Improving National Security Using GPS Tracking System Technology

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Abstract *The spate of insecurity in Nigeria has received global attention lately and thus a need for an improved Global Positioning System (GPS) based tracking system is required to meet quickly evolving security issues in Nigeria. GPS tracking technology is one of the most rapidly growing technologies around the world. This paper is an attempt to explore the security benefits embedded in the GPS tracking system in respect to the National Security dilemma and its deployment into Nigeria Security System. The paper delves into the architecture of a GPS tracking system, the mechanism of GPS system and the importance of geofencing and its application in the security of National emoluments(e.g refineries, mast e.t.c), human lives, Cars, Government facilities e.t.c. This paper is a clarion call to the Nigeria Government to implement an holistic approach towards the realisation of the optimum utilization of the NIGCOMSAT satellite especially in the area of security of lives and properties. This paper call the attention of the federal govt to the need for the full implementation of NIGCOMSAT Nigeria to avert some of the cases of bombing that has characterised the political landscape.Hence,a full implementation of Satellite Tracking Technology is capable of averting some of the security problem in the Nation.*

Keywords: *Global positioning system, Insecurity, GPS tracking system, NIGCOMSAT.*

Introduction

Today, the whole word feels insecure; the environment know no peace and the people can't sleep with even one of their eyes closed. These are apparently evidenced in incessant wars between nations that have resulted in genocide and carnage while extent of damages, "Crimes Against Humanity" being perpetrated by man against fellow man has wrecked on lives and properties cannot be quantified. The sounds of guns, Weapons of Mass Destruction (WMD) and Bomb blast have enveloped the entire world (Comandclem, 2007). The situation in Nigeria is not an exemption. The uproar in the Niger-Delta and the frequent Bomblast occurrence in the major states in Nigeria are clear evidences of the Level of insecurity in the Nation. Lack of security for life and property has assumed a crisis dimension in Nigeria.

The insecurity in Nigeria has led to the destruction of Lives and properties and has discouraged foreign investors from investing in the Nation economy.

In addressing the challenge to the survival of democracy in Nigeria, it is pertinent to consider security issues and problems that have affected or capable of affecting the attitude, confidence and cooperation of all groups and segments that make up the Nigerian federation. It is also necessary to explore the gaps and gray areas in the national constitution that are responsible for various problems and crises and how these gaps can be addressed. Some of the major security problems currently confronting the nation have been identified to include: political and electioneering conflicts, socio-economic agitations, ethno-religious crises, ethnic militias, boundary disputes, cultism, criminality and organised crimes (Abdulsalami, 2004).

The methodology of tackling insecurity has remained the same: vote more money to purchase vehicles and equipment, recruit more policemen and give orders for arbitrary arrest, urge all arms of security and intelligence to collaborate in ways that permit those dealing with intelligence and counter-intelligence to dabble in security matters and vice versa, as is the case between the Nigerian police and the State Security Services (SSS).

Abdulsalami(2004) retreated that recent international debates have also raised the need to see security in the broader sense as the struggle to secure the most basic necessities of life: food, fuel, medicine and shelter. This broader human security is important for the attainment of physical and national security and overall peace and development as social unrests arising from the absence of such basic human security can

indeed lead to security problems and conflicts.

Globally, Information Technology has been adopted in the developed World to combat the problem of insecurity and uproar. One of the approaches of addressing the problem of insecurity is the use of Cyberspace or Cybersecurity.Cybersecucrity has been adopted in the developed world to combat the problem of insecurity and other related Crimes. Cybersecurity is the body of technologies, processes and practices designed to protect networks, computers, programs and data from attack, damage or unauthorized access.(whatis.techtarget.com/definition/cybersecurity.html).

GPS tracking System is one of the most rapidly growing technologies around the world. Most developed countries have focused on the GPS technologies in resolving some of their inherent security problems. According to Michael K., McNamee A and Micheal M.G. (2006),*the* Global Positioning System (GPS) is increasingly being adopted by private and public enterprise to track and monitor humans for location based services (LBS). A location-based service (LBS) is an information or entertainment service, accessible with mobile devices through the mobile network and utilizing the ability to make use of the geographical position of the mobile device .LBS can be used in a variety of contexts, such as health, indoor object search, entertainment, work, personal life, etc. LBS include services to identify a location of a person or object, such as discovering the nearest banking cash machine or the whereabouts of a friend or employee. LBS include parcel tracking and vehicle tracking services. LBS can include mobile commerce when taking the form of coupons or advertising directed at customers based on their current location. They include personalized weather services and even location-based games. They are an example of telecommunication convergence(Wikipedia).Some of these applications include personal locators for children, the elderly or those suffering from Alzheimer's or memory loss, and the monitoring of parolees for law enforcement, security or personal protection purposes.

