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Review paper on GPS & GSM Technology

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Abstract

If we are ever been lost and wished there was an easy way to find out which way we needed to go and also ever find that perfect fishing and not been able to remember how to get back to it easily? How about finding ourselves out hiking a not known which direction we should go to get back? Ever been flying along and needed to locate the nearest airport and identify the type of air space we were in? With GPS System unit we could know where we are located on the planet at all times. Whether it be for fun, saving lives, or whatever use you can ever dream of, GPS navigation is becoming more common technique. In this paper, we have elucidated the segments of GPS system, the working principle, and its receiver technology. Besides these we also elaborated the sources of errors in GPS positioning, working of Differential Global Positioning System, and Wide Area Augmentation System. The concepts of Mapping and Navigation are briefed. A brief description of Mapping, Navigation is dealt and finally the important applications of Global Positioning System are discussed.

Index Terms: GPS, GSM etc.

1. Global Positioning System

The Global Positioning System is space-based radio-navigation system. It consists of 24 satellites, which orbit the Earth at an altitude of approximately 11,000 miles & ground stations. Global positioning system provides users with accurate information on position, velocity, and time anywhere in the world and in all weather conditions. Concisely it is a network of satellites that continuously transmit coded information which makes it possible to precisely identify locations on earth by measuring distances from satellites. It refers to group of US Department of Defense Satellites constantly circling the earth. The satellites transmit very low power radio signals allowing any one with a Global positioning system receiver to determine their location on earth. Global positioning system actually predates introduction of the personal computer. The designers originally had military application in mind. GPS receivers would aid Navigation, troop deployment and artillery fire and Later GPS was made available for civilian use also.

Satellite Position In GPS

Stand-alone GPS uses 24 satellites placed asymmetrically in 6 orbital planes, where 550 relative to the equatorial plane incline each plane. The satellites are approximately 26,560 km above the center of the earth, with the orbital period of 12 hour and repeating ground tracks. The orbital period is measured in sidereal time, where a sidereal day is the period of earth's

rotation relative to the fixed stars and is approximately 4 minutes shorter than a solar day. Hence the noontime subsatellites point slowly drifts in its fixed groundtrack from day to day.

1.1 Working of GPS

Location is everything: The GPS receiver has to know two things if it is going to do its job. It has to know where the satellites are i. e location and how far away they are i. e distance. The GPS receiver picks up two kinds of coded information from the satellites and 1 type of information, called "almanac" data, contains the appropriate positions of the satellites. This data is continuously transmitted and stored in the memory of Global positioning system receiver so it knows the orbits of satellites and where each satellite is supposed to be. The almanac data is periodically updated with new informations as satellites move around. Any satellite can travel slightly out of orbit, so the ground monitor stations keep track of the satellite orbits, altitude, location and speed, etc. The ground station send the orbital data to master control station, which in turn sends the corrected data up to the satellites. This corrected and exact position data is called the "ephemeris" data and which is valid for about 4 to 6 hours, and is transmitted in the coded information to the GPS receiver. So having received the almanac and ephemeris data

the Global Positioning System receiver knows the location of the satellites at all times.

Time is of the Essence: Even though Global Positioning System receiver knows the precise location of the satellites in space, it still needs to know how far the satellites are so it can determine its position on Earth. Global Positioning System works on the principle "Time of Arrival". Using the simple formula velocity x time travel = distance, we can find the distance from the satellites & receiver already knows the velocity. Its speed of a radio wave is 186,000 miles per second i. e speed of light, less any delay as the signal travels through the Earth's atmosphere. Now Global Positioning System receiver needs to determine the time part of the formula. The transmitted code is called 'Pseudo-random code' because it looks like a noise signal. When a satellite is generating the pseudo-random code, the Global Positioning System receiver is generating the same code and tries to match it up to the satellite core. This delay shift means time is multiplied by the speed of light to get the distance. Global Positioning System receiver clock does not keep the time as precisely as the satellite clocks. Putting an automatic clock in your Global Positioning System receiver would make it much larger and far too expensive! So each distance measurement needs to be corrected to account for the Global positioning system internal clock error. Hence the range measurement is referred to as 'pseudo range'. To determine the position using pseudo-range data, a minimum of 4 satellites must be tracked and 4 fixes must be recomputed until the clock error disappears.

Components of GPS consists of three segments-

Space segment:

Composed of satellites that transmit signals from space, on the basis of which time & position of the user is measured and This set of satellites is called as "constellation".GPS uses two satellite constellations i.e. NAVSTAR and GLONASS.NAVSTAR NAVSTAR composed of 24 satellites, arrayed in 6 orbital planes, inclined 55 degrees to the equator and with a 12 hrs period. They orbit at altitudes of about 20,200 kilometer each. Each satellite contains 4 precise atomic clocks, only one of which is in used at a time.

