

Urkund Analysis Result

Analysed Document: Assignment_report_theme3.docx (D10564378)
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Sources included in the report:

Learning_Task3_YETGOUE_TOUKAM_Florian.pdf (D10559424)
<http://en.wikipedia.org/wiki/User:Doggitydogs/GPS>
<http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
<http://en.wikipedia.org/wiki/L2C>
http://en.wikipedia.org/wiki/Differential_GPS_post-processing
<http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc>
<http://en.wikipedia.org/wiki/A-GPS>
<http://en.wikipedia.org/wiki/NAVSTAR>
<http://electronics.howstuffworks.com/gadgets/travel/gps2.htm>
http://www.greenresources.no/portals/1/Training/GPS_TrainingManual.pdf
<http://en.wikipedia.org/wiki/Pseudolite>
<http://www.clarkson.edu/class/cs463/wireless.sp2007/students/GlobalPositioningSystem.ppt>
<http://gpstrackingtools.blogspot.com/>
[http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation))
http://www.trimble.com/gps_tutorial/dgps-how.aspx
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[http://en.wikipedia.org/wiki/Dilution_of_precision_\(GPS\)](http://en.wikipedia.org/wiki/Dilution_of_precision_(GPS))
http://en.wikipedia.org/wiki/European_Geostationary_Navigation_Overlay_Service

Instances where selected sources appear:

Name : Nayani Srinivas Vijayanand ASSIGNMENT THEME 3 How are the GPS's satellites organized? How many they are and what kind of orbits they have?

0: <http://xa.yimg.com/kq/groups/21620206/615119600/name/3.%20GPS%20Segments.ppt> 53%

The GPS design originally called for 24 satellites

each in three approximately circular orbits ,but this was modified to six

orbital planes with four satellites each. The

plane of orbiting satellite intersects the earth equator at 55° . The six orbit planes have approximately 55° inclination and are separated by 60°

apart.

0: <http://en.wikipedia.org/wiki/NAVSTAR> 99%

The orbital period is one-half a day , i.e., 11 hours and 58 minutes

so that the satellites pass over the same locations or almost the same locations every day.

The

orbits are arranged so that at least six satellites are always within line of sight from

almost everywhere on Earth's surface.

The result of this objective is that the four satellites are not evenly spaced (90 degrees) apart within each orbit. In general terms, the angular difference between satellites in each orbit is 30, 105, 120, and 105 degrees apart which sum to 360 degrees.

All GPS satellites are orbiting at 11000- 12000 miles above the earth altitude and hence are not effected by any atmospheric factors. The satellite positions are monitored by department of US defense and corrected for any errors that are affecting the satellite orbit. This is done by accurate radar which can check satellites accurate position, exact altitude and speed. How is

0: Learning_Task3_YETGOUE_TOUKAM_Florian.pdf 55%

the trilateration organized in the 3D-space? Why is the fourth satellite needed to specify the location point?

For our discussion , let us consider our receiver has access to 3 satellites A,B,C orbiting at 11000 , 11500, 12000 miles in the space and see how trilateration is deduced. Considering the satellite A is at 11000 miles

0: <http://electronics.howstuffworks.com/gadgets/travel/gps2.htm> 92%

in the space , you could be anywhere on the surface of a huge, imaginary sphere with a 11000-mile radius.

0: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc> 100%

Knowing that we're 11,000 miles from a particular satellite narrows down all the possible locations we could be in the whole universe to the surface of a sphere that is centered on this satellite and has a radius of 11,000 miles .

Now we calculate the distance to another satellite as 11500

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93%

miles

from satellite B, you can overlap the first sphere with another, larger sphere. The spheres intersect in a perfect circle. Similarly If

you

have another satellite at a distance of 12500 miles ,

we

get a third sphere, which intersects with this circle at

0: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc>

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two points.

So by ranging from three satellites we can narrow our position to just two points in space.

In these two points

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one of the points is either too far from Earth and can be rejected without a measurement.

0: http://www.greenresources.no/portals/1/Training/GPS_TrainingManual.pdf

97%

The Earth itself can

act as a fourth sphere -- only one of these two possible points will actually be on the surface of the planet, so you can eliminate the one in space. Receivers generally look to four or more satellites, however, to improve accuracy and provide precise altitude information.

0: <http://gpstrackingtools.blogspot.com/>

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In

typical GPS operation, four or more satellites must be visible to obtain an accurate result. Four sphere surfaces typically do not intersect. Because of this, it can be said with confidence that when the navigation equations are solved to find an intersection, this solution gives the position of the receiver along with

the difference between the time kept by the receiver's on-board clock and the true time-of-day,

thereby eliminating the need for a very large, expensive, and power hungry clock.

Explain picture 2.28 in Bensky's book. Is there something wrong in that picture? Yes, Picture 2.28 does not show the 90 phase shift quadrature signal modulated with CA code from L1 carrier is not to be (added) to in-phase P(Y)Code modulated signal. So in the picture part of summation of CA Code and P(Y) Code is absent before the signal is transmitted via antenna from L1 carrier. Only P(Y) code is transmitted here from L1. Why there are two separate codes and frequencies? How they are used? Satellites in space segment transmit on two different frequencies which are 1,575.42 MHz, and 1,227.6 MHz referred as L1 and L2. Reason of transmitting in two different frequencies is for receivers to accurately calculate speed of propagation of signal in the atmosphere. Signal is transmitted as spread spectrum on two channels with chip rate of 1.023 Mbps on L1 and 10.23 Mbps on L2. Chip rate can be defined as rate of coded bits that are modulated with the data to spread signal bandwidth beyond that required for data alone. Satellites use sets of orthogonal codes at two chip rates for code division multiple access so that transmissions on same frequency does not interfere. There are two different types of codes for two different types of services i.e standard service and precision service. The 1.023 Mbps code is called standard or coarse acquisition code (C/A-code). CA code has a time period of 1 millisecond. This is most commonly used by all GPS receivers and provides less accurate positioning information. Other 10.23 Mbps code is called Precision code or P-Code with a period of one week. Y-Code is an encrypted P-Code, which is primarily used for defense purposes. Usually US and NATO allies have access to the encrypted keys and therefore take advantage of this high precision and more accurate positioning systems which is possible via higher code rate and greater bandwidth. Navigational data that receiver needs for calculating position is transmitted at 50 bps and is modulated on both CA and P-Codes. How is the synchronization between satellites and receivers achieved? What function does the CDMA code have in this operation? In order to measure the time of flight, clocks in receiver and transmitter have to be synchronized. Synchronization between satellites and GPS receivers is achieved by signal correlation which is essentially a mechanism for delaying the reference code at the receiver end. Receiver has the ability to slide the receiver's spreading code in relation to received code from satellite in an effort to make them in line. Reference or replica code is generated in the receivers at the start time that is synchronized with clock of receiver. We know that there can be definite time delay in signal propagation and received code will be certain phase difference compared against the generated receiver code. It is necessary to change this generated signal phase and line up with the received code signal, which is delayed due to transmission time. So there is a certain delay between the received code and reference code in the receiver. Synchronization is attained by receiver slowing down the reference code to allow to line up with the received code. Receiver is able to measure how much of phase shift there was from the reference in the receiver until the phase shift two signals are lined up. How does the receiver know where the satellite is? Satellites provide embedded information needed for receivers in their transmissions as data frames.

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100%

The navigation message itself is constructed from a 1,500 bit frame, which is divided into five subframes of 300 bits each and transmitted at 50 bit/s. Each subframe, therefore, requires 6 seconds to transmit. Each subframe has the GPS time

Each sub-frame begins with telemetry word and handover word where telemetry contains synchronization preamble and handover gives the exact transmission time of satellite when the signal is transmitted. Sub frame 1

0: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS>

100%

contains the GPS date (week number) and information to correct the satellite's time to GPS time, plus satellite status and health

whether the satellite can be used or not. Sub frames 2 and 3 together contain the transmitting satellite's ephemeris data. This data describes the location of the satellite in its orbit. Satellites coordinates are calculated as function of time using the ephemeris data from sub frames 2 and 3. Sub frames 4

0: <http://en.wikipedia.org/wiki/L2C>

100%

and 5 contain components of the almanac. Each frame contains only 1/25th of the total almanac; a receiver must process 25 whole frames worth of data

to

retrieve the entire 15,000 bit almanac message. At this rate, 12.5 minutes are required to receive the entire almanac from a single satellite.

The

almanac consists of coarse orbit and status information for each satellite in the constellation.

Almanac assists receivers

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in the acquisition of satellites at power-up by allowing the receiver to generate a list of visible satellites based on stored position and time, while an ephemeris from each satellite is needed to compute position fixes using that satellite

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The second purpose is for relating time derived from the GPS (called GPS time) to the international time standard of utc.

Almanac contains additional data required for measurement accuracy , specifically a correction factor for adjusting the propagation time of signal which changes slightly according to the parameters of ionosphere. It also allows receiver to convert from the satellite time to GPS time. From almanac data receiver can determine what satellites are in the view of its location. Almanac data can be used only for initial satellite acquisition by the receiver. We know that GPS receivers does a signal correlation job using the replica of code transmitter by the each satellite. In order to get the above information from enough satellites, receivers should do this correlation job on all these satellites most often done in paralle using digital tracking mechanism rather that in series. Sequential steps on how GPS receivers calculate and know their geographical position . • GPS receivers lock on to the satellites means locking or lining up with the satellites code with the replica code in the receivers. • Calculate the pseudo range which is the time difference between received signal and transmitted time multiplied by the speed of propagation. • Fetch the satellite position coordinates from the navigation message. • Receiver position can be calculated once it knows the satellite positions. • As final step, the receiver position can be used to calculate geographic position i.e Latitude , longitude and altitude. Explain how the following errors are originated and how at least part of them can be corrected in GPS system: Satellite clock errors Satellite orbit errors Ionosphere and troposphere errors Multipath errors Dilution of precision Orbit errors: Satellite Orbit errors are also referred as ephemeris errors. Ephemeris data is part of navigation message (sub-frame 2 &3) from the satellites. This data describes satellites position in the orbit. Ephemeris data is transmitted every 30 seconds and this information may be couple of hours old. Ephemeris errors may be result of solar radiation in the outer atmosphere. Receivers are enabled with almanac of this data for all

the satellites and they update the data when ever new data is available. It is also feasible to put ephemeris data on web where receivers connect to and load the updated information. Satellite Clock Errors: Satellites have atomic clocks and can experience noise and clock drifts errors. Navigation messages contain this clock error correction information as part of sub-frame 1 and based on the accuracy of atomic clock. For precise positioning , effects of clock drifts can be overcome by using differential GPS which is using simultaneously using two or more receivers at multiple survey points. Ionosphere and troposphere errors: Errors can creep in while GPS signal passes through the Earth's outer and inner atmosphere. These errors can pose a significant challenge for maintaining position accuracy. Errors caused by ionosphere is due to presence of ionized particles in the outer space. Ionospheric effects are smallest when satellite is right overhead and maximum when satellites are nearer the horizon. Ionospheric delay of microwave signal depends on its frequency due to signal dispersion in the space . Ionosphere errors

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can be calculated from measurement of delays for two or more frequency bands , allowing delays at other frequencies to be estimated.

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The effects of ionosphere generally change slowly and can be averaged

out in

0: <http://www.clarkson.edu/class/cs463/wireless.sp2007/students/GlobalPositioningSystem.ppt>
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time.

Once the receiver's approximate location is known, a mathematical model can be used to estimate and compensate for these errors.

Humidity and water vapor are the major contributors to tropospheric errors , they vary with temperature and pressure.

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86%

This effect is more localized and changes more quickly than ionospheric effects, and is not frequency dependent. This makes precise measurement and compensation of humidity errors more difficult than ionospheric

effect. GPS receivers apply mathematical models to computes this error ,

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either by applying a function regression or correlating margin of atmospheric error to ambient pressure using a barometric altimeter.

Multipath errors In a real world scenario , Signal take multiple paths to reach any receiver because they are bound to bounce on other objects in the environment before they reach the receiver. However the signal that reaches first is the one that travelled direct path and the delayed ones are from reflections. Reflected signals can be strong enough to induce errors and cause faulty

measurements . Advanced GPS receivers use various signal processing techniques to nullify the reflected signal and use the direct ones. Dilution of precision Dilution of precision (DOP) or geometric dilution of precision is the additional multiplicative effect of navigational satellite geometry on positional measurement position. Primary idea is how the errors in the measurement will effect the final state

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measurement. When visible navigation satellites are close together in the sky, the geometry is said to be weak and the DOP value is high; when far apart, the geometry is strong and the DOP value is low.

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The effect of geometry of the satellites on position error is called geometric dilution of precision and it is roughly interpreted as ratio of position error to the range error.

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If satellites overlap at right angles, the greatest extent of the overlap is much smaller than if they overlap in near parallel. Thus a

low DOP value represents a better positional precision

due to the wider angular separation between the satellites used to calculate

a unit's position. Other factors that can increase the effective DOP are obstructions such as nearby mountains or buildings.

Explain the main principle of differential GPS (DGPS). Differential GPS is improved version of GPS in terms of positional accuracy. GPS accuracy is approximately around 15 meter and differential GPS can bring around 10 meter accuracy.