GPS has the ability to calculate the position, time, and velocity of any GPS receiver. It does so using a
process of triangulation, which works on the premise that you can find any position if the distance from three other locations is also known.

Eric M.Conway(2008) noted that the U.S Department of Defense first launched a Global Positioning Systems (GPS) satellite in 1978 and achieved a full constellation of 24 satellites in 1994, which the U.S. government has named Navstar.Today, GPS is used for both civil and military purposes and is controlled by a joint civilian/military executive board of the U.S. Government.The system is maintained by the U.S. Air Force on behalf of all users. GPS relies on three components: a constellation of satellites (currently 27) orbiting about 20,000km (11,500 miles) above the earth's surface which transmit ranging signals on two frequencies in the microwave part of the radio spectrum, a control segment which maintains GPS through a system of ground monitor stations and satellite upload facilities, and user receivers (civil and military).

Originally conceived by the U.S. Air Force for military purposes in the 1960s, it was commercially released in 1995. In 2000, selective availability was turned off, providing consumers the same level of accuracy as the U.S. military. Since that time, mobile business applications based on GPS and cellular network technologies have proliferated. The rate of innovation has been high, and the level of adoption has been steadily increasing, showing a great deal of promise for the small start-up companies which are targeting GPS solutions at families, enterprises, and security-related government initiatives. Pasi Kamppi (2009) affirmed that satellite tracking is one of the most rapidly growing business areas in the world . Tracking devices have become quite cheap, and they are available to nearly everybody. Even Smartphone can be used as tracking devices.

Sturdevant Rick W. (2009) affirmed that the the Navtar Global positioning System (GPS) is the first satellite navigation system that enabled users to determine precisely their location in three dimensions and time within billionths of a second and grew from a concept into a fully operational system in slightly more than two decades. The widely-used GPS system are the US-based GPS (Global Positioning System) and Russian-based GLOSNASS (Global'naya Navigatsionnaya Sputnikowaya Sistema, Global Navigation Satellite System) satellite positioning systems.

By 1972,the U.S. Air Force(USAF) and the U.S.Navy had been studying for several years the possibility of improved satellite-based radio navigation. The main reasons for GPS development were the need to deliver weapons precisely on target and to reverse the proliferation of navigation systems in the U.S. military.

Gak Gyu(2007) in his paper Locating and Tracking Assets using RFID, states that "Accurate locating or tracking is required in many fields from navigating for rescuing wounded people in emergency situation to decision-making for striking the target during the military operations. Therefore, the fields of the academic circles and the industries have been interested in locating and tracking objects or people over the years. The study is getting broad for inside as well as outside. Being able to rapidly locate equipment is critical in-building, including hospitals, manufacturing floors and warehouses. To utilize the limited budget and resources more efficiently, it is important to make optimal strategic decision."

The use of GPS in conjunction with GIS, cartographic mapping, and other technologies proved beneficial in disaster relief and recovery efforts. After hurricane Andrew devastated Florida in 1992, the Federal emergency management Agency (FEMA) contracted with survey crews to experimentally carry out the inventory on the damage using GPS/GIS technology instead of the traditional, manual assessment that involved house-by-house interviews. Based on encouraging results from that experiment, FEMA, the U.S. Army corps of engineers, and a private contractor with GPS/ GIS expertise formed a team in July 1993 to produce maps for *disaster response*, *recovery efforts*, and *risk mitigation* in the wake of severe Mississippi river floods that inundated more than 13 million acres, destroyed billions of dollars in crops, and left hundreds of people homeless. Following a GPS-equipped helicopter survey, a pair of two-person ground observer teams with GPS/GIS handheld receivers inspected and inventoried structures in approximately 75 communities south of Quincy, Illinois,more than 1,500 maps/data sheets were produced within a week of the teams' initial transfer of data to the corps of engineers' rock island, illinois, base station. Prior to GPS/GIS, it would have taken a team of 50 people years to complete the same task. With the maps quickly delivered to FEMA decision makers, they began meeting with local officials and citizens to discuss assistance and requirements to rebuild above the 100-year flood elevation.

