The different types of satellite constellation designs are,

1. Global positioning system
2. Global star
3. Iridium satellite constellation
4. GLONASS star etc.

1. Global Positioning System

GPS abbreviates global positioning system which contains 24 to 32 Medium Earth Orbit (MEO) satellites in its constallation. It was developed by defense department of United States of America.

GPS is defined as the process of determining the position of a point with reference to its latitude, longitude, elevation etc. from the known point of fixed baseline. It is also called Navstar i.e., Navigation Satellite Timing and Ranging.

The simplified schematic of GPS system is shown in figure (1).

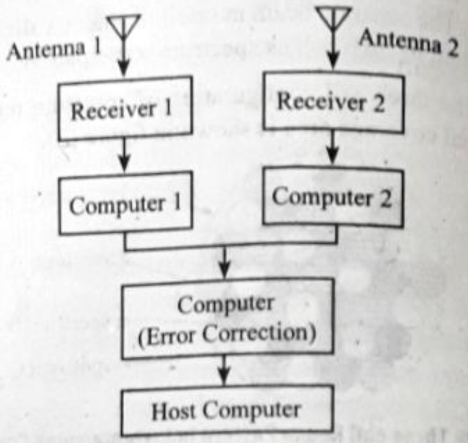

Figure (1): GPS System

Antennas 1 and 2 receives the information and then forwards to the receivers 1 and 2. The receivers output is fed to the respective computers where error-detection is carried. The error signal is produced from the comparison of relative strengths of the received signal. This information is then analyzed by host computer to give the location of position.

There are three major segments in GPS. They are,

(i) The control segment

(ii) The space segment

(iii) The user segment.

(i) The Control Segment

The control segment consists of three monitoring stations to serve as uplink transmitter and 100 monitoring stations to serve as master control stations. It is used to launch, maintain and monitor all GPS satellites.

(ii) The Space Segment

The space segment consists of 24 NAVASTAR satellites (in which 21 are operational and 3 are in-orbit spares) arranged in 6 orbital planes inclined at 55° with equator. The satellites orbit at 20000 km of altitude at 12-hour rotation period. They are used for self-monitoring and data processing based on on-board computer and atomic clocks present in it.

(iii) **The User Segment**

The user segment comprises earth based GPS receivers that decodes the timing signals from four satellites at a time. It gives the distance, latitude, elevation, longitude and time of the position point.

Differential GPS

Differential GPS (DGPS) techniques are used to improve the accuracy of GPS measurements. One among these techniques uses comparative phase of most signals in GPS transmission so as to improve the accuracy of the GPS timing measurements. Assume that the number of cycles of L_1 (1575 MHz) carrier wave between GPS receiver and the satellite are countable, and the GPS satellites are motionless for the period of time it takes to count at two different locations. The L_1 carrier thus has a wavelength of 0.19043 m. Therefore, for a drift of the receiver by 0.01 m away from satellite, it will result in change of phase of received wave by 18.9°. If the total number of cycles between the GPS receiver and satellite are identified and calculations of fractional cycles is done with a phase resolution of 2.0° then the exact length to the satellite can be known with an accuracy of 0.01 m. This method of finding the receiver movements at centimeter level is known as differential phase GPS or kinematic DGPS.

Counting the number of L_1 carriers between the GPS receiver and the satellite is very difficult. Yet, the phase angle calculations, comparing the time of arrival of different GPS signals at two separate locations and the movement between the two locations can be determined. The measurements are a bit simple if one among the receivers is fixed. This fixed receiver helps in finding the accurate location of other GPS receiver.

The complexity in DGPS phase comparison measurements is the L_1 carrier, because the wave replicates itself for every 0.19043 where one cycle is similar to the next. This results in range ambiguity that should be resolved with respect to wavelengths of other signals.

The P-code (10.23 MHz) transmission of L_1 carrier has chip length of 29.326 m. This length is 154 cycles of the L_1 carrier.

The range ambiguity of carrier waveform can be determined within the length of P code chip. This is possible by comparing the time of arrival of any cycle of L_1 carrier with starting time of P-code chip. The P-codes can be included in real-time differential calculations even without having its knowledge as only their time of arrivals comparisons of code bits are needed.

Uses

The differential phase GPS or kinematic DGPS is used for the following,

1. For the purpose of land surveying. For example, establishing a reference station at a predetermined location.
2. For determining position of aircraft comparative to the runway of an airport so as to set up the approach path.
3. For tracking flight paths of an aircraft to a 2 cm accuracy for distance of tons of kilometers.