AN INTRODUCTION TO GPS

The global positioning system or GPS as we know it is more accurately defined as **a navigational system that relies on satellite signals to show an objects location**

There are many different types of navigational satellite systems from countries across the world but the most popular and commonly used system is Navstar which is the United States system.

Work was started on this technology in the 1950s but it was not until 1978 that the US Department of defence launched the first GPS satellites for military purposes. They were made available for civilian use in the 1980s. Today GPS satellites are operating with coverage in most parts of the world.

There are Russian, Indian, Chinese and European equivalent systems although the Chinese and Indian systems sit in a geosynchronous orbit above their countries which means that they can only be used in those countries so they are not a worldwide system.

So how does GPS work?
A minimum of 24 satellites are required for the GPS system to function but Navstar has around 31 solar powered satellites circling the globe at any one time in case one fails. These satellites orbit the Earth twice a day, at around 13,000 miles or 20,000 km above us.

GPS satellites are set up in such a way that from almost anywhere on the surface of the Earth there is a direct line of sight to at least four satellites.

As GPS units are receivers, there needs to be some sort of signal sent out– for a device (like your phone) to receive. The apps on your devices work by receiving signals from the satellites

Each satellite (built to last approximately 10 years) broadcasts a navigational message towards earth. This message contains two pieces of information:

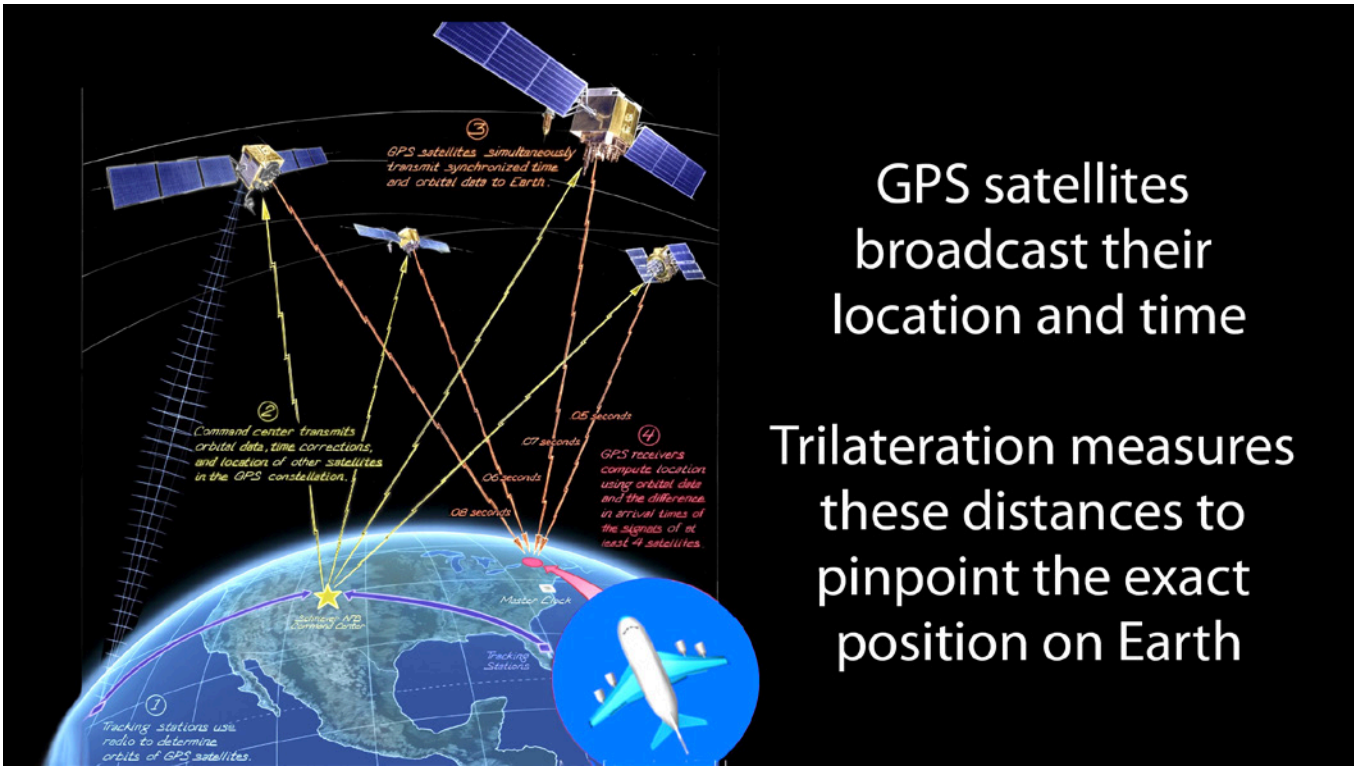
1. – **The current time**, which contains an extremely accurate timestamp (obtained through atomic clocks on board the satellites) and

2. – **Where exactly above the Earth the satellite is at that time.**

The GPS receivers, such as your phone, or navigational units in your cars, use these two pieces of

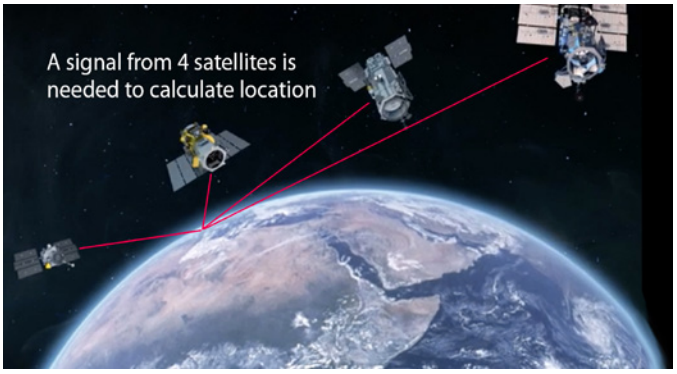
information to do a special calculation called trilateration (not triangulation or multilateration which is a common misconception with GPS) allowing you to see where you are on the planet at any moment typically down to 5 to 10 metres on avarage.
As GPS satellites broadcast their location and time, the apps in our receivers compare the time that the signal was sent from the satellite, with the time that the signal was received.

The difference in time indicates the distance between the receiver and the satellite.



Trilateration measures these distances to pinpoint the exact position on Earth.

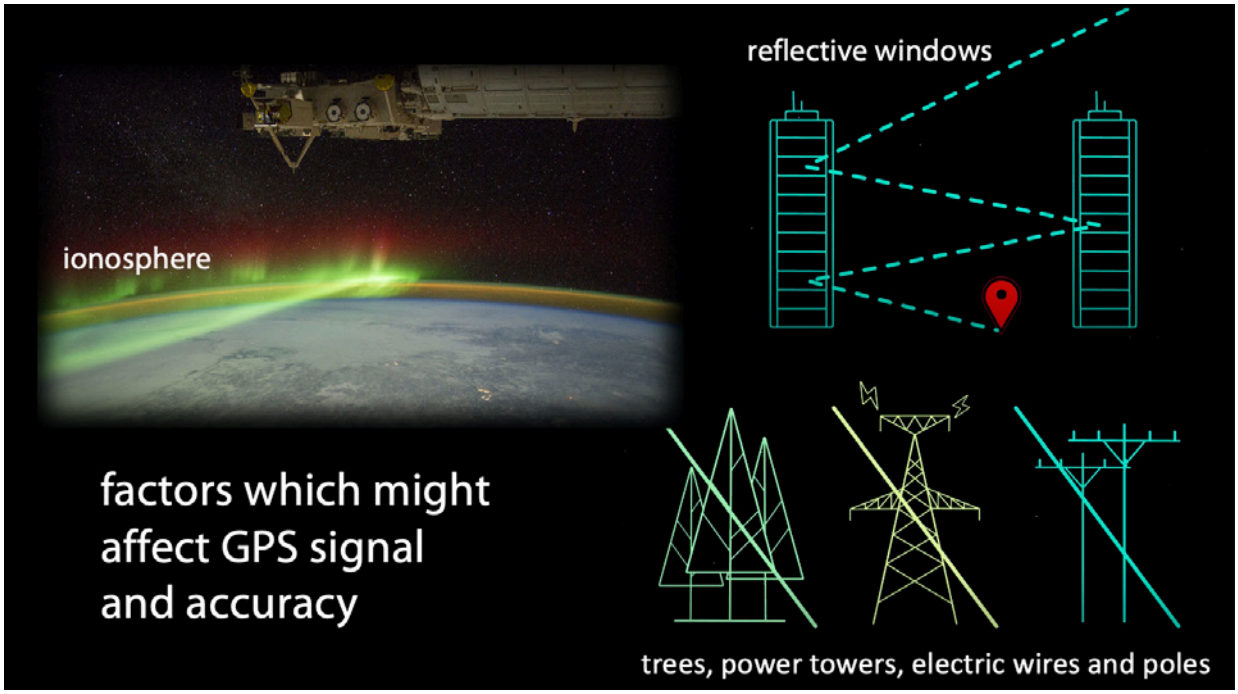
Theres a lot more could be told about these timings because if there are any physicists with us you will know all about how a moving object can warp time. So to insure accuracy, minute adjustments have to be made by your app to compensate. These are continually being uploaded to the satellites from a command center.



As we touched on earlier a GPS receiver needs to get signals from four satellites, three to calculate latitude and longitude and the fourth to calculate altitude.

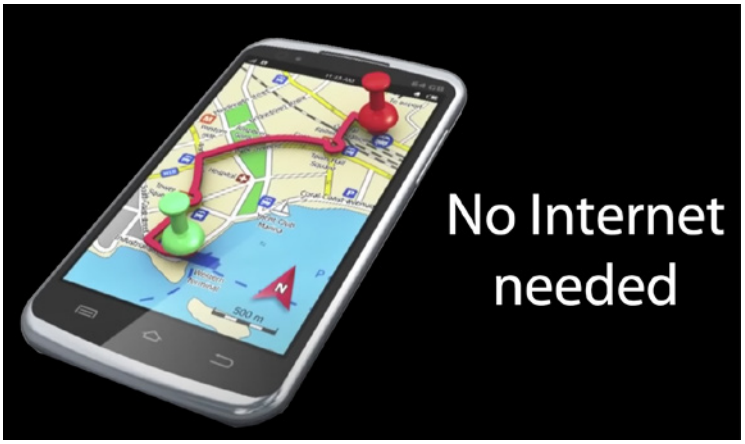
There are a lot of factors which might affect GPS signal and accuracy, the most significant is due to the ionosphere, a part of the upper atmosphere extending from 60 km to 2000 km. Free electrons in the ionosphere affect electromagnetic waves passing through it. This is not so relevant when the satellite is directly overhead as opposed to being near the horizon where the signal has to travel through more of the atmosphere.

Other factors that might affect accuracy are for example: an area which is full of tall buildings. Not only will the reflective windows delay the GPS signal but also the dense buildings will block the signal and lower the GPS accuracy. Trees, power towers, cell sites, electric wires and poles can also interfere with the signal. So GPS will always work better in an open area.



GPS is used in many ways. As well as allowing you to find your way to unload known location, scientists use GPS to gather data about earthquakes, surveyors use it to determine property lines businesses use it to track delivery vehicles. A valuable tool and since its invention, GPS is changing the way we view the world.

There is no internet connection required to use GPS services. The Global positioning system (GPS) is available FREE of cost everywhere on earth. That's the reason your car's GPS can work even if there is no internet connectivity in car's navigation system.



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