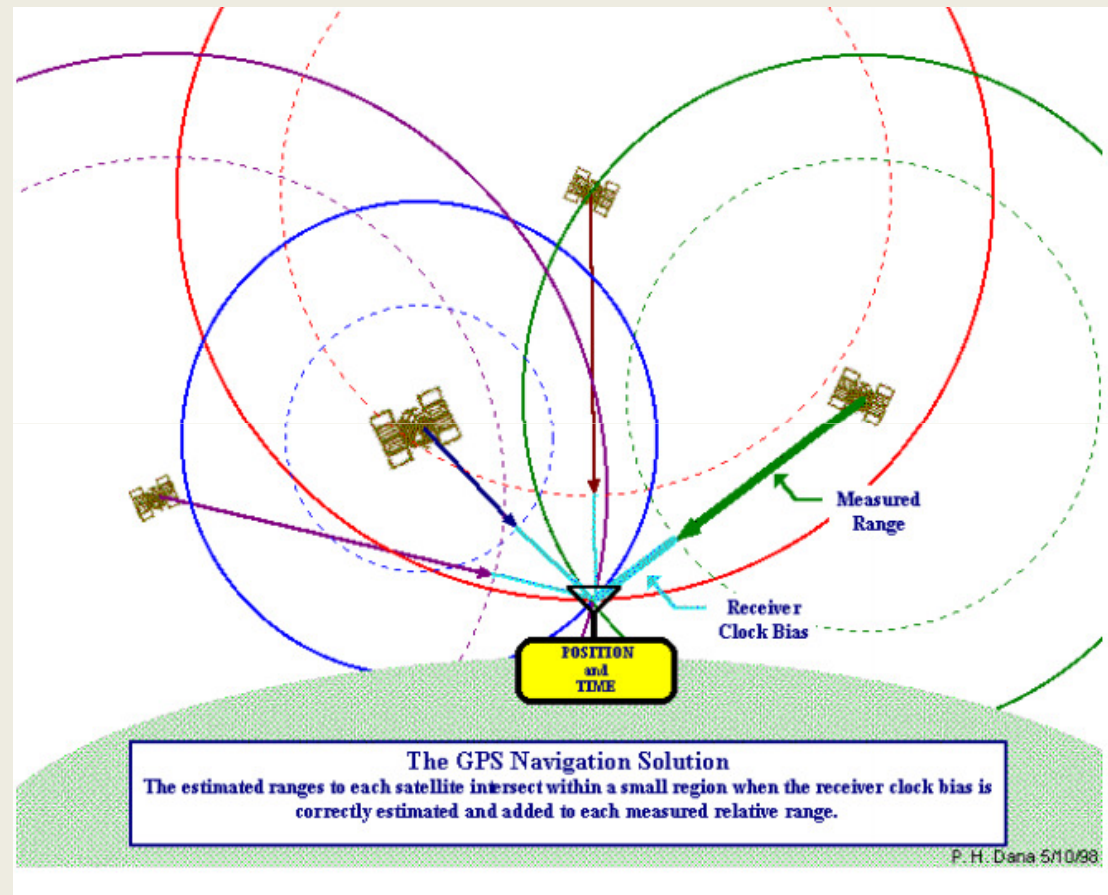


- User Segment of GPS:



# Computation of Position by GPS

- If only one satellite signal was available to a receiver, the best that a receiver could do to use the signal time to determine its distance from that satellite, but the position of the receiver could be at any of the infinite number of points defined by an imaginary sphere with that radius surrounding the satellite (the “range” of that satellite)





## Satellite Ranging

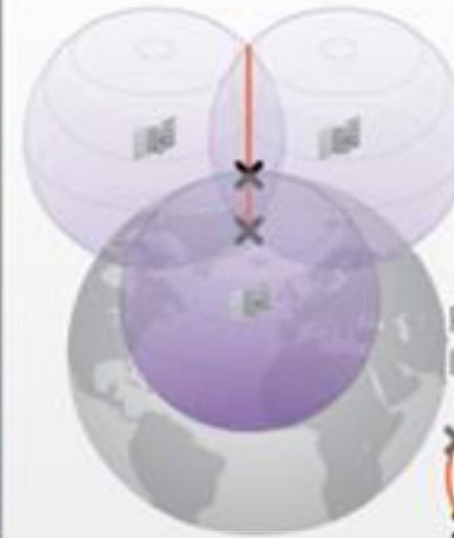


**One satellite:** Position is anywhere on surface of sphere.



Possible Locations

**Two satellites:** Position is anywhere on circle where spheres intersect.



Possible Locations

**Three satellites:** Position is one of two locations where all three spheres intersect.

Location nearest Earth is chosen.

- Three satellites are sufficient, at least theoretically, to provide receiver location
  - More satellites simply add confirmation to the receiver location
  - In practice, the more satellites the better
  - **Four satellites** are the minimum to secure only one, absolutely technically, trigonometrically unambiguous location (3D position)

THANK YOU