What is GPS?

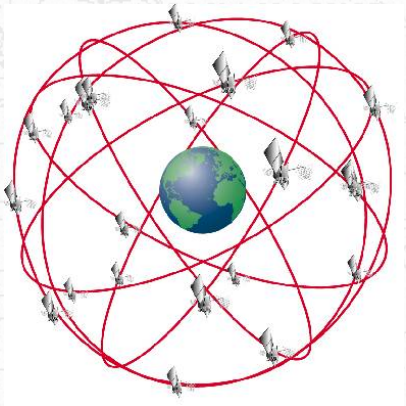
GPS, which stands for Global Positioning System, is the only system today able to show you your exact position on the Earth anytime, in any weather, anywhere.

The three parts of GPS are:

- Satellites
- Receivers
- Software

GPS Satellites

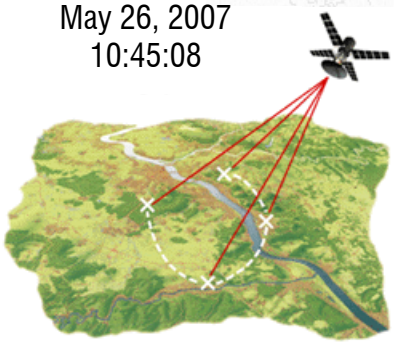
The GPS Operational Constellation consists of 24 satellites that orbit the Earth in very precise orbits twice a day. GPS satellites emit continuous navigation signals and data, which can be used to calculate location and time.



GPS Receivers

GPS receivers are made to communicate with GPS satellites to find out precisely, and in a split second the exact place, elevation, time, and speed.

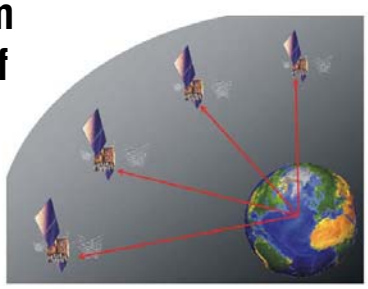
37° 23.323' N
122° 02.162' W
885 m (MSL)
May 26, 2007
10:45:08



Different grades of GPS units yield different precisions (from within 15 meters to subfoot).

Calculating Distance

GPS measures its distance from a satellite and the travel time of radio signals.



Signal travels at the speed of light, which is roughly 186,000 miles per second (mps).

Velocity x Time = Distance

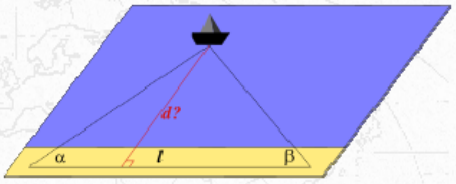
If it takes 0.06 seconds to receive a signal transmitted by a satellite floating directly overhead, one can use this formula to calculate one's distance from the satellite.

186,000 mps **x 0.06** seconds = **11,160 miles**

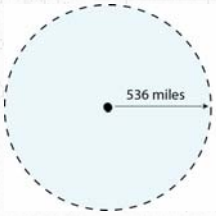
Triangulation

Geometric Principle:

You can find one location if you know its distance from other already known locations.



Triangulation can be used to find the coordinates and distance by angle measurements

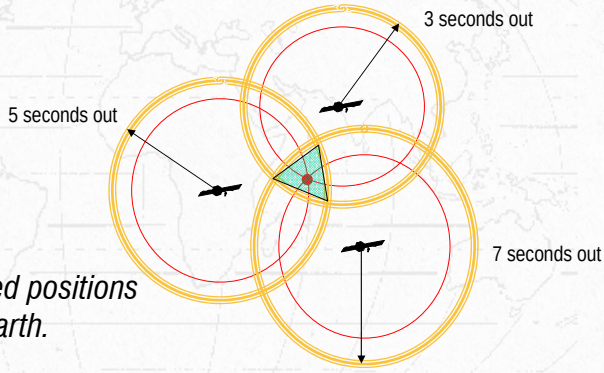


The Law of Sines: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$

where R is the radius of triangle's circumcircle

Trilateration

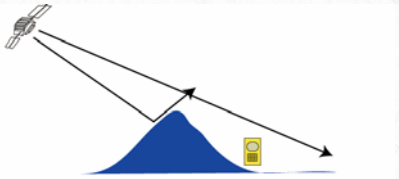
Ideally, the three spheres will intersect at a discrete point.



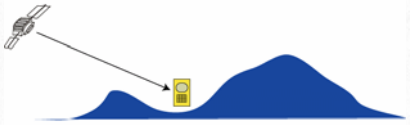
In GPS trilateration, the fixed positions are satellites orbiting the earth.