0: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc>

79%

Differential GPS involves the cooperation of two receivers, one stationary and another roving around making position measurements. The stationary receiver calculates the satellite measurements into a solid local reference.

Differential GPS

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100%

uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the satellite systems and the known fixed positions. These stations broadcast the difference between the measured satellite pseudoranges and actual internally computed pseudoranges, and receiver stations may correct their pseudoranges by the same amount.

The

baselines represent a three-dimensional line drawn between the two points occupied by each pair of GPS antennas. The post-processed measurements allow more precise positioning, because most GPS errors affect each receiver nearly equally, and therefore can be cancelled out in the calculations.

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This

reference station receives the same GPS signals as the

mobile or any GPS receiver. This reference station having pre-known its coordinates, tries to calculate the position from the GPS signals and determines the deviation from the exact against calculated values. The difference between the actual fixed values and the calculated values from the GPS signal

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is an "error correction" factor. The receiver then transmits this error information to the other receivers to correct their measurements.

Differential GPS can also aid in correcting

0: http://www.trimble.com/gps_tutorial/dgps-how.aspx

88%

errors that are common to both the reference receiver and the revolving receiver.

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Post-processing is used in Differential GPS

to obtain precise positions of unknown points by relating them to known points such as survey markets. The GPS measurements are usually stored in memory in the GPS receivers, and are subsequently transferred to a computer running the GPS post-processing software. The software computes

baseline data

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using simultaneous measurement data from two or more GPS receivers.

How do the EGNOS and WAAS systems complement the GPS system? Both EGNOS and WAAS are satellite based augmentation systems which work on network of ground based reference stations which can measure the small variations in the GPS satellite signals. These measurements are routed to master stations which queue the correction messages and send these to geostationary satellites in timely manner. These satellites broadcast the corrections messages back to earth where GPS receivers can use this information to improve the accuracy. EGNOS is a European space agency's version of satellite based augmentation positioning system. EGNOS supplements the GPS and GLONASS by reporting on accuracy and reliability of the positioning data. EGNOS has started operations in 2005 with an accuracy of 2 meters.

WAAS, is Wide area augmentation service developed by Federal Aviation Administration from United States and is active in North America. Accuracy of the WAAS is around 7 meters around 95% of the time.

0: http://en.wikipedia.org/wiki/European_Geostationary_Navigation_Overlay_Service

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Similar to WAAS, EGNOS is mostly designed for aviation users which enjoy unperturbed reception of direct signals from satellites up to very high latitudes. The use of EGNOS on the ground, especially in urban areas.

Explain the idea of A-GPS. (This will be studied further in mobile positioning's theme) AGPS (assisted GPS) is a mechanism to improve startup performance for GPS based positioning systems. It takes approximately 30 to 40 seconds for traditional GPS receivers to lock on to the GPS satellites initially. As we know GPS receivers

0: <http://en.wikipedia.org/wiki/A-GPS>

99%

system needs orbital information of the satellites to calculate the current position, The data rate of the satellite signal is only 50 bit/s, so downloading orbital information like ephemeris and almanac directly from satellites typically takes a long time if the satellite signals are lost during the acquisition of this information.

Traditional GPS receivers use radio signal from the satellites. But devices can take the advantage of

0: <http://en.wikipedia.org/wiki/A-GPS>

82%

A-GPS technology which

uses network resources to locate and use the satellites in poor signal conditions

where GPS signal is difficult to penetrate.

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A-GPS feature as stated by mobile phone device specification today is mostly the internet network-dependent one, the one that requires you to connect to internet or ISP.

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A assisted GPS-enabled receiver will use a data connection (Internet or other) to contact the assistance server for aGPS information

Assisted GPS can be categorized as Mobile station based and Mobile station assisted. Mobile Station Based (MSB): Here AGPS allows the receiver to acquire and lock on satellites quickly by supplying

0: <http://en.wikipedia.org/wiki/A-GPS>

73%

orbital data for the GPS satellites to the GPS receiver, enabling the GPS receiver to lock to the satellites more rapidly in some cases.

Mobile station assisted (MSA) calculation of position by the server using information from the GPS receiver

by capturing the snapshot of the GPS signal and time for the server to do some post processing into a position.

Servers here would have good satellite signals and powerful enough to compute the data from the signal that it receives from satellites.

Explain the idea and main principles of pseudolite systems. Pseudolite is an synonym to “Pseudo –Satellite” which means they behave and perform functions similar to satellite systems.

