



GPS Glossary
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Accuracy: Position accuracy describes the *probable* difference between a calculated point position and the 'true' point position. 2DRMS accuracy represents a 95% probability that the position error will be less than the indicated quality value. For example, a displayed quality term of 0.6 meters means that there is a 95% probability that the reported position is within 0.6 meters of the 'true' position.

Almanac: The almanac is a temporary database of satellite orbital parameters and clock information. The almanac is broadcast weekly by the GPS satellites using information received from the Ground Control. Almanac information is primarily used for satellite reacquisition and session planning. The ephemeris is a much more precise set of parameters used for the data processing necessary to determine a position.

Azimuth: Azimuth is the horizontal angle measured clockwise from North (0 to 360 degrees).

Bandwidth: The range of frequencies in a signal.

C: Constant for the speed of light. Light speed is only constant in a vacuum. As a GPS signal passes through the charged particles of the [ionosphere](#) and then through the water vapor in the [troposphere](#) it gets slowed down a bit, and this creates the same kind of error as bad clocks.

C/A code: The Course/Acquisition GPS code is the civilian frequency of 1.023 MHz. It is used to quickly acquire the GPS signals and the military then uses this information to lock onto their more precise P-code frequency. The CA code carries digital sequence of 1023 pseudo-random, binary, biphasic modulations on the GPS carrier phase.

Carrier: The frequency of the unmodulated GPS frequency. This signal can be varied by modulation to carry data. GPS measurements are based on the L1 or L2 carrier signal. The actual GPS satellite signal which contains time tags and other navigation data is called the carrier signal. Accurate GPS receiver tracking of this carrier signal produces carrier phase measurements which are used to refine and improve on the pseudorange measurements.

Channel: A channel of a GPS receiver consists of the circuitry necessary to receive the signal from a single GPS satellite. A GPS receiver with 8 channels can track 8 satellites simultaneously.

Clock bias: The difference between the clock's indicated time and true universal time (UTC).



Code: GPS measurements based on the pseudo random code (C/A or P) as opposed to the carrier of that code.

Control segment: A world-wide network of GPS monitor and control stations (Ground Stations) that ensure the accuracy of satellite positions and their clocks.

Constellation: The arrangement in space of a set of satellites.

Constellation Change: A loss or acquisition change in the satellites being tracked that causes a change in the position being computed by the GPS receiver.

Cycle slip: A discontinuity in the measured carrier beat phase resulting from a temporary loss of lock in the carrier tracking loop of a GPS receiver.

Data message: A message included in the Almanac that reports the satellite's location, clock corrections and health. Included is rough information on the other satellites in the constellation.

Differential Correction: Differential correction is the process of removing “calculated” error observed by the roving GPS receiver by subtracting (differencing) the same observed error measured by the stationary GPS receiver (Base Station). Both the Rover and the Base must track the same GPS signals to remove the error. Private, Beacon and WAAS real-time corrections have supplanted post-processed differential corrections.

Dilution of Precision (DOP): DOP is the multiplicative factor that reduces positioning accuracy. It is caused solely by the geometry between the receiver and the satellites tracked. Dilution of Precision is a measure of the effect of satellite geometry on the accuracy of a position. Smaller values generally allow more accurate positions. Different variations of this measure indicate the effect in different directions: horizontal DOP (HDOP) indicates the effect in horizontal directions (two dimensional), vertical DOP (VDOP) indicates the effect in the vertical direction (one dimensional), and position DOP (PDOP) indicates the combined effect in three dimensions.

Doppler-aiding: The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver. This signal processing strategy uses a measured Doppler shift of the GPS signal to help the receiver smoothly maintain the track of the GPS signal. This allows more precise velocity and position measurement.

Dual Frequency: Another technique called "Carrier-phase GPS" takes advantage of the GPS signal's carrier signal to improve accuracy. The carrier frequency is much higher than the GPS signal which means it can be used for more precise timing measurements.

Elevation Mask: The elevation mask is the term given to the user-entered lowest elevation (in degrees) at which a receiver will track satellites. An elevation mask value of 15 degrees is commonly adopted.



Ephemeris: The predictions of current satellite position that are transmitted to the user in the data message. An ephemeris is a set of short-term satellite orbital parameters which are used to determine satellite coordinates during processing. An almanac is a similar set of parameters with a longer interval of use and lower precision.

Frequency band: A particular range of frequencies.

Frequency spectrum: The distribution of signal amplitudes as a function of frequency.

Ground Stations: The Control Segment includes stations that monitor the GPS satellites, checking both their operational health and their exact position in space. The master ground station transmits corrections for the satellite's ephemeris constants and clock offsets back to the satellites themselves. The satellites can then incorporate these updates in the signals they send to GPS receivers. The five monitor stations are in Hawaii, Ascension, Diego Garcia, Kwajalein, and Colorado Springs.

Hardover word: The word in the GPS message that contains synchronization information for the transfer of tracking from the C/A to P code.

IALA: International Association of Lighthouse Authorities. Many IALA member organizations broadcast free dGPS corrections on their maritime radio beacons. These stations often transmit on the radio beacons that are already in place for radio direction finding (usually in the 300kHz range).

Ionosphere: The band of charged particles 80 to 120 miles above the Earth's surface. The ionosphere is the layer of the atmosphere ranging in altitude from 50 to 500 km. It consists largely of ionized particles that perturbate and refract the GPS signals. While much of the error induced by the ionosphere can be removed through mathematical modeling, it is still one of the most significant error sources.

Latitude: Latitude is the North or South component of a location on the earth's surface, usually given in degrees.

Longitude: Longitude is the East or West component of a location on the earth's surface, usually given in degrees.