The most rapidly expanding area of GPS use for civil, commercial, and personal purposes was probably location-based services (LBS)—positioning and navigation.Similarly,Land-based users include automobile drivers, railroads, fleet managers of trucks, delivery vehicles, and public transportation; emergency responders such as fire, ambulance, and police; and recreational activities such as hiking,hunting,skiing, biking, and golfing. According to Alan A.vargheseXXXX from ABI research in oyster Bay, new york, shipments of recreational GPS devices alone rose from 3.2 million in 2002 to 5 million in 2003, with a predicted annual growth of 31 percent until 2009. Sea-based applications ranged from recreational sailing, fishing, and managing shipping fleets, to assisted steering, risk assessment, and hazard warning. pilots of all varieties—airplane, helicopter, hot-air balloon—relied increasingly on GpS for monitoring their flight path, for collision avoidance, and for landing. Search-and rescue personnel on land, at sea, and in the air has considered GPS as indispensable. Ultimately, Scientists and Engineers experimented with using GPS for launch and on-orbit operation of Spacecraft. The use of GPS-aided technology for management of vehicle fleets has saved governments and businesses hundreds of millions of dollars by enabling more efficient planning of routes, monitoring misuse by employees, or locating stolen vehicles. Emergency responders found GPS capabilities invaluable. In 1992,a GPS-aided response system was tested in a large crossfield natural gas field north of calgary,Alberta and it was concluded that it offered noteworthy cost and safety improvements over earlier systems by "providing nearly immediate identification of an alarm site and the nearest field personnel, as well as detailed maps that show the best route to the scene of an alarm. Recovery of stolen vehicles became much more likely with GPS.

The aim of this paper is to explore the current services being offered by GPS system especially in the area of security of lives and properties and to call the attention of the Government of the day to some of the untapped potential of GPS tracking system.

What is GPS

The Global Positioning System (GPS) is actually a constellation of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails). The U.S. military developed and implemented this satellite network as a military navigation system, but soon opened it up to everybody else.

Each of these 3,000- to 4,000-pound solar-powered satellites circles the globe at about 12,000 miles (19,300 km), making two complete rotations every day. The orbits are arranged so that at anytime, anywhere on Earth, there are at least four satellites "visible" in the sky. A GPS receiver's job is to locate four or more of these satellites, figure out the distance to each, and use this information to deduce its own location. This operation is based on a simple mathematical principle called *Trilateration.*

Figure 1.
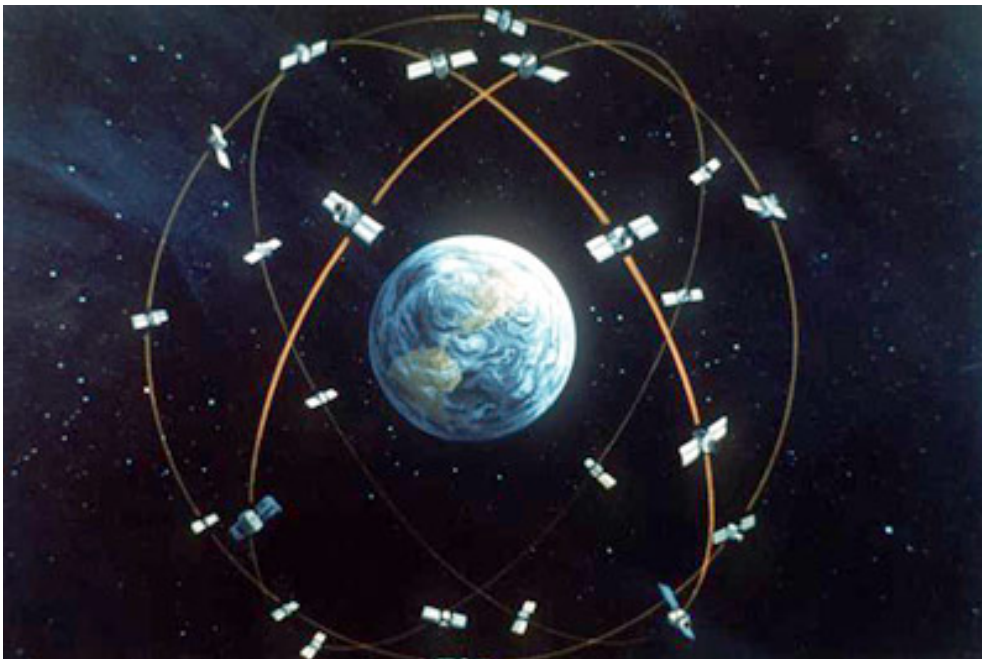
Photo courtesy U.S. Department of Defense

In order to make the simple calculation of the location, then, the GPS receiver has to know two things:
1) The location of at least three satellites above you
2) The distance between you and each of those satellites

Overview of GPS Tracking System

A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a vehicle, person, or other asset to which it is attached and to record the position of the asset at regular intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location database, or internet-connected computer, using a cellular (GPRS), radio, or satellite modem embedded in the unit (see Figure 1). This allows the asset's location to be displayed against a map backdrop either in real-time or when analysing the track later, using customized software.

A GPS tracking system uses the GNSS (Global Navigation Satellite System) network. This network incorporates a range of satellites that use microwave signals which are transmitted to GPS devices to give information on location, vehicle speed, time and direction. So, a GPS tracking system can potentially give

both real-time and historic navigation data on any kind of journey. A GPS tracking system can work in various ways. From a commercial perspective, GPS devices are generally used to record the position of Objects e.g vehicles as they make their journeys. Some systems will store the data within the GPS tracking system itself (known as passive tracking) and some send the information to a centralized database or system via a modem within the GPS system unit on a regular basis (known as active tracking).

Types of GPS Tracking System

A Passive GPS Tracking System Passive System monitors location and stores its data on journeys based on certain types of events. So, for example, this kind of GPS system may log data such as turning the ignition on or off or opening and closing doors. The data stored on this kind of GPS tracking system is usually stored in internal memory or on a memory card which can then be downloaded to a computer at a later date for analysis. In some cases the data can be sent automatically for wireless download at predetermined points/times or can be requested at specific points during the journey.

An Active GPS Tracking System Active System is also known as a real-time system as this method automatically sends the information on the GPS system to a central computer or system in real-time as it happens. This kind of system is usually a better option for commercial purposes such as fleet tracking and individual vehicle tracking as it allows the company to know exactly where their vehicles are, whether they are on time and whether they are where they are supposed to be during a journey. This is also a useful way of monitoring the behaviour of employees as they carry out their work and of streamlining internal processes and procedures for delivery fleets.

Figure 2. The architecture of a GPS tracking system
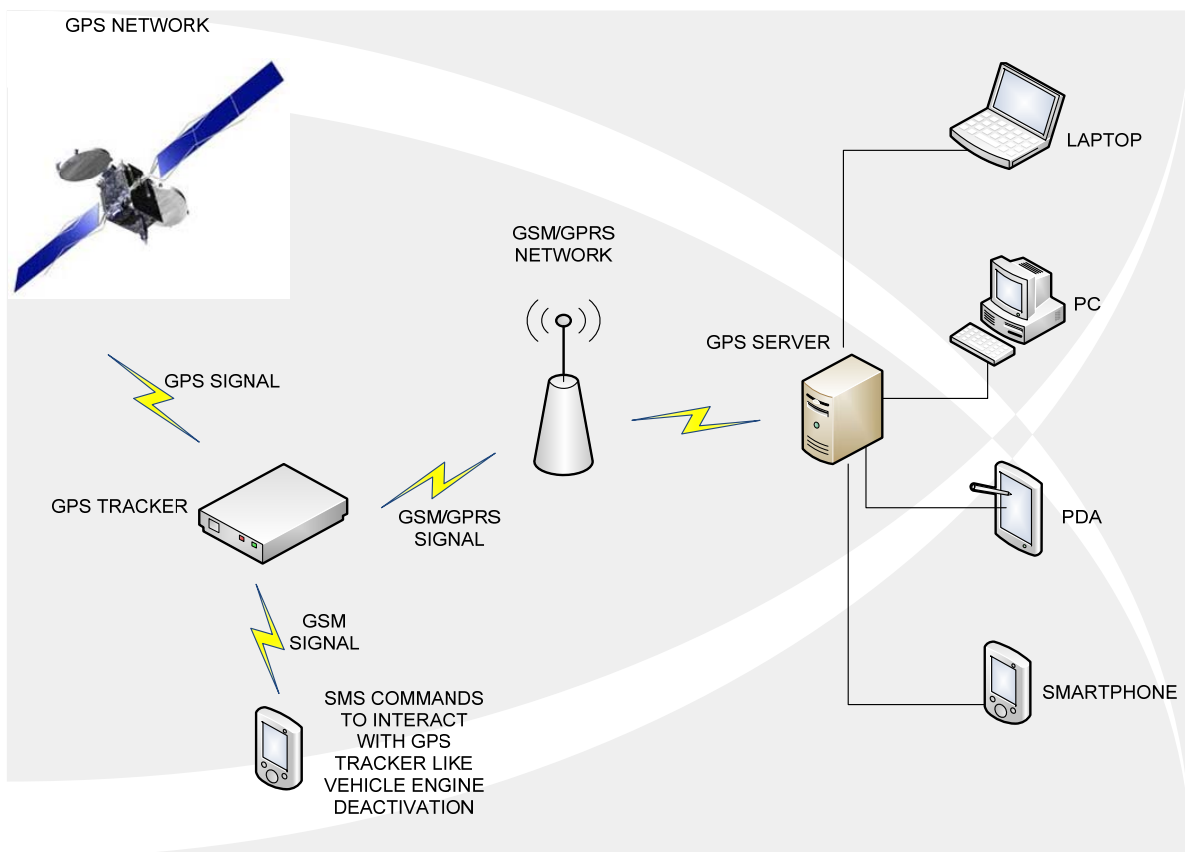
GPS Tracking System Units

Three Types of GPS Tracking Units are there. There are currently three categories of GPS tracking units. The categories are split into how GPS data is logged and retrieved.

Data Loggers

Data loggers are usually the most basic type of GPS tracking; a GPS data logger simply logs the position of the object at regular intervals and retains it in an internal memory. Usually, GPS loggers have flash memory on board to record data that is logged. The flash memory can then be transferred and accessed using USB or accessed on the device itself. Usually data loggers are devices used for sports and hobby activities. They might include devices that help log location for hikers, bikers and joggers.

Data Pushers

Data Pushers are GPS tracking units that are mainly used for security purposes. A data pusher GPS tracking unit sends data from the device to a central database at regular intervals, updating location, direction, speed and distance. Data pushers are common in fleet control to manage trucks and other vehicles. For instance, delivery vehicles can be located instantly and their progress can be tracked. Other uses include the ability to track valuable assets. If valuable goods are being transported or even if they reside in a specific location, they can constantly be monitored to avoid theft. Data pushers are also common for espionage type tasks. It is extremely easy to watch the movements of an individual or valuable asset. This particular use of GPS tracking has become an important issue in the field of GPS tracking, because of its potential for abuse.

Data Pullers

The last category of GPS tracking units is the data pusher units. These types of units push data or send data when the unit reach a specific location or at specific intervals. These GPS units are usually always on and constantly monitoring their location. Most, if not all data puller unit also allow data pushing (the ability to query a location and other data from a GPS tracking unit).

Features of the GPS Tracking System

Generally all of the GPS Tracking System has some of the common features that are listed below:

GSM/GPRS Module - It is used to send the location to the user online. In some case, if the user wants the location through the internet then this module is very useful. By the help of the GSM/GPRS module, we can send data real time. It can be seen on the internet enabled any device as a PC, mobile phone, PDA etc.

Track Playback - Animates your driver's daily driven route so that you can follow every move. The track animation line is colour coded to indicate the speed your driver was travelling during his route.

Idle Time Report - Gives you an accurate report detailing when your driver was stopped and has left the engine running on the vehicle. This report was designed with input from our existing customers who were concerned about high fuel bills.

Track Detail - Provides you with a split screen view when reviewing your driver's route. Stop and transit times, as well as speed information, are displayed in the bottom pane. You can easily toggle between stops by clicking the stop number on the track detail pane.

Group Reporting - Allows you to set vehicles up into groups for faster and easier reporting.

Geo Fencing – It allows us to limit some region of area and if your vehicle goes beyond the boundary of that region then urgent message will be sent by the system to the manager to control the driver. So that the time and money can be saved by this system.

Ignition ON/OFF detection – The system can save the information about the engine that it is in working condition or stop by ignition ON/OFF detection so that the manager can know for how many times the driver stopped the fleet and for how many time. So much time can be saved.

SMS / GPRS Communication - The location about the fleet or the person can be send by SMS or email by this facility.

On-Line and Off-Line tracking – Every user has different requirement and as per the requirement the data can be viewed real time or it can be saved in the unit and when the vehicle reach to its manager, manager can download data and see the route of the vehicle and every other detail that can be seen by the real time.

Buzzer for alerting the driver – Some system uses the buzzer system to alert the driver that he is going out of the boundary or the speed is very high,or anything that is restricted. So that the driver is able to know that he is going wrong.

Monitoring digital events – If you need to know when a piece of machinery was turned On/Off or when a door was Open/Shut, this system will provide you with best options.

Reports – start stop report, standard report, stop sensor report, aggressive driving report, excessive idling report, vehicle mileage report etc reports can be generated by the system to help understand the driver's behaviour and to improve it.

Disscussion

How GPS Tracking System Works

The flowchart below depicts the true pictures on how a GPS tracking system works.

