

## Glossary of GPS Terminology

### **Autonomous Positioning**

The least precise form of positioning that a GPS receiver can produce. The position fix is calculated in real time from satellite data alone. Autonomous positions are generally accurate to within 10 meters.

### **Base station**

A base station is comprised of a GPS antenna and receiver positioned on a known location specifically to collect data for differential correction. Base data needs to be collected at the same time as you collect data with a GPS rover unit. A base station can be a permanent installation that collects base data for provision to multiple users, or a rover unit that you temporarily locate on known coordinates for the duration of a specific project or datalogging session.

### **Carrier Phase**

The difference between the carrier signal generated by the internal oscillator of a roving GPS receiver and the carrier signal emitted from a particular GPS satellite.

### **Coarse/Acquisition (C/A) Code**

A pseudorandom noise code (PRN) modulated onto a L1 signal which helps the GPS receiver to compute the distance from each satellite. Specifically, the difference between the pseudorandom number code generated by the GPS rover software and the pseudorandom number code coming in from the satellite is used to quickly compute the distance to a satellite and therefore calculate your position.

### **CORS (Continuously Operating Reference) Station**

A network of GPS base stations coordinated by the National Geodetic Survey for the purpose of providing GPS reference data to permit end users to perform post-processed differential correction of GPS data collected with roving receivers. Reference data is typically acquired via direct download from the Internet.

### **Data Dictionary**

A term used to describe the schema, or structure, that defines the relationship between features and their descriptive attributes that will be located in the field with a professional GPS receive. This description typically includes feature name(s), data type classification (point, line, or area), attribute names, attribute types, and attribute values. After being created on a PC, a data dictionary is transferred to a GPS datalogger and used when collecting data in the field.

### **Data Message**

A message included in the GPS signal, which reports a satellite's location, clock correction, and health. It includes information on other satellites' health and their approximate positions.

## **Datum**

A datum is a mathematical model of the earth's surface. World geodetic datums are typically defined by the size and shape of an ellipsoid and the relationship between the center of the ellipsoid and the center of the earth. Because the earth is not a perfect ellipsoid, any single datum will provide a better model in some locations than others. Therefore, various datums have been established to suit particular regions. For example, maps in the United States are often based on the North American datum of 1927 (NAD-27) or 1983 (NAD-83). All GPS coordinates are based on the WGS-84 datum surface.

## **Datum Transformation**

A datum transformation is a mathematical calculation that converts the coordinates of a position in one datum to coordinates in terms of another datum. Two types of datum transformations are supported by most professional grade GPS data collection and management software: three-parameter and seven-parameter. A datum transformation is used when the GPS results are required in terms of a local datum.

## **Declination**

See magnetic declination.

## **Differential Correction**

Differential correction is the process of correcting GPS data collected on a rover with data collected simultaneously at a base station. Because it is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real time, or after the data has been collected by post processing.

## **Dilution of Precision (DOP)**

An indicator of the quality of a GPS position, which takes account of each satellite's location relative to the other satellites in the constellation, and their geometry in relation to the GPS receiver. A low DOP value indicates a higher probability of accuracy.

Standard DOPs for GPS applications are:

PDOP – Position (three coordinates)

HDOP – Horizontal (two horizontal coordinates)

VDOP – Vertical (height only)

TDOP – Time (clock offset only)

## **Dual-frequency Receiver**

A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions by compensating for ionospheric delays.

## **Earth Centered, Earth Fixed (ECEF)**

A Cartesian coordinate system used by the WGS-84 reference frame. The center of the system is at the earth's center of mass. The  $z$  axis is coincident with the mean rotational axis of the earth, the  $x$  axis passes through  $0 \times N$  and  $0 \times E$ , the  $y$  axis is perpendicular to the plane of the  $x$  and  $z$  axes.

**EGNOS** (European Geostationary Navigation Overlay Service)

A satellite-based augmentation system (SBAS) that provides a free-to-air differential correction service for GPS users in Europe. EGNOS is the European equivalent of WAAS, which is available in the United States.

**Elevation Mask**

*See* Minimum elevation.

**Ellipsoid**

An ellipsoid is the three-dimensional shape that is used as the basis for mathematically modeling the earth's surface. The ellipsoid is defined by the lengths of the minor and major axes. The earth's minor axis is the polar axis and the major axis is the equatorial axis.

**Ephemeris**

The current satellite position predictions that are transmitted from a GPS satellite in the NAVDATA message.

**Epoch**

The measurement interval of a GPS receiver.

**Global Positioning System (GPS)**

GPS is the generic term used to describe the satellite-based timing and positioning system operated by the United States Department of Defense (DoD).

**Height Above Ellipsoid (HAE)**

HAE is a method for referencing altitude. Altitudes expressed in HAE are actually giving the height above the datum, not the ellipsoid. GPS uses the WGS-84 datum and all heights are collected in relation to this surface. It is important to use the same datum when comparing altitudes in HAE.

**Horizon** The line at which the earth and sky seem to meet for any particular observer.

**Horizontal Dilution of Precision (HDOP)**

*See* DOP.

**L1**

The primary L-band carrier used by GPS satellites to transmit satellite data. The frequency is 1575.42 MHz. It is modulated by C/A code, P-code and a 50 bit/second navigation message.

**L2**

The secondary L-band carrier used by GPS satellites to transmit satellite data. The frequency is 1227.6 MHz. It is modulated by P-code and a 50 bit/second navigation message.

## **Latitude**

Latitude is an angular measurement made from the center of the earth to north or south of the equator. It comprises the north/south component of the latitude/longitude coordinate system, which is used in GPS data collection. Traditionally, north is considered positive, and south is considered negative.

## **Longitude**

Longitude is an angular measurement made from the center of the earth to the east or west of the Greenwich meridian (London, England). It comprises the east/west component of the latitude/longitude coordinate system, which is used in GPS data collection. Traditionally, east is considered positive, and west is considered negative.

## **Magnetic Declination**

Magnetic declination is the difference between magnetic north and true north. Declination is expressed as an angle and differs between locations.

## **Magnetic North**

A bearing that is relative to magnetic north uses the north magnetic pole as its north reference.

## **Map Projection**

A defined method of transforming positions defined on an ellipsoid to a map grid; for example, the Transverse Mercator and Parallel Lambert projections.

**Maximum PDOP** The highest PDOP value at which a receiver will compute positions.

## **Mean Sea Level (MSL)**

Mean Sea Level is a method of altitude reference. Altitudes expressed in relation to MSL actually give a height above the geoid. It is important to use the same geoid when comparing altitudes in MSL.

## **Minimum Elevation**

The angle above and relative to the horizon, below which your GPS rover will not track satellites. It is normally set to 15° to avoid interference problems caused by buildings and trees and multipath errors.

## **Multipath**

Interference, similar to *ghosts* on a television screen, which occurs when GPS signals arrive at an antenna after traversing different paths. The signal traversing the longer path will yield a larger pseudorange estimate and increase positional error. Multipath occurs when GPS signals reflect off a surface before reaching the GPS antenna.

## **NAVDATA**

The Navigation Message broadcast by each GPS satellite on both the L1 and L2 transmitters. This message contains system time, clock correction parameters, ionospheric delay model parameters, and the satellite vehicle's ephemeris and health. A GPS receiver uses this information to process GPS signals and thus obtain user position and velocity.

## **NAVigation Satellite Timing And Ranging (NAVSTAR) System**

The formal name given to the United States Department of Defense's navigation and timing system comprised of GPS satellites, monitoring stations, and Master Control Station.

## **P-Code**

The precise code transmitted by the GPS satellites. Each satellite has a unique code that is modulated onto both the L1 and L2 carrier waves. The P-code is replaced by a Y-code when Anti-Spoofing is active.