Signal Interference

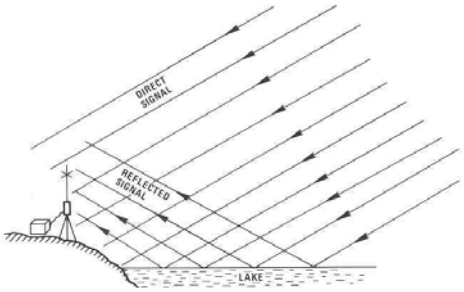
GPS transmissions are 'line of sight'. Sometimes the signals bounce off things before they hit the receivers.



No line of sight reception



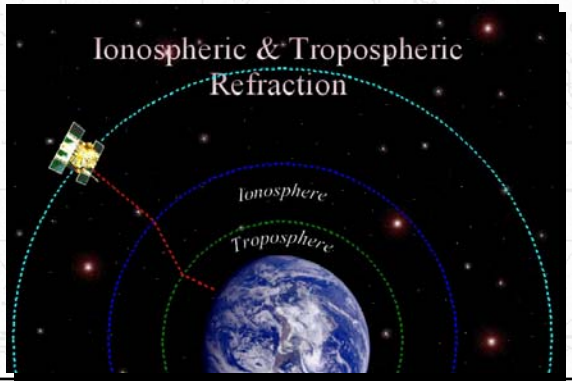
Line of sight reception



Obstructions such as trees, buildings, towers, or natural formation may prevent clear line of sight.

Signal Refraction

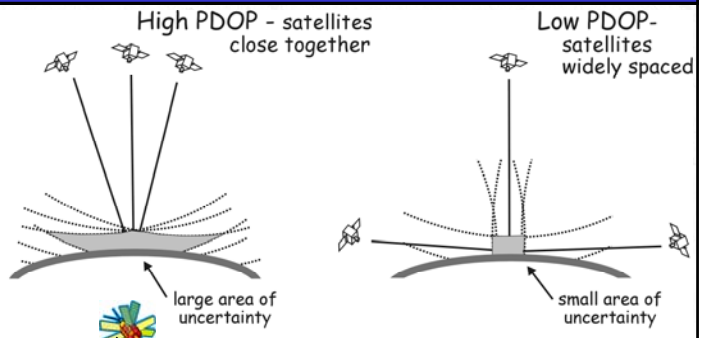
Signals from satellites can be bent a little when they hit some interference (air patterns in the atmosphere).

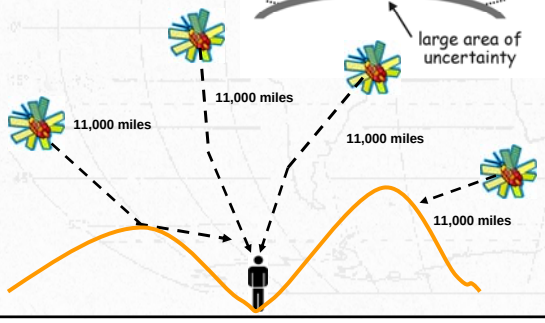


Satellite Distribution

PDOP = Positional Dilution of Precision

- <4 is excellent
- 4-8 is good
- 8 is poor





When the satellites are all in the same part of the sky, readings will be less accurate.

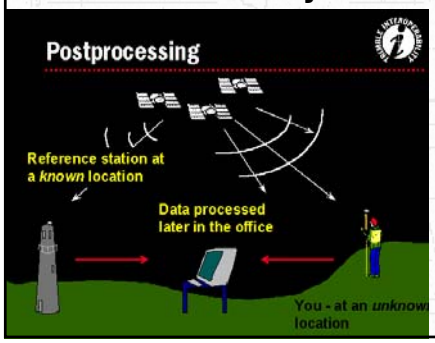
Improve Accuracy

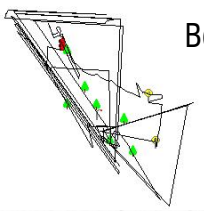
In the field….

A GPS antenna can reduce signal error.

In the office….

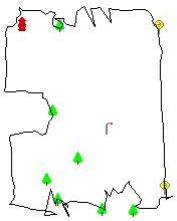
GPS software can correct GPS data collected by a user to improve accuracy.





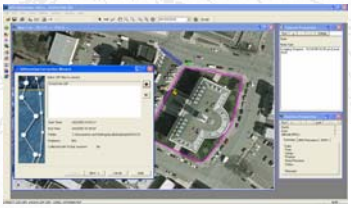
Before

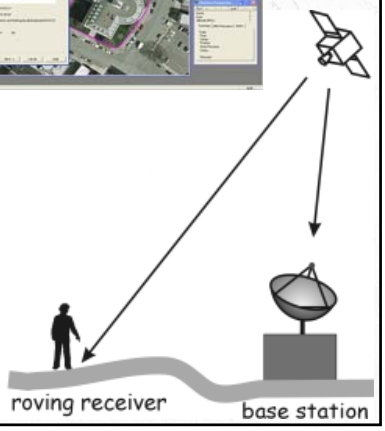
After



Differential Correction

Differential correction is a technique that greatly increases the accuracy of the collected GPS data. It involves using a receiver at a known location - the "base station"- and comparing that data with GPS positions collected from unknown locations with "roving receivers."





