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Global Positioning System (GPS)

The **Global Positioning System** (**GPS**) is a space-based satellite navigation system that provides location and time information in all weather conditions.

The GPS project was developed in 1973.

Created and realized by the U.S. Department of Defense (DoD) and was originally run with 24 satellites.

Fully operational in 1995.

Bradford Parkinson, Roge L. Easton, and Ivan A. Getting are credited with inventing it.

Global Navigation Satellite System

- Global Positioning System (GPS – USA – 31 [24 operational + 7 operational spares + 9 Reserve]) (72 has been launched As of February 2016)
- GLONASS - Globalnaya Navigazionnaya Sputnikovaya Sistema (Russian – 24 operational [134 has been launched As of May 2016])
- COMPASS (BeiDou – 2 / BDS, Chinese – 20 operational [27 has been launched As of June 2016])
- Galileo (European Union – 13 operational [20 has been launched as of November 2016])
- NAVIC (Indian Regional Navigation Satellite System – 6 operational [7 has been launched as of January 2017])
- QZSS (Quasi-Zenith Satellite System – Japan – 1 [4 satellites; 7 will be operational in 2023])
- DORIS (Doppler Orbitography and Radio-positioning Integrated by Satellite - French)

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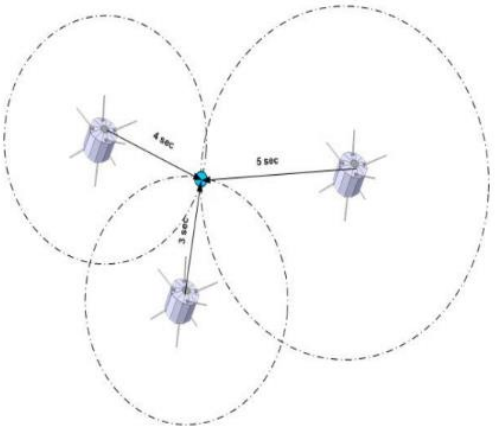
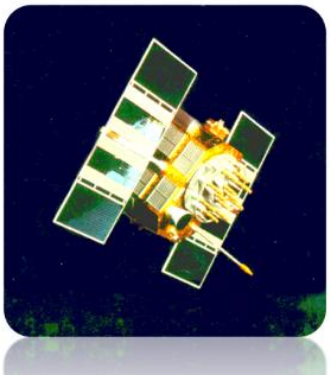
Four Primary Functions of GPS

- Position and coordinates.
- The distance and direction between any two waypoints, or a position and a waypoint.
- Travel progress reports.
- Accurate time measurement.

✓ In typical GPS operation, three or more satellites must be visible to obtain an accurate result