L-band: The group of radio frequencies extending from 390 MHz to 1550 MHz. The GPS carrier frequencies (1227.6 MHz and 1575.42 MHz) are in the L band.

Measurement: A measurement is a single one-way range estimate between a receiver and a satellite. If five satellites are tracked, an epoch of data collection will yield five measurements. A minimum of four measurements per epoch is required to achieve position results within product specifications. Collecting more than four satellite measurements per epoch improves position accuracy by increasing the strength of the satellite geometry, and by providing the position determination with greater redundancy.



Modelling: A mathematical tool to estimate the atmospheric error by estimating the typical GPS signal delay on a typical day for a local region of the Earth.

Multipath error: Errors caused by the interference of a signal that has reached the receiver antenna by two or more different paths. Usually caused by one path being bounced or reflected.

NMEA-0183: National Marine Electronics Association, (USA) Standard # 0183, is for the interconnection of marine electronic devices (including GPS receivers and dGPS Beacon receivers.) It specifically covers the signal requirements, protocols, timing and formats for one-way, 4800-baud data transfer.

P-code: The Precise code. A very long sequence of pseudo random binary biphasic modulations on the GPS carrier at a chip rate of 10.23 MHz which repeats about every 267 days. Each one-week segment of this code is unique to one GPS satellite and is reset each week. The P-code handles the Precise Positioning Service (PPS) with is the most accurate dynamic positioning possible.

PDOP: Position Dilution of Precision (or PDOP) is a measure of the combined effect of satellite geometry on the accuracy of a position in three dimensions. Smaller values generally allow more accurate positions.

Pseudolite: A stationary, ground-based differential GPS receiver which transmits a signal like that of an actual GPS satellite. It is used for local, accurate ranging, typically around airports for aircraft landing.

Pseudo random code: A signal with random noise-like properties. It is a very complicated but repeating pattern of 1's and 0's.

PRN: The Pseudo Random Noise (PRN) Code is a unique code broadcast by each GPS satellite, commonly used for identification.

Pseudorange: A distance measurement based on the correlation of a satellite transmitted code and the local receiver's reference code, that has not been corrected for errors in synchronization between the transmitter's clock and the receiver's clock. Pseudorange measurements are based on time tags encoded on the GPS satellite signals and, except for satellite and receiver clock misalignment, are equivalent to the distance between the satellite and GPS receiver near the Earth's surface.

RINEX: The Receiver INdependent EXchange Format is an industry-wide standard GPS file format. Differential Processors can use RINEX files as reference files. RINEX files are typically produced by community base stations whose correction files are available for public downloading.



RMS: The root mean square or *rms* is a statistical measure of the magnitude of a varying quantity. It can be calculated for a series of discrete values or for a continuously varying function. The rms of a series of n values x_0 to x_{n-1} is:

$$x_{\text{rms}} = \sqrt{\left(\sum_{n=0}^{n-1} (x_n^2) / n \right)}$$

RTCM: Radio Technical Commission for Maritime services, is a standards-setting organization concerned with the GPS system. RTCM corrections are differential corrections that are broadcast from a known reference point, and received and applied in real time by a rover unit during collection.

Selective Availability (SA): A policy adopted by the Department of Defense to introduce some intentional clock noise (dithering) into the GPS satellite signals thereby degrading their accuracy for civilian users. This policy was discontinued as of May 1, 2000 and now SA is turned off.

Space segment: The part of the whole GPS system that is in space, i.e. the satellites.

Spread spectrum: A system in which the transmitted signal is spread over a frequency band much wider than the minimum bandwidth needed to transmit the information being sent. This is done by modulating with a pseudo random code, for GPS.

Standard Positioning Service (SPS): The normal civilian positioning accuracy obtained by using the single frequency C/A code. Standard Positioning Service (SPS) comprises GPS signals broadcast on the L1 frequency which allow point positioning with an accuracy of approximately 100 meters during SA and now appears to be about 15 meters accurate without SA.

Static positioning: Location determination when the receiver's antenna is presumed to be stationary on the Earth. This allows the use of various averaging techniques that improve accuracy by factors of over 1000.

Triangulation/Trilateration: Triangulation uses angles to determine your location. But GPS uses distance measurements termed "trilateration" to determine your location. Triangulation is an incorrect term that most people understand.

Troposphere: The troposphere is the lower part of the earth's atmosphere that encompasses our weather. It's full of water vapor and varies in temperature and pressure. But as messy as it is, it causes relatively little error. Physics says that as light moves through a given medium, low-frequency signals get "refracted" or slowed more than high-frequency signals.



User interface: The way a receiver conveys information to the person using it. The controls and displays.

User segment: The part of the whole GPS system that includes the receivers of GPS signals.

UTC: Universal Time Coordinated, the same as GMT and Zulu time.

SV: Space Vehicle --- NAVSTAR GPS satellites built by Rockwell International. They weigh 1900 lbs and measure 17 ft with solar panels extended. The orbit is 10,900 nautical miles takes 11 hrs 58 minutes. Their life is 7.5 years and are being replaced by 24 Block II production satellites and those are to be replaced by 21 Block IIRs developed by Martin Marietta.

WAAS: Wide Area Augmentation System in the aviation industry is developing a type of GPS called "**Augmented GPS**" which involves the use of a geostationary satellite as a relay station for the transmission of differential corrections and GPS satellite status information. These corrections are necessary if GPS is to be used for instrument landings. The geostationary satellite would provide corrections across an entire continent.

WGS-84 Coordinates: WGS84 coordinates use the World Geodetic System (1984) mathematical ellipsoid. WGS is a three-dimensional Cartesian coordinate system with its origin at the Earth's center and distances measured in meters.