Figure 3
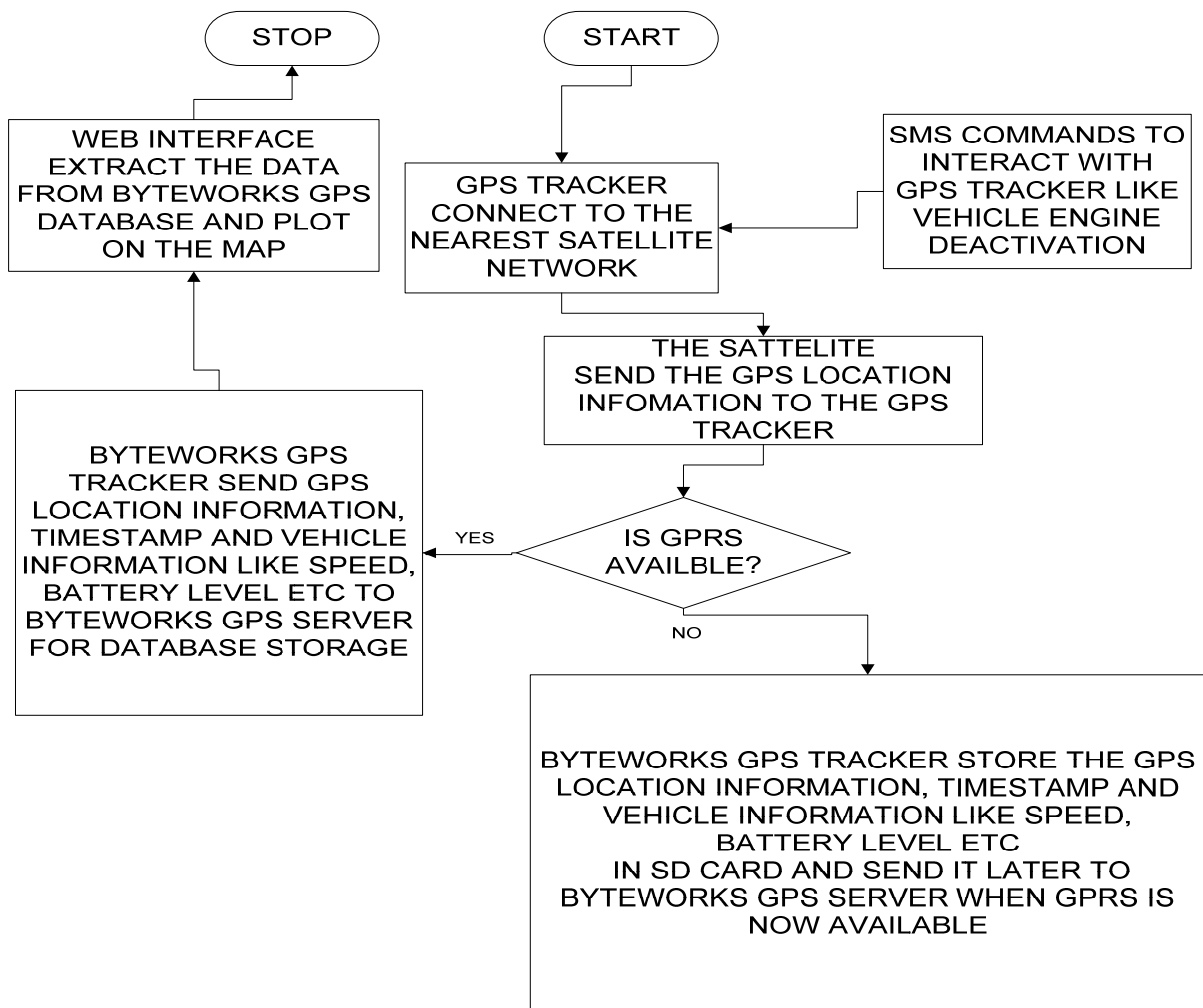
Security Benefit of a GPS Tracking System

Employee Monitoring

Employees that are tracked using GPS usually travel in vehicles over long distances. Tracked workers include couriers, and bus and truck drivers. The motivation for tracking employees is linked to improving company productivity. Automated Waste Disposal Incorporated uses GPS to ensure their truck drivers do not speed and are on track to meet their delivery schedule. The company imposed GPS tracking on its employees to reduce overtime and labor costs. After implementing the GPS tracking system the number of overtime hours dropped from 300 to 70 hours on average per week.

Paroole and Sex Offender

Today many parolees are fitted with a small tamperproof GPS tracker worn as a bracelet or anklet. The ankle device is in the shape of a rigid plastic ring, accompanied by a small tracking box that can fit in a pocket . Companies such as iSECUREtrac, design GPS monitoring systems to track parolees and sex offenders ensuring they do not commit any crimes, alert authorities if they enter certain locations, (e.g. schools,parks), and prevent them from leaving their homes, if that is prohibited . Some GPS units can also offer the added capability of knowing how much alcohol a person has consumed by measuring perspiration levels every hour. Parolee and paedophiles tracking is widespread in the United States with an estimated 120,000 tracked parolees in 28 states . However, there are over 50,000 convicted sex offenders in the US that are not tracked at all.