Control segment:

Control segment consists of a collection of 5 ground based monitor stations, three antennas and a master control station. The Master Control facility is located at Schreiber Air Force Base (formerly Falcon AFB) in Colorado. The monitor station measures signals from the SVs continuously and provides data to the master control station and this master control station calculates satellite ephemeris and clock correction coefficients and forwards them to an antenna. The antenna transmits the data to each satellite at least once a day. The SVs then send subsets of the orbital ephemeris to Global positioning system receivers over radio signals.

User segment:

Global positioning system User Segment consists of the GPS receiver and the user community. The receiver is composed of an antenna and pre-amplifier, radio signal microprocessor, control and display device, data recording unit, and power supply,etc. Global positioning system receivers convert SV signals into position, velocity, and time estimates. A minimum of 4 satellites are required to compute the four dimensions of X, Y, Z position and Time.

1.2. Uses of GPS

Global positioning system has a variety of applications on land, at sea and in the air. The Global positioning system allows to recording or creating locations from place on the earth and helping you navigate to and from those spots. Global positioning system can be used everywhere except where it is impossible to receive the signal such as inside buildings, parking garages, and other subterranean locations and under water. The most common air borne application includes Navigation by general aviation and commercial aircraft. Land based applications are more diverse. The scientific community uses Global positioning system for its precision timing capability and a myriad of applications. Surveyors use Global positioning system for an increasing portions of their work and It offers an incredible cost savings by drastically reducing set up time at the survey site. It also provides accuracy. Global positioning system is becoming increasing popular amongs snow mobiles, mountain bikers, and cross-country skiers. GPS is rapidly becoming common places in automobiles as well. Some systems are already in place to providing emergency roadside assistances at the push of a button. More or some sophisticated systems can display the vehicle's position on an electronic map display, allowing drivers to keep track of where they are and look up street address, restaurants, hotels and other destinations. More systems can even automatically create a route and give turn-by-turn directions to a designated location.

1.3 Applications of GPS

Surveying and Mapping

Navigation

Remote Sensing and GIS

Geodesy

Military

2. Global system for mobile communication

Global system for mobile communication (GSM) is used for transmitting mobile voice and data services. GSM provides new services are call making, call hold, conference calling, short message servicing and fax and electronic mail.

GSM is a digital mobile network that is widely used by mobile phone users in Europe and other parts of the world. Global system for mobile communication uses a variation of time

division multiple access and is the most widely used of the three digital wireless telephony technologies: TDMA, GSM and code-division multiple access. Global system for mobile communication digitizes and compresses data, then sends it down a channel with 2 other streams of user data, each in its own time slot. It operates at either the 900 megahertz or 1,800 MHz frequency band. GSM system, together with other technologies, is part of the evolution of wireless mobile telecommunications.

2.1 Architecture of GSM

The Global system for mobile communication specialized determinations characterize the distinctive components inside the GSM organize design. It characterizes the distinctive components and the routes in which they communicate to empower the general framework operation to be kept up. The Global system for mobile communication organize design is presently entrenched and with the other later cell frameworks now settled and other new ones being sent, the essential Global system for mobile communication arrange engineering has been overhauled to interface to the system components required by these frameworks. The fundamental GSM framework design has been kept up, and the system components depicted underneath play out an indistinguishable capacities from they did when the first Global system for mobile communication framework was propelled in the mid 1990s. The Global system for mobile communication arrange engineering as characterized in the GSM determinations can be assembled into four principle territories:

1. Mobile station (MS)
2. Base-Station Subsystem (BSS)
3. Network and Switching Subsystem (NSS)
4. Operation and Support Subsystem (OSS)

1. Mobile station (MS):-

Versatile stations or portable gear cell or cell phones fill in as the segment of a GSM cell arrange that the client sees and works. As of late their size has fallen significantly while the level of usefulness has incredibly expanded. A further preferred standpoint is that the time between charges has essentially expanded.

There are various components to the wireless and two principle components are the fundamental equipment and the SIM. The equipment itself contains the primary components of the cell phone used to produce the flag, and process the information beneficiary and to be transmitted. It likewise contains a number known as the International Mobile Equipment Identity. This is introduced in the telephone at fabricate and can't be changed. It is gotten to by the system amid enrollment to check whether the hardware has been accounted for as stolen.

The Subscriber Identity Module (SIM) contains the data that gives the personality of the client to the system. It contains are

assortment of data including a number known as the International Mobile Subscriber Identity (IMSI).

2. Base Station Subsystem (BSS):-

The Base Station Subsystem (BSS) segment of the GSM organizes engineering that is on a very basic level related with speaking with the mobiles on the system. It comprises of two components:

1) Base Transceiver Station (BTS): The Base Transceiver Station utilized as a part of a GSM organizes involves the radio transmitter recipients, and their related reception apparatuses that transmit and get to straightforwardly speak with the mobiles. The Base Transceiver Station is the characterizing component for every cell. The Base Transceiver Station speaks with the mobiles and the interface between the two is known as the Um interface with its related conventions.

2) Base Station Controller (BSC): The Base Station Controller shapes the following stage over into the GSM organize. It controls a gathering of Base Transceiver Stations, and is regularly co-situated with one of the BTSs in its gathering. It deals with the radio assets & controls things. It speaks with the Base Transceiver Stations over what is named the Abis interface.

3. Network Switching Subsystem (NSS):

The GSM framework engineering contains an assortment of assorted components, and is typically

Named the middle system. It gives the principle control and interfacing for the complete versatile system. The varied components inside the middle system include:

1) Mobile Switching administrations Center (MSC):- The elemental component inside the middle system region of the last word GSM arranges engineering is that the Mobile exchanging Services Center. The MSC demonstrations style of a typical exchanging hub inside a PSTN or Compatibility with integrated services digital network additionally gives extra usefulness to empower the necessities of a transportable client to be upheld. These incorporate enlistment, verification, call area, between Mobile Switching Center handovers and call steering to a transportable supporter. It additionally gives an interface to the Public Switching Telephone Network so calls are often directed from the portable system to a telephone related to a landline. Interfaces to different Mobile Switching Centers are given to empower calls to be made to mobiles on various systems.

2) Home Location Register (HLR):- In HLR database contains all the regulatory data about every supporter alongside their last known area. Along these lines, the Global System for Mobile communication system can course calls to the applicable base station for the MS. At the aim when a client switches on their telephone, the phone registers with the system and from this it's conceivable to figure out which BTS it speaks with so approaching calls are steered suitably. Not

with standing when the phone isn't dynamic it re-enrolls intermittently to make sure that the system knows about its latest position. there's one HLR per organize, despite the particular proven fact that it would be dispersed crosswise over different sub-focuses to for operational reasons.

3) Visitor Location Register (VLR):- In VLR contains those data from the HLR that empowers the those administrations for the individual endorser of lean. The VLR are actualized as a particular substance, however it's generally acknowledged as a necessary a component of the MSC, instead of a particular element. Along these lines get to is created speedier and more advantageous.

4) Equipment Identity Register (EIR):- The EIR is that the substance that chooses whether given portable hardware may well be permitted onto the system. Every mobile phone encompasses a number referred to as the International Mobile Equipment Identity. This number, as said above, is introduced within the hardware and is checked by the system amid enlistment. Subordinate upon the information held within the EIR, the versatile may well be assigned one amongst three statespermitted onto the system, banished get to, or observed on the off chance that its issues.

5) Authentication Center:- it's an ensured database that contains the mystery enter likewise contained within the client's SIM card. it's utilized for verification and for figuring on the radio channel.

6) Gateway Mobile Switching Center (GMSC):- The GMSC is that the indicate which a ME ending call is initially steered, with no information of the MS's area. The GMSC is hence responsible for acquiring the Mobile Station Roaming Number from the HLR in light of the Mobile Station ISDN number, the "index number" of a Mobile stationand steering the selection to the proper visited MSC. The "MSC" part of the term GMSC is misdirecting, since the passage operation doesn't require any connecting to a MSC.

7) SMS Gateway (SMS-G): The SMS-G or SMS door is that the term that's utilized to any or all things considered portray the 2 Short Message Services Gateways characterized within the GSM measures. the 2 portals handle messages coordinated in various bearings. The Short Message Service Gateway MSC is for brief messages being sent to a ME. The Short Message Service Inter- Working Mobile Switching Center is employed for brief messages started with a conveyable thereon system. The SMS-GMSC part is like that of the GMSC, while the SMS-IWMSC gives a settled get to point the Short Message Service Center.

4. Operation and Support Subsystem (OSS):-The OSS or operation bolster subsystem would be a component inside the GSM organizes engineering that's related to segments of the NSS and also the BSC. it's utilized to manage and screen the GSM system and it's additionally accustomed control the movement heap of the BSS. It must be noticed that because the amount of Base Station increments with the scaling of the supporter populace variety of the maintenance errands are

exchanged to the BTS, permitting funds within the worth of responsibility for framework.