0: <http://en.wikipedia.org/wiki/Pseudolite>

78%

Pseudolites are devices with small transceivers that are used to create a local and a ground-based GPS alternative. The range of each transceiver's signal is dependent on the power available to the unit.

This kind of system is more usefull in places where GPS signal can not reach or jammed on purpose.

0: <http://en.wikipedia.org/wiki/Pseudolite>

82%

Applications for pseudolite systems include precision approach landing systems for aircraft and highly accurate tracking of transponders

and at indoor positioning systems.

What are the main differences and similarities between Glonass, Galileo and GPS. Make a table including the most important features. Development of alternative GPS system, Russia began developing GLONASS in 1976 with installation of full constellation was completed in 1995.

0: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>

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Galileo is the European initiative for Global National Satellite Systems (or GNSS). As with everything that is the result of intricate negotiations and contracts, its development has been slow, with the first satellite launch in 2011.

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The satellite constellation is important because at least 4 satellites need to be visible at a given point in time for a receiver to be able to calculate its position. Since none of the constellations are geo-stationary, the number of satellites in the constellation, as well as the number and position of orbits will dictate the viability of the service. The global navigational position approach is to have 6

orbitals, while the Russian GLONASS and European Galileo would

0: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>

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go for 3. All things considered, GLONASS provides better accuracy of the northern skies, while GPS does a fairly good job of taking on the rest. Galileo is too young – only 2 prototypes are in

orbit at this time – but simulations on the final product show augmented error around the tropics, with pretty good resolution elsewhere.

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Galileo is the European initiative for Global National Satellite Systems (or GNSS). As with everything that is the result of intricate negotiations and contracts, its development has been slow, with the first satellite launch in 2011. Galileo holds the promise of a geolocalization revolution, with the upcoming introduction of new services.

0: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>

96%

GPS GLONASS Galileo Number of satellites in a complete constellation 32 24 27 + 3

spares Orbital planes 6 3 3 Orbital plane inclination 55 deg 64.8 deg 56 deg Orbital radius 26650 km 14100 km 23222 km Satellite Period 12 hrs 11 hrs 15 min

Below is the characteristics of different positioning systems and how the information systems

0: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>

81%

GPS utilizes three bands, which overlap with the 3 generations of the service. It is important to note as well that CDMA is utilized in GPS technology where as GLONASS uses FDMA, with 25 channels (for 24 satellites).

Gallielo uses CDMA technology similar to GPS

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GPS GLONASS Galileo Encoding CDMA FDMA & CDMA CDMA Modulation BOC, BPSK BOC, BPSK Civil Data rate 50 bps, up to 100 sps 50 bps 50 bps, up to 1000sps Error, raw mode, civilian band 5 – 20 m 50 – 70 m Claimed 1m Operation bands L1, L2, L5 L1, L2, L3, L5 E1, E5, E6

What is the situation of Glonass and Galileo today? Are they functioning completely?

0: <http://en.wikipedia.org/wiki/GLONASS>

90%

In 2010, GLONASS had achieved 100% coverage of Russia. By October 2011, the full orbital constellation of 24 satellites was restored enabling full global coverage. The GLONASS satellites' designs have undergone several upgrades, with the latest version being GLONASS-K.

0: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation))

78%

Galileo is a navigational system currently being built by the European Union and European space agency.

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94%

One of the aims of Galileo is to provide a high-precision positioning system, upon which European nations can rely, independently from the Russian GLONASS

and GPS.

By

0: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation))

100%

October 2011

the first two of four operational satellites were launched to validate the system. The next two followed on 12 October 2012, making it possible to test Galileo end-to-end. .

Complete systems of constellation

0: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation))

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of the 30-satellite Galileo system, 27 operational plus three active spares is expected by 2019.

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the trilateration organized in the 3D-space? Why is the fourth satellite needed to specify the location point?

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the trilateration is organized in the form of circles, spheres or triangles. ? The fourth satellite is needed to specify the location point

Instances from: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS>

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The navigation message itself is constructed from a 1,500 bit frame, which is divided into five subframes of 300 bits each and transmitted at 50 bit/s. Each subframe, therefore, requires 6 seconds to transmit. Each subframe has the GPS time

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contains the GPS date (week number) and information to correct the satellite's time to GPS time, plus satellite status and health

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in the acquisition of satellites at power-up by allowing the receiver to generate a list of visible satellites based on stored position and time, while an ephemeris from each satellite is needed to compute position fixes using that satellite

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The second purpose is for relating time derived from the GPS (called GPS time) to the international time standard of utc.