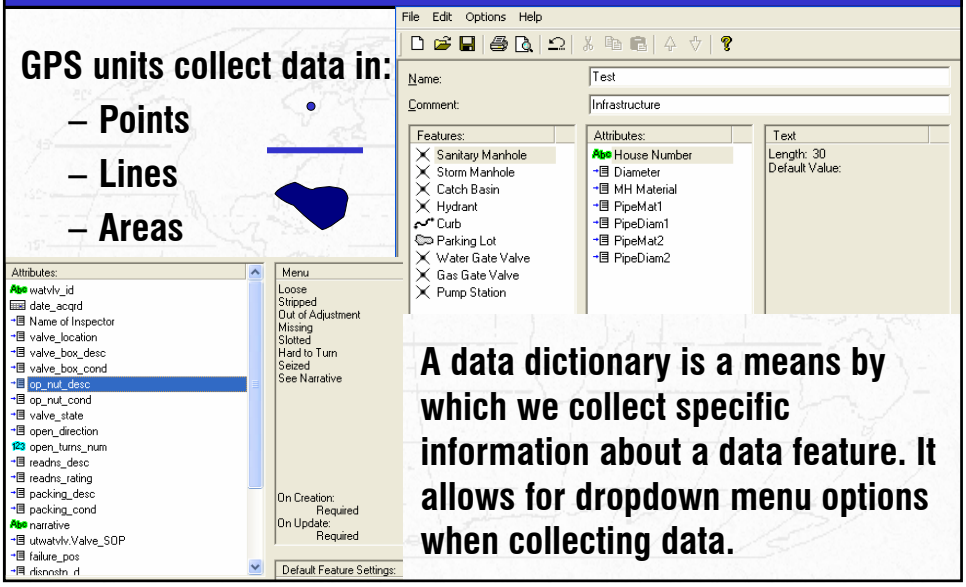
GPS Uses

- Utility and Asset Inventory
- Emergency Response
- Recreation & Tourism
- Navigation
- Incident Reporting
- Vehicle Tracking
- Code Enforcement
- Wetland Delineation
- Map makers
- Species Inventory
- Pollution Control

Data Dictionary

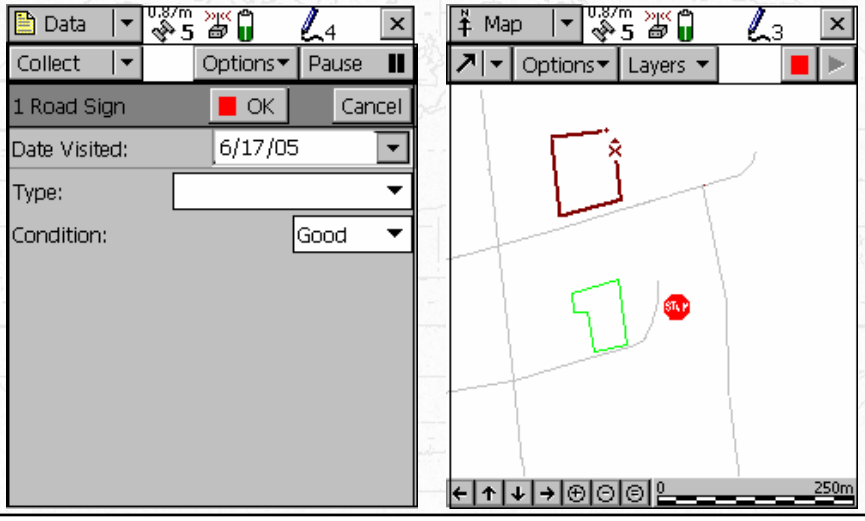
GPS units collect data in:

- Points
- Lines
- Areas



A data dictionary is a means by which we collect specific information about a data feature. It allows for dropdown menu options when collecting data.

GPS Field Data Collection



In a Nutshell

- GPS receivers are used for navigation, mapping or surveying
- GPS satellite signals are free
- Accuracy varies depending on the GPS receiver design
- Differential Correction is required to improve accuracy
- Integration with GIS is simple
- Spatial and tabular data are collected simultaneously
- The process is relative time concise, easy, and FUN

Questions

Trimble GeoXH Support
http://www.trimble.com/geoxh_ts.asp?Nav=Collection-36702

Trimble White Paper
http://www.trimble.com/geoxh_wp.asp

GPS World
http://www.gpsworld.com/gpsworld/

Let's try it out in the field!

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