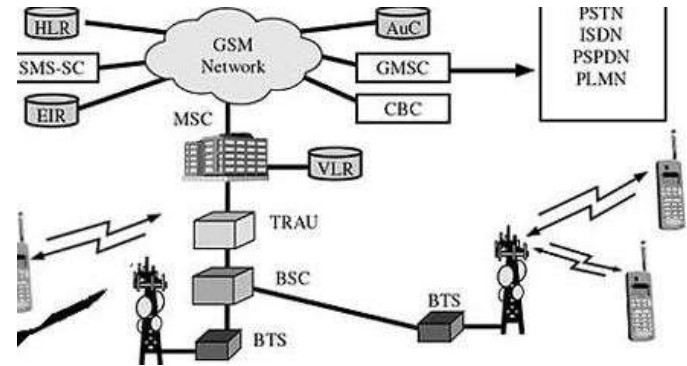


Figure 1: GSM Architectural Elements

2.2 Features of GSM Module:

Improved spectrum efficiency

International roaming

Compatibility with integrated services digital network (ISDN)

Support for new services.

SIM phonebook management

Fixed dialing number (FDN)

Real time clock with alarm management

High-quality speech

Uses encryption to make phone calls more secure

Short message service (SMS)

2.3 Benefit of GSM

Global System for Mobile Communications is how mobile phones communicate round the world. Over 3 billion people are using it. it's many benefits over CDMA and is becoming more and more utilized by the year. GSM phones have made text messaging a daily occurrence in many places round the world, even aggregation countries.

Emergency Response:-

The 112 is now a universal emergency number among GSM networks. irrespective of where the user is, if they're using GSM, they will demand help.

Technological Growth:-

The growth of engineering has been prompted by worldwide competition, allowed by the universality of GSM. This has cause a reliable cell-phone service and improved quality in both connection stability and ease.

Universal Data Transfer:-

The Global System for Mobile Communications allows for reliable and efficient data transfer. It even allows text and pictures to be sent from anywhere the system is available.

Universal Data Transfer:-

The Global System for Mobile Communications allows for reliable and efficient data transfer. It even allows text and pictures to be sent from anywhere the system is on the market.

Better sound:-

As a digital carrier, a world System for Mobile Communications telephone makes for clearer connections, because it can filter noise. This makes communication, despite distance, easy.

Has international capabilities:-

While sometimes costly, Global System for Mobile communication phones have built-in international capabilities. Occasionally, it costs more reckoning on what region the decision is being placed to, but it remains a valuable benefit.

2.4 Disadvantages of GSM

Range problem in hilly area.

It has fixed max call sites range up to 35 km that's very limited.

IS-95 is often installed in small tower.

In the communication systems the voice quality is extremely poor but in GSM network technology we get good voice quality and also the frequency range is additionally good. it's higher frequency ranges and data rates.

Table1. 1Comparison between GSM and GPS:

Parameter-s	GSM	GPS
Full Form	Global System for Mobile Communications	Global Positioning System
Definition	It is a specification of wireless network infrastructure. The system has been developed by the European Telecommunications Standards Institute.	GPS stands for "Global positioning System". It is a satellite-based navigation system that was developed by the United States Department of Defense.
Technology	An object's position is determined using signal strength and triangulation from	Triangulation to at least three or four of the 24 satellites

	base stations.	that orbit the earth.
Accuracy (in difficult scenario)	Base stations are capable of providing locations in areas like tunnel and dense areas.	Comparatively difficult in area surrounded by tall buildings.
Mobile tracking	Phone's international mobile equipment identity number, etc. are used to track the location of a cell phone.	Digital maps, etc. are used to track the location in real time.
Advantage-s	<ol style="list-style-type: none"> 1. World wide roaming 2. The facilities of GSM are highly protected 3. Reasonable Devices and Facilities 	<ol style="list-style-type: none"> 1. Provides the exact location 2. Provides the exact latitude and longitude 3. Helps in searching the local area for nearby amenities
Disadvanta- ges	<ol style="list-style-type: none"> 1. Released and missed calls 2. Calls made through GSM mobiles can be tampered. 	<ol style="list-style-type: none"> 1. Battery life 2. Inaccuracy in certain scenarios

3. CONCLUSION

Global Positioning System may be a network of satellites that continuously transmit coded information, which makes it possible to exactly identify locations on earth by measuring distance from the satellites. Global positioning system although was developed for military purposes, but the no. of civilian users of GPS already well far exceeds than no. of potential military and as discussed in above topic, its application field is vast and new application will still be created because the technology evolves. we've tried to relinquish and over view of Global Switching for Mobile communication system and therefore the GSM is that the standard that ensures interoperability without stifling competition and innovation among the suppliers to the advantage of the general public both in terms of cost and repair quality.

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