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15: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 100%

can be calculated from measurement of delays for two or more frequency bands , allowing delays at other frequencies to be estimated.

16: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 95%

The effects of ionosphere generally change slowly and can be averaged

18: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 86%

This effect is more localized and changes more quickly than ionospheric effects, and is not frequency dependent. This makes precise measurement and compensation of humidity errors more difficult than ionospheric

19: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 100%

either by applying a function regression or correlating margin of atmospheric error to ambient pressure using a barometric altimeter.

can be calculated from measurements of delays for two or more frequency bands, allowing delays at other frequencies to be estimated.[164]

16: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 95%

The effects of the ionosphere generally change slowly, and can be averaged

18: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 86%

This effect both is more localized and changes more quickly than ionospheric effects, and is not frequency dependent. These traits make precise measurement and compensation of humidity errors more difficult than ionospheric

19: <http://en.wikipedia.org/wiki/User:Doggitydogs/GPS> 100%

either by applying a function regression or correlating margin of atmospheric error to ambient pressure using a barometric altimeter.[]

Instances from: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>

38: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
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Galileo is the European initiative for Global National Satellite Systems (or GNSS). As with everything that is the result of intricate negotiations and contracts, its development has been slow, with the first satellite launch in 2011.

39: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
90%

The satellite constellation is important because at least 4 satellites need to be visible at a given point in time for a receiver to be able to calculate its position. Since none of the constellations are geo-stationary, the number of satellites in the constellation, as well as the number and position of orbits will dictate the viability of the service. The global navigational position approach is to have 6

40: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
100%

go for 3. All things considered, GLONASS provides better accuracy of the northern skies, while GPS does a fairly good job of taking on the rest. Galileo is too young – only 2 prototypes are in orbit at this time – but simulations on the final product show augmented error around the tropics, with pretty good resolution elsewhere.

41: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
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42: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
96%

GPS GLONASS Galileo Number of satellites in a complete constellation 32 24 27 + 3

spares Orbital planes 6 3 3 Orbital plane inclination 55 deg 64.8 deg 56 deg Orbital radius 26650 km 14100 km 23222 km Satellite Period 12 hrs 11 hrs 15 min

43: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
81%

GPS utilizes three bands, which overlap with the 3 generations of the service. It is important to note as well that CDMA is utilized in GPS technology where as GLONASS uses FDMA, with 25 channels (for 24 satellites).

44: <http://deltas.blog.com/2012/12/05/gps-vs-galileo-vs-glonass-2/>
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GPS GLONASS Galileo Number of satellites in a complete constellation 32 (Block III) 24 27 + 3 spares Orbital planes 6 3 3 Orbital plane inclination 55 deg 64.8 deg 56 deg Orbital radius 26650 km 14100 km 23222 km Satellite Period 12 hrs 11 hrs 15 min

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GPS GLONASS Galileo Encoding CDMA FDMA & CDMA CDMA
Modulation BOC, BPSK BOC, BPSK Civil Data rate 50 bps, up to
100 sps 50 bps 50 bps, up to 1000sps Error, raw mode, civilian band
5 – 20 m 50 – 70 m Claimed 1m Operation bands L1, L2, L5 L1, L2,
L3, L5 E1, E5, E6

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Instances from: <http://en.wikipedia.org/wiki/L2C>

12: <http://en.wikipedia.org/wiki/L2C>

100%

and 5 contain components of the almanac. Each frame contains only 1/25th of the total almanac; a receiver must process 25 whole frames worth of data

to

retrieve the entire 15,000 bit almanac message. At this rate, 12.5 minutes are required to receive the entire almanac from a single satellite.

The

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Instances from: http://en.wikipedia.org/wiki/Differential_GPS_post-processing

24: http://en.wikipedia.org/wiki/Differential_GPS_post-processing
100%

uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the satellite systems and the known fixed positions. These stations broadcast the difference between the measured satellite pseudoranges and actual internally computed pseudoranges, and receiver stations may correct their pseudoranges by the same amount.

The

28: http://en.wikipedia.org/wiki/Differential_GPS_post-processing
96%

Post-processing is used in Differential GPS

to obtain precise positions of unknown points by relating them to known points such as survey markets. The GPS measurements are usually stored in memory in the GPS receivers, and are subsequently transferred to a computer running the GPS post-processing software. The software computes

29: http://en.wikipedia.org/wiki/Differential_GPS_post-processing
100%

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Instances from: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc>

4: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc> 100%

Knowing that we're 11,000 miles from a particular satellite narrows down all the possible locations we could be in the whole universe to the surface of a sphere that is centered on this satellite and has a radius of 11,000 miles .