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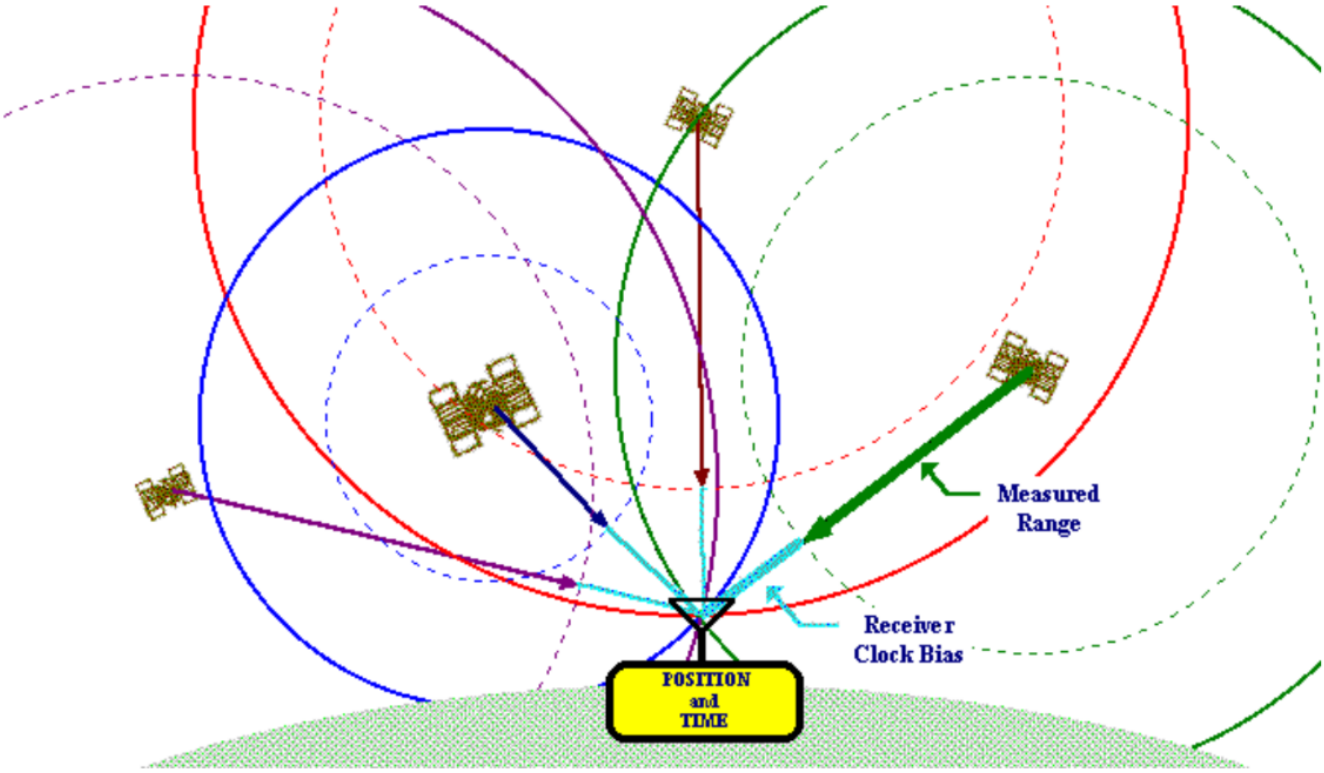

How a Receiver Determines Its Position

Traveling at the speed of light each satellite PRN (Pseudorandom Noise) signal takes a short, but measurable amount of time to reach a GPS receiver. The difference between when the PNR signal is sent and the time it is received, multiplied by the speed of light, enables a GPS receiver to accurately calculate the distance between it and each satellite, provided that several factors are met.

Those factors are:

- Good satellite signal lock by the GPS receiver
- A minimum of four satellite signals
- Good satellite geometry

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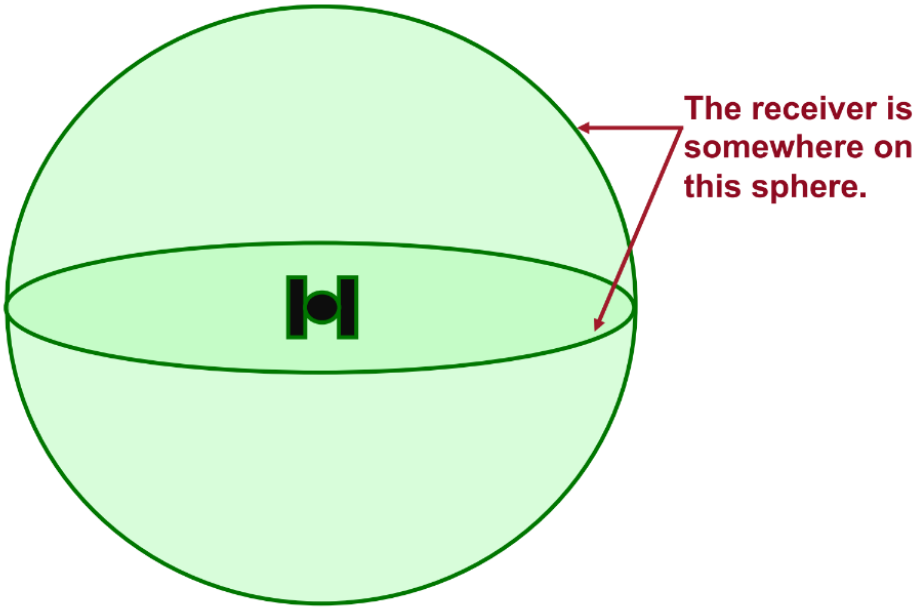
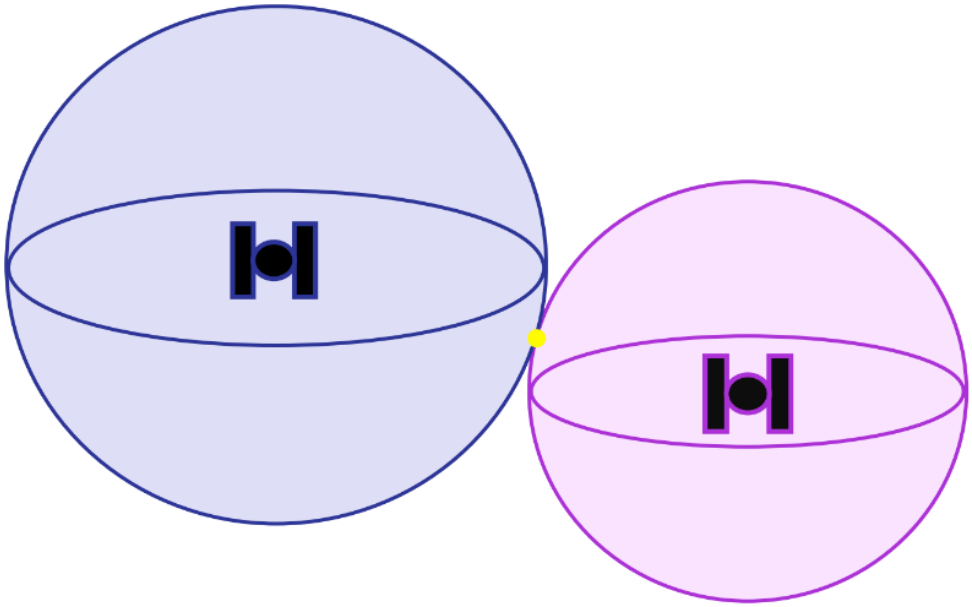
Signal From One Satellite



Signals From Two Satellites



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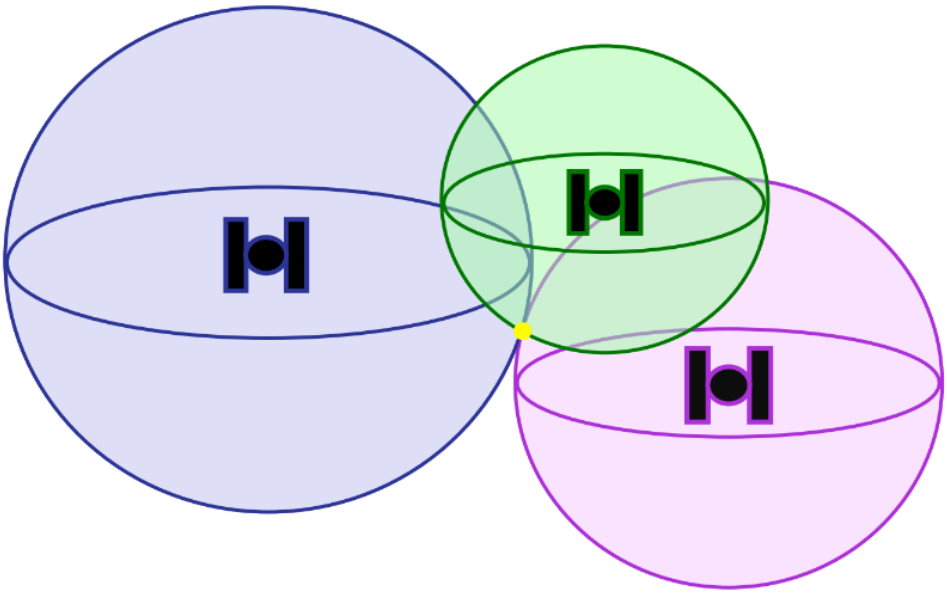
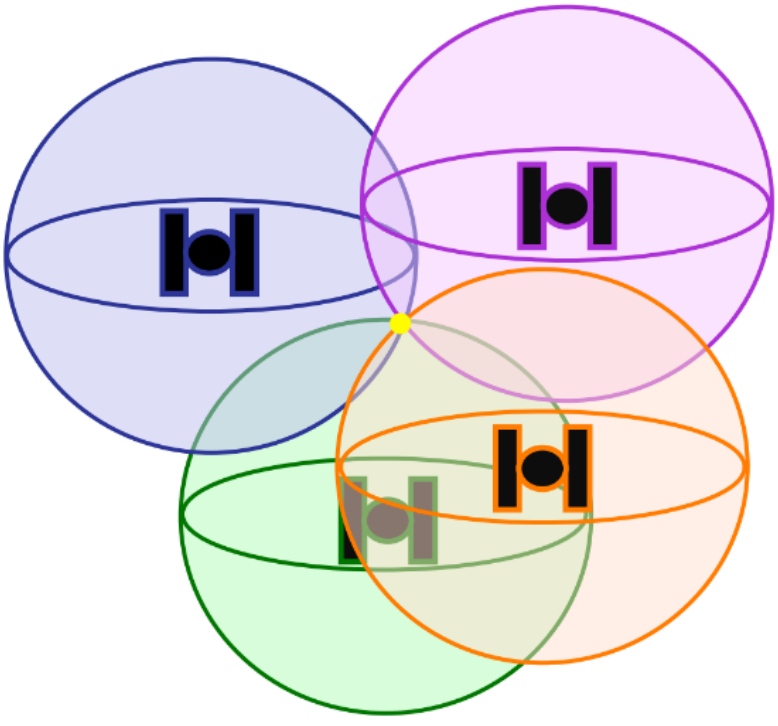
Three Satellites (2D Positioning)



Three Dimensional (3D) Positioning



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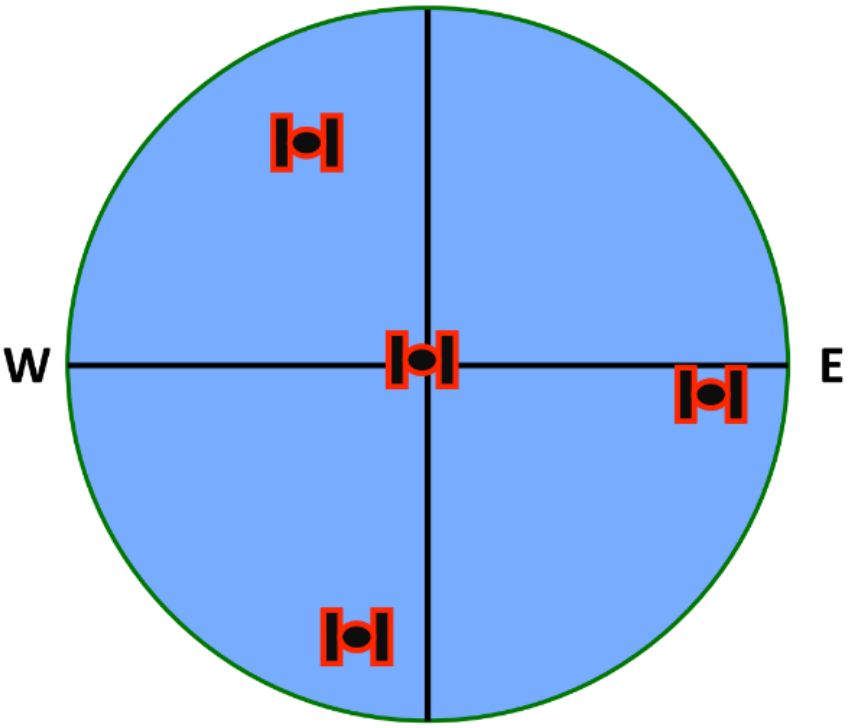
Ideal Satellite Geometry



Poor satellite geometry