Global Positioning System

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**Abstract**

Gps is worldwide utility that allows us to know where we are, what time it is with great accuracy anywhere. In this paper, I’ll be writing about the background of GPS, the development and different versions of the GPS system. Gps originated during the cold war which coincidentally was also the sputnik era in the 20th / 21st century. It has been very beneficial to the day to day activities. I will explain on the 3 segments of GPS operation which is

* GPS ground control satellite
* GPS satellite
* GPS receiver

We also talk about the different versions such as

* BeiDou-2 ( used in china)
* Glonass (used in Russia)
* Galileo (used in UK)
* GPS (used in the USA)

**Background**

Gps is worldwide utility that allows us to know where we are, what time it is with great accuracy anywhere. Gps originated during the cold war which coincidentally was also the sputnik era in the 20th / 21st century. The scientist at MIT in October 4th 1957 discovered that the frequency of a small Russian satellite radio signal increases as it approaches and decreases as it moves away same way sound waves behave, this is known as Doppler effect.

By recognizing that phenomenon, they realized satellites can be tracked from the ground by measuring their radio signal frequency emitted. Basically, that led to the founding of GPA technology.

Transit is the first satellite navigation system, it was developed by the US military in 1960, the satellites travelled on well-known paths and known frequency, by monitoring this frequency shift over time, the receiver will be able to determine its location to one side or the other of the satellite. Several measurements merged together with a precise knowledge of the satellite's orbit can fix a particular position.

**Variation of GPS technology**

**Galileo:** In march 2002, the European union’s space agency decided to have their own version of GPS, they called it the Galileo positioning system. This took full effect on the 15th of December 2016 costing an estimated of 3 billion euros. Galileo is expected to be compatible with the GPS, and the receiver will be able to combine both the galileo and gps satellites which will greatly increase accuracy. Galileo is expected to be at full service by 2020 but at a relatively higher cost. The main modulation of used is Open Service signal.

**BeiDou-2:** China have plans of upgrading their positioning system by 2020, this will be improving from COMPASS, it will consist of 30 MEO satellites and 5 geostationary satellites. They are expanding current regional services into global coverage by 2020.

**Glonass:** the global navigation satellite system is a space based satellite navigation system that provides a civilian radio navigation-satellite service. This form of global positioning system is founded and used by the Russians

**Operational principle of GPS**

Orbital data is broadcasted by a satellite, which contains the precise time and position the signal is transmitted. The satellite uses an atomic clock to maintain synchronization of all the satellites in the constellation. The time of broadcast is received by the receiver and compared thereby, measuring the time of flight to each satellite. With each distance measurement, regardless of the system being used, places the receiver on a spherical shell at the measured distance from the broadcaster. By taking several such measurements and then looking for a point where they meet, a fix is generated. For fast moving receivers, as signals are received from different satellites, the position of the signal moves and the radio signals slow slightly as they move through different ionosphere.

**How global positioning system works**

The Global Positioning system consists of 3 different parts which work in unism.

1. GPS Ground control Satellites:

This segment known as the control segment uses measurements collected by the monitor stations to predict the behavior of each satellite's orbit and atomic clocks. The prediction data is linked up to the satellites for transmission to users, this segment also ensures that GPS satellites remind along their orbits and within limits, also it ensure that the satellites do not drift away. Example of master control stations includes Colorado spring, Hawaii, Ascension Island in the Atlantic, Kwajalein Island, and also the monitor station at Falcon AFB.

1. GPS Receiver

GPS receivers vary is different versions. We have the ones use in cars, and GPS is also incorporated in devices such as phones e.t.c, this is the device that gives us access to GPS services. Luckily, out of the 3 branches of a GPS system, this is the only aspect we get to pay for. Going to places you have never been before, or travelling on routes you have never travelled on has been made earlier thanks to GPS devices. Once lost, feel free to use your phone and find yourself even without the use of the internet.

1. GPS satellites

With each orbit lasting 12 hours, the gps satellites orbit in circular orbits at 17,440 km altitude. The orbits are tilted to the equator by 55 to ensure coverage in polar regions. The satellites are powered by solar cells to continually orientate themselves to point the solar panels towards the Sun and the antennas towards the Earth. Each satellite contains four atomic clocks. The space segment include the satellites and the delta rockets that launch the satellites from cape Canaveral in Florida.

**Advantages of GPS**

1. DEVICE OPTION: GPS units come in a variety of different formats. For example, certain vehicles come equipped with a built-in system that uses a CD or a satellite to provide directions. If your car lacks this capability, however, portable GPS devices you can mount on the windshield or dash offer the same functionality. In addition, many smartphones feature a navigation system that you can keep at your fingertips. This type of GPS device diversity offers a solution to meet most needs.
2. AFFORDABILITY: luckily, consumers of gps services only get to pay for one out of 3 fragments of this technology. We do not pay for the satellite services in space or ground control service, all we pay for is the receiver device. The signal is free to access anywhere without the aid of internet
3. REGULAR UPDATE: Most times, constructions happen which may lead to closure of routes and change in path but thanks to the US government, there is regular update which alerts users when there is a road block and shows alternate routes.

**Limitations of GPS**

1. SYSTEM TROUBLE: When you forego maps for GPS, you may find yourself in a bind in certain situations. For example, if you are in an area that can't gain access to the satellite, you must wait until you are within satellite range before you can get directions. Likewise, a smartphone navigation system only works where you have cellular service. Other potential problems include dead batteries, lost cables and complete hardware failure.
2. BATTERY LIFE: most GPS receivers have limited battery life, in a scenario whereby one is stranded with no way to recharge and the devices dies, this will be a dangerous or stressful situation for a user. The dependence on a GPS device in most times might be a case of life and death.
3. UNFORESEEABLE REASONS: Sometimes the GPS may fail due to certain reasons and in that case you need to carry a backup map and directions.
4. WEATHER CONDITION: Sometimes the GPS signals are not accurate due to some obstacles to the signals such as buildings, trees and sometimes by extreme atmospheric conditions such as geomagnetic storms.

**REFERENCE AND APPENDIX**

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