6: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc> 92%

two points.

So by ranging from three satellites we can narrow our position to just two points in space.

7: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc> 70%

one of the points is either too far from Earth and can be rejected without a measurement.

23: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc> 79%

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one of the two points is a ridiculous answer (either too far from Earth or moving at an impossible velocity) and can be rejected without a measurement.

23: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc> 79%

Differential GPS involves the cooperation of two receivers, one stationary and another roving around making position measurements. The stationary receiver calculates the satellite measurements into a solid local reference.

25: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc>

100%

This

reference station receives the same GPS signals as the

26: <http://www.fs.fed.us/database/gps/aboutgps/documents/howgpswo.doc>

100%

is an "error correction" factor. The receiver then transmits this error information to the

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The stationary receiver is the key. It ties all the satellite measurements into a solid local reference.

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Instances from: <http://en.wikipedia.org/wiki/A-GPS>

31: <http://en.wikipedia.org/wiki/A-GPS> 99%

system needs orbital information of the satellites to calculate the current position, The data rate of the satellite signal is only 50 bit/s, so downloading orbital information like ephemeris and almanac directly from satellites typically takes a long time if the satellite signals are lost during the acquisition of this information.

32: <http://en.wikipedia.org/wiki/A-GPS> 82%

A-GPS technology which
uses network resources to locate and use the satellites in poor signal conditions

33: <http://en.wikipedia.org/wiki/A-GPS> 96%

A-GPS feature as stated by mobile phone device specification today is mostly the internet network-dependent one, the one that requires you to connect to internet or ISP.

34: <http://en.wikipedia.org/wiki/A-GPS> 92%

A assisted GPS-enabled receiver will use a data connection (Internet or other) to contact the assistance server for aGPS information

35: <http://en.wikipedia.org/wiki/A-GPS> 73%

31: <http://en.wikipedia.org/wiki/A-GPS> 99%

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35: <http://en.wikipedia.org/wiki/A-GPS> 73%

orbital data for the GPS satellites to the GPS receiver, enabling the GPS receiver to lock to the satellites more rapidly in some cases.

Mobile station assisted (MSA) calculation of position by the server using information from the GPS receiver

by capturing the snapshot of the GPS signal and time for the server to do some post processing into a position.

orbital data or almanac for the GPS satellites to the GPS receiver, enabling the GPS receiver to lock to the satellites more rapidly in some cases. • The network can provide precise time. • Mobile Station Assisted (MSA): Calculation of position by the server using information from the GPS receiver • The device captures a snapshot of the GPS signal, with approximate time, for the server to later process into a position. •

Instances from: <http://en.wikipedia.org/wiki/NAVSTAR>

1: <http://en.wikipedia.org/wiki/NAVSTAR>

99%

The orbital period is one-half a day , i.e., 11 hours and 58 minutes so that the satellites pass over the same locations or almost the same locations every day.

The

orbits are arranged so that at least six satellites are always within line of sight from

almost everywhere on Earth's surface.

The result of this objective is that the four satellites are not evenly spaced (90 degrees) apart within each orbit. In general terms, the angular difference between satellites in each orbit is 30, 105, 120, and 105 degrees apart which sum to 360 degrees.

1: <http://en.wikipedia.org/wiki/NAVSTAR>

99%

The orbital period is one-half a sidereal day, i.e., 11 hours and 58 minutes so that the satellites pass over the same locations[61] or almost the same locations[62] every day. The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface.[63] The result of this objective is that the four satellites are not evenly spaced (90 degrees) apart within each orbit. In general terms, the angular difference between satellites in each orbit is 30, 105, 120, and 105 degrees apart which sum to 360 degrees.

Instances from: <http://electronics.howstuffworks.com/gadgets/travel/gps2.htm>

3: <http://electronics.howstuffworks.com/gadgets/travel/gps2.htm> 92%

in the space , you could be anywhere on the surface of a huge, imaginary sphere with a 11000-mile radius.

5: <http://electronics.howstuffworks.com/gadgets/travel/gps2.htm> 93%

miles

from satellite B, you can overlap the first sphere with another, larger sphere. The spheres intersect in a perfect circle. Similarly If

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3: <http://electronics.howstuffworks.com/gadgets/travel/gps2.htm> 92%

in the sky, you could be anywhere on the surface of a huge, imaginary sphere with a 10-mile radius.