**PDOP mask** *See* Maximum PDOP.

## **Position Dilution of Precision (PDOP)**

A unitless figure of merit expressing the relationship between the error in user position and the error in satellite position. Values considered *good* for positioning are small, such as 3. Values greater than 7 are considered *poor*. PDOP is related to horizontal and vertical DOP by the following formula:  
 $PDOP^2 = HDOP^2 + VDOP^2$ . *See also* DOP.

## **Postprocessing**

Postprocessing is the processing of satellite data after it has been collected in order to eliminate error. This involves using PC software to compare data from the rover to data collected at the base station. Because the base station is on a known location, systematic errors can be determined and removed from the rover data.

**Precision** A measure of the repeatability of a measurement.

## **Pseudorandom Noise or Number (PRN)**

A signal that carries a code that appears to be randomly distributed like noise, but can be exactly reproduced. PRN codes have a low auto-correlation value for all delays or lags, except when they are exactly coincident. Each NAVSTAR satellite has its own unique PRN code.

## **Radio Technical Commission for Maritime Services (RTCM)**

A commission established to define a differential data link for real-time differential correction of roving GPS receivers. There are two types of RTCM differential correction messages. Most modern GPS receivers use the newer Type 2.2 RTCM protocol.

## **Reference Station**

*See* Base station.

### **Root Mean Square (RMS)**

An expression of the accuracy of a point measurement. It is the radius of the error circle, within which approximately 68% of position fixes are to be found. RMS is typically expressed in distance units of feet or meters.

### **Rover/Roving Receiver**

Any mobile GPS receiver and data collector used for determining location in the field. A roving receiver's position can be differentially corrected relative to a stationary base GPS receiver.

### **RTK (Real-Time Kinematic)**

A real-time differential GPS method that uses carrier phase measurements for greater accuracy. RTK measurements typically yield relative horizontal accuracy of approximately one centimeter.

### **SBAS (Satellite Based Augmentation System)**

SBAS is the generic term that refers to differential GPS applied to a wide area, such as an entire continent. WAAS and EGNOS are examples of SBAS networks, and are comprised of a series of reference stations that generate GPS corrections which are broadcast to GPS rovers via geostationary satellites.

### **Selective Availability (SA)**

The artificial and deliberate degradation of GPS satellite signals by the United States Department of Defense. Selective Availability was implemented in order to enhance national security, but was turned off on May 10, 2000 due to the presence of several sources of various differential correction (DGPS) messages, which rendered SA obsolete.

### **Signal-to-Noise Ratio (SNR)**

The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dBHz. The quality of a GPS position is degraded if the SNR of one or more satellites in the constellation falls below 39. This value is used to determine whether the signal strength of a satellite is sufficient for that satellite to be used by the GPS receiver. If a satellite's SNR is below the configured minimum SNR, that satellite is not used to compute positions.

### **SV**

Satellite Vehicle or Space Vehicle.

### **Time Dilution of Precision (TDOP)**

*See* DOP.

### **True North**

A bearing that is relative to true north uses the north celestial pole as its north reference.

### **Vertical Dilution of Precision (VDOP)**

*See* DOP.

### **VRS (Virtual Reference Station)**

A VRS system consists of GPS hardware, software, and communication links. It uses data from a network of base stations to provide corrections to each rover that are more accurate than corrections from a single base station. To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the base station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM correction messages back to the rover.

### **WAAS (Wide Area Augmentation System)**

WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GPS signals over its coverage area, which includes the continental United States and outlying parts of Canada and Mexico. The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a channel on the GPS receiver, exactly like a GPS satellite.

### **Waypoint**

A waypoint is a geographical point that, unlike a feature, holds no attribute information beyond a name and location. Typically, waypoints are used to denote objects or locations of primary interest, such as a survey mark. Waypoints are most often used for navigation.

### **WGS-84**

World Geodetic System (1984), the mathematical ellipsoid used by GPS since 1984. *See also* Ellipsoid.