Global Positioning System

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How does GPS work? Describe the system.

The GPS (Global Positioning System) is a U.S. worldwide navigation system consisting of three main components. These are the space segment, the control and check segment and the user segment.

The space segment includes 24 GPS satellites in orbit 20 200 km above the Earth. The satellites are on six orbits with a declination of 60°. Each satellite contains propulsion and navigation system, power supply system, computer, atomic clocks, nuclear tests detectors and radio transmitter/receiver. The navigation signal is broadcast on the L-band. Freqency L1 (1575,42 MHz) carries a publicly usable coarse-acquisition (C/A) code as well as an encrypted precision P(Y) code. L2 (1227,60 MHz) usually carries only the P(Y) code, but also carries a second C/A code on the modernized Block II-R GPS satellite series and subsequent satellites. L3 (1381,05 MHz) carries the signal for the GPS constellation's alternative role of detecting missile/rocket launches, nuclear detonations, and other high-energy infrared events. L4 (1841,40 MHz) is used for additional ionospheric correction and L5 (1176,45 MHz) is proposed for use as a civilian safety-of-life (SoL) signal. The first Block IIF GPS satellite that would provide this signal is set to be launched in 2008. Binary data are parting to 30 bits words, 24 of which carry informations and 6 bits are Hamming's code. These data are modulated by Binary Phase Shift Keying (BPSK) and more over each satellite codes signal by CDMA (Code Division Multiple Access) with unique Gold's code seqeunce.

The ground-based segment provides control and check GPS satellites. The flight paths of the satellites are measured by five monitor stations around the world (Hawaii, Kwajalein, Ascension Island, Diego Garcia, and Colorado Springs). The master control station, at Schriever Air Force Base, processes their combined observations and sends updates to the satellites through the stations at Ascension Island, Diego Garcia, and Kwajalein. The updates synchronize the atomic clocks on board each satellite to within one microsecond and also adjust the ephemeris of the satellites' internal orbital model to match the observations of the satellites from the ground.

The position calculated by a GPS receiver relies on three accurate measurements: the current time, the position of the satellite, and the time delay for the signal. The GPS accuracy is 20 meters with SPS (Standart Positioning Service) or 16 meters with PPS (Precision Positioning Sevice). PPS is only for military service. In NavWar mode (Navigation War) is accuracy with SPS about 300 meters, but with PPS is the same. Differential GPS (DGPS) can improve the normal accuracy to 1 – 3 meters. DGPS uses a network of stationary GPS receivers to calculate the difference between their actual known position and the position as calculated by their received GPS signal. The "difference" is broadcast as a local FM signal, allowing many civilian GPS receivers to "fix" the signal for greatly improved accuracy.