5: <http://electronics.howstuffworks.com/gadgets/travel/gps2.htm> 93%

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Instances from: http://www.greenresources.no/portals/1/Training/GPS_TrainingManual.pdf

8: http://www.greenresources.no/portals/1/Training/GPS_TrainingManual.pdf

97%

The Earth itself can

act as a fourth sphere -- only one of these two possible points will actually be on the surface of the planet, so you can eliminate the one in space. Receivers generally look to four or more satellites, however, to improve accuracy and provide precise altitude information.

8: http://www.greenresources.no/portals/1/Training/GPS_TrainingManual.pdf

97%

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Instances from: <http://en.wikipedia.org/wiki/Pseudolite>

36: <http://en.wikipedia.org/wiki/Pseudolite> 78%

Pseudolites are devices with small transceivers that are used to create a local and a ground-based GPS alternative. The range of each transceiver's signal is dependent on the power available to the unit.

37: <http://en.wikipedia.org/wiki/Pseudolite> 82%

Applications for pseudolite systems include precision approach landing systems for aircraft and highly accurate tracking of transponders

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Instances from: <http://www.clarkson.edu/class/cs463/wireless.sp2007/students/GlobalPositioningSystem.ppt>

17: <http://www.clarkson.edu/class/cs463/wireless.sp2007/students/GlobalPositioningSystem.ppt> 100%

time.

Once the receiver's approximate location is known, a mathematical model can be used to estimate and compensate for these errors.

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Instances from: <http://gpstrackingtools.blogspot.com/>

9: <http://gpstrackingtools.blogspot.com/>

100%

In

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the difference between the time kept by the receiver's on-board clock and the true time-of-day,

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Instances from: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation))

46: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation)) 78%

Galileo is a navigational system currently being built by the European Union and European space agency.

47: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation)) 94%

One of the aims of Galileo is to provide a high-precision positioning system, upon which European nations can rely, independently from the Russian GLONASS

and GPS.

48: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation)) 100%

October 2011

the first two of four operational satellites were launched to validate the system. The next two followed on 12 October 2012, making it possible to test Galileo end-to-end. .

49: [http://en.wikipedia.org/wiki/Galileo_\(satellite_navigation\)](http://en.wikipedia.org/wiki/Galileo_(satellite_navigation)) 88%

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Instances from: http://www.trimble.com/gps_tutorial/dgps-how.aspx

27: http://www.trimble.com/gps_tutorial/dgps-how.aspx 88%

errors that are common to both the reference receiver and the revolving receiver.

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45: <http://en.wikipedia.org/wiki/GLONASS>

90%

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Instances from: <http://xa.yimg.com/kq/groups/21620206/615119600/name/3.%20GPS%20Segments.ppt>

0: <http://xa.yimg.com/kq/groups/21620206/615119600/name/3.%20GPS%20Segments.ppt> 53%

The GPS design originally called for 24 satellites 8

each in three approximately circular orbits ,but this was modified to six

orbital planes with four satellites each. The

pane of orbiting satellite intersects the earth equator at 55 .The six orbit planes have approximately 55° inclination and are separated by 60°

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Space Segment (SS) • • The orbital planes are centered on the Earth. • • The six planes have approximately 55° inclination and are separated by 60°

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20: [http://en.wikipedia.org/wiki/Dilution_of_precision_\(GPS\)](http://en.wikipedia.org/wiki/Dilution_of_precision_(GPS)) 100%

measurement. When visible navigation satellites are close together in the sky, the geometry is said to be weak and the DOP value is high; when far apart, the geometry is strong and the DOP value is low.

21: [http://en.wikipedia.org/wiki/Dilution_of_precision_\(GPS\)](http://en.wikipedia.org/wiki/Dilution_of_precision_(GPS)) 100%

The effect of geometry of the satellites on position error is called geometric dilution of precision and it is roughly interpreted as ratio of position error to the range error.

22: [http://en.wikipedia.org/wiki/Dilution_of_precision_\(GPS\)](http://en.wikipedia.org/wiki/Dilution_of_precision_(GPS)) 97%

If satellites overlap at right angles, the greatest extent of the overlap is much smaller than if they overlap in near parallel. Thus a

low DOP value represents a better positional precision

due to the wider angular separation between the satellites used to calculate

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30: http://en.wikipedia.org/wiki/European_Geostationary_Navigation_Overlay_Service 98%

Similar to WAAS ,EGNOS is mostly designed for aviation users which enjoy unperturbed reception of direct signals from satellites up to very high latitudes. The use of EGNOS on the ground, especially in urban areas.

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