Due to the current over-crowding problem in British prisons, certain types of criminal are being tagged and released. The use of active tags with a large range capability can allow the police and probation services to monitor the whereabouts of tagged criminals and take appropriate action when necessary(Craddock R.J,2004).

Tracking Suspected Terrorist

GPS tracking is used in developed countries to monitor the activities of a suspected terrorist or group. A number of national laws stipulate the use of a tracking device affixed to any person suspected of "activities prejudicial to security" (e.g. ASIO Act1979). Previously, the maximum period of time a suspected terrorist could be tracked was 6 months, however, during the Council of Australian Government (COAG) meeting on counter-terrorism it was planned to increase this period to 12 months.

Demential Wondering

Dementia is a symptom of a number of diseases.However; the most common forms are Alzheimer's disease, vascular dementia and dementia with Lewy bodies. It currently affects five per cent of people aged over 65 years and twenty per cent of people aged over 80 years. Dementia becomes a serious problem when a patient begins to wander. Due to his/her mental state a dementia sufferer may get lost easily and may even be injured or killed. Since it is difficult to keep constant watch over a dementia sufferer, a caregiver can employ a variety of assistive technologies which notify family members automatically by phone or email if problems arise. Proponents of this application emphasize that the technology grants dementia sufferers more independence and freedom to give them a better quality of life(Craddock R.J,2004)..

Parent Tracking Children

Today, parent use GPS tracking device to monitor the activities of their children .Some of the tracking devices are in form of a Wristwatch. However, some parent desired a platform that would allow them to call their wards, therefore a need for a mobile platform. Users can find the location of their child by logging onto the GPS provider website and viewing data on a map. Locations are updated every two minutes in some tracking solution so parents can keep a constant eye on their child's activities

Car Tracking

Wikipedia described a car tracking system as the one that combined the installation of an electronic device in a vehicle, or fleet of vehicles, with purpose-designed computer software at least at one operational base to enable the owner or a third party to track the vehicle's location, collecting data in the process from the field and deliver it to the base of operation. It stated futher that modern vehicle tracking systems commonly use GPS or GLONASS technology for locating the vehicle, but other types of automatic vehicle location technology can also be used. Vehicle information can be viewed on electronic maps via the Internet or specialized software.

Owners of expensive cars can put a tracker in it, and "activate" them in case of theft. "Activate" means that a command is issued to the tracker, via SMS or otherwise, and it will start acting as a fleet control device, allowing the user to know where the thieves are.

Animal control

When put on a wildlife animal (e.g. in a collar), it allows scientists to study its activities and migration patterns. Vaginal implant transmitters are used to mark the location where pregnant females give birth. Animal tracking collars may also be put on domestic animals, to locate them in case they get lost.

Espionage / Survillance

When put on a person, or on his personal vehicle, it allows the person monitoring the tracking to know his/her habits. This application is used by private investigators, and also by some parents to track their children.

R. J. Craddock (2004) identifies other major areas applications of GPS tracking system to include the following;

- Position reporting for marine navigation systems
- Positioning and tracking of transport containers
- Development of high accuracy positioning systems using differential GPS
- Tagging of ships, providing remote information access
- Personnel tracking and mapping using Wireless LANs
- GNSS location based systems
- Tracking of emergency services personnel entering hazardous sites, using GPS and RF tags

## Niger-Delta Uproar: GPS System to the Rescue

The adoption of gps tracking system by the Federal Government can help to forstall possible attack on government facilities by the Militants and other aggrieved groups in the creeks. Geofencing will go a long way in curbing the activities of these militant group,the facilities are tracked or tagged and the presence of any

invader(untracked person or object is quickly recognised and a signal sent to the appropriate Law enforcement agents via SMS for quick action to be taken.Similarly,a real time tracking of the expatriate and their families will go a long way in reducing the case of kidnapping in the Niger-Delta .

The use of tagged security passes can assist in controlling who can and cannot enter certain areas of a site or venue. Entry into some prohibited areas e.g. in ports, can be difficult to control. A network of tag readers can be used to alert security personnel when unauthorised tags have or are about to enter a prohibited area (using predictive tracking). In addition, the combination of a tag reader network with a network of smart cameras can provide alerts of un-tagged people within particular areas (Craddock,2004)

Proposed Framework

Fig 2. GPS-Driven intelligent information collaboration security system
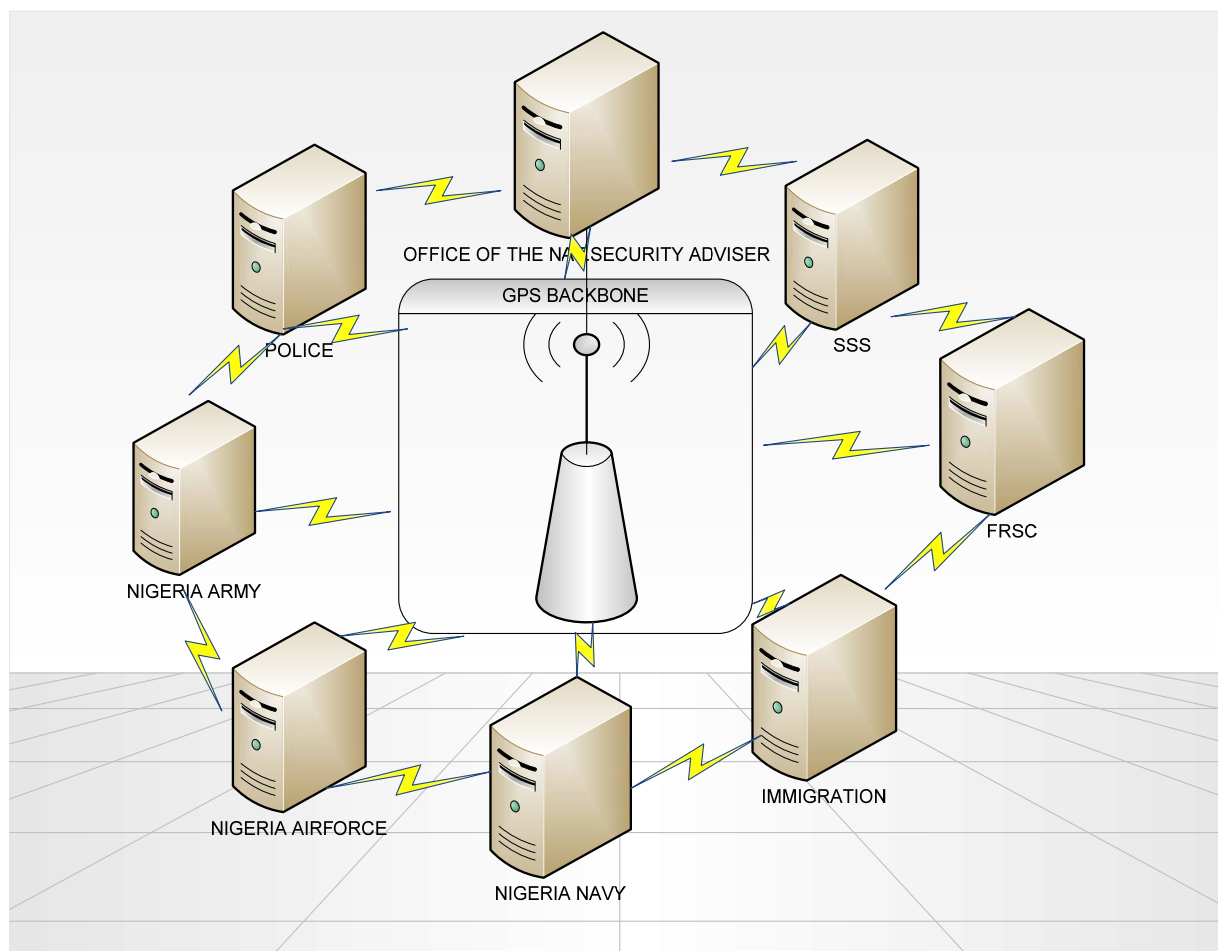
We proposed a model (fig 2) – an intelligent collaboration security system which is gps-driven.This model advocate for an integrated information system among the security outfits with GPS as the driven force in Nigeria.Furthermore,once an early warning system powered by a GPS system has been triggered,at any part of the Nation with the help of the Satellite, the information can be shared among the security agencies and joint response or action is initiated to forestall any threat or form insecurity.

Conclusion

With this paper, we have been able to x-ray the inherent security benefit embedded in the satellite tracking

with a bias in gps tracking system. This paper is without any doubt a blueprint for the Nigeria government to tap into the seemingly latent potential in the gps tracking system in tackling security problem in the Nation. The financial benefits of installing GPS tracking are more than enough to justify the costs. When coupled with increased security, the return on investment (ROI) of GPS tracking is nearly immediate. We end this paper with the statement from the Managing Director and Chief Executive of NigComsat;Engr Timasaniyu Ahmed Rufai, "The complete installation of satellite particular the one to be replaced after its crash in the orbit was capable of averting recent bomb blast in Jos and Abuja that Killed Scores of innocent Nigerians.

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