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Monitored Fleet Management System using GPS

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ABSTRACT

Security to a Fleet Management is basically shown in terms of tracking the vehicle and monitoring the vehicle under survivalence. A fleet is a group of employees working for a single organization or many organizations and managing a transportation system as per their timings with their specific origin and destinations is called as Fleet Management. The tracking system is operated embedding a GPS System into the vehicle, here we install Google maps into the device, the GPS kit has 2 digital input and output devices along with a RS 232 port, with one of the port a GSM mobile device is connected which is facilitated with a GPRS. A Passive RFID reader is connected to the GPS kit with a RS 232 protocol, here the RFID reader is used to allow the access to the authorized customers only. Every customers are given a RFID Tag where they are asked to tag on the reader every time they use the services. With the GPS device, we design a GEO Fence to the particular vehicle where it triggers an alert at the Central station whenever it crosses beyond the geographical orbit.

The next security measure of survivalance is done with a embedded Closed Circuit Camera which is operated at all the times, there is also a SOS/Panic alarm to alert the Central Station (Customer service) where the operator can communicate with the customers or driver and enquires regarding and the CCTV footage images or used for the records, if the situation in the vehicle is found beyond the control, the vehicle is turned OFF by delimiting the fuel supply of the vehicle and alert the nearest Police Station.

AIM & OBJECTIVES

The main aspect of this project is to provide a secured and easily accessible transportation system to the Fleet. Here everything is monitored and controlled remotely by the authorized persons who are trained to operate.

GPS

Is a space based navigation system that provides location and time information in all weather conditions, anywhere on or near The Earth where there is an unobstructed line of sight to four or more GPS satellites.

GSM

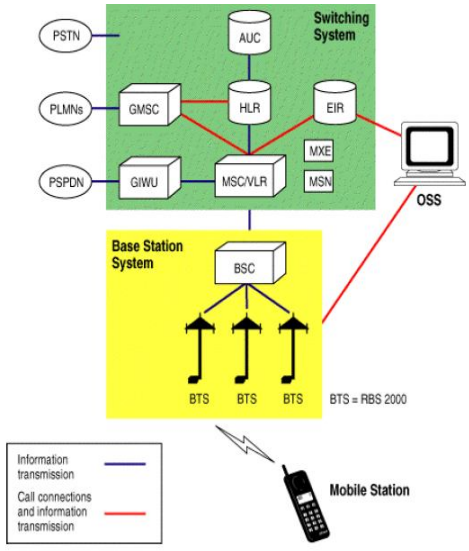
Global System for Mobile Communication (GSM) is a globally standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan – European mobile cellular radio system operating at 900MHz. It is estimated that many countries outside of Europe will join the GSM partnership.

The GSM Network Architecture

GSM provides recommendations and requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems:

The Switching System (SS)
The Base Station System (BSS)
The Operation and Support System (OSS)

The basic GSM network elements are shown in the figure below.



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GSM NETWORK ELEMENTS

The Switching System

The Switching System (SS) is responsible for performing call processing and subscriber – related functions. The Switching System includes the following functional units:

Home Location Register (HLR): The HLR is a database for storage and management of subscriptions. The HLR is considered the most important database, as it stores permanent data about subscribers including a subscriber's service profile, location information, and activity status. When an individual buys a subscription from one of the PCS operators, he or she is registers in the HLR of that operator.

Mobile Services Switching Center (MSC): the MSC performs the telephony switching functions of the system. It controls calls to and from other telephone and data systems. It also performs such functions as toll ticketing, network interfacing, common channel signaling, and others.

Visitor Location Register (VLR): The VLR is a database that contains temporary information about subscribers that is needed by the MSC in order to service visiting subscribers. The VLR connected to that MSC will request data about the mobile station from the HLR. Later, if the mobile station makes a call, the VLR will have the information needed for call setup without having to interrogate the HLR each time.

Authentication Center (AUC): A unit called the AUC provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each call. The AUC protects network operators from different types of fraud found in today's cellular world.

Equipment Identity Register (EIR): The EIR is a database that contains information about the identity of mobile equipment that prevents calls from stolen, authorized, or defective mobile stations. The AUC and EIR are implemented as stand – alone nodes or as a combined AUC/EIR node.

The Base Station System (BSS)

All radio related functions are performed in the BSS, which consists of Base Station Controllers (BSC's) and the Base Transceiver Stations (BTS's)

BSC: The BSC provides all the control functions and physical links between the MSC and BTS. It is a high capacity switch that provides functions such as handover, cell configuration data, and control of radio frequency (RF) power levels in Base Transceiver Stations. A number of BSC's are served by an MSC.

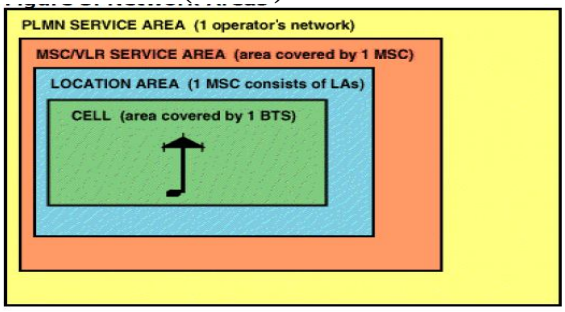
BTS: the BTS handles the radio interface to the mobile station. The BTS is the radio equipment (transceivers and antennas) needed to service each cell in the network. A group of BTS's are controlled by a BSC.

The Operation and Support System

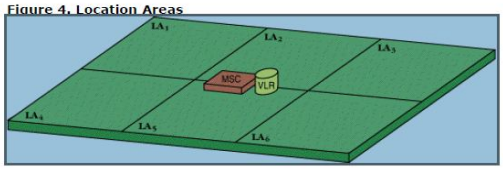
The Operation and Maintenance Center (OMC) is connected to all equipment in the switching system and to the BSC. The implementation of the OMS is called the operation and support system (OSS). The OSS is the functional entity from which the network operator monitors and controls the system. The purpose of OSS is to offer the customer cost – effective support and centralized, regional, and local operational and maintenance activities that are required for a GSM network. An important function of OSS is to provide a network overview and support the maintenance activities of different operation and maintenance organizations.

GSM Network Areas

The GSM network is made up of geographical areas, as shown in the figure below, these areas include cells, location areas (LA's), MSC/VLR service areas, and public land mobile network (PLMN) areas.



The cell is the area given radio coverage by one base transceiver station. The GSM network identifies each cell via the cell global identity (CGI) number assigned to each cell. The location area is a group of cells; it is the area in which the subscriber is paged. Each LA is assigned a Location Area Identity (LAI) number.



An MSC/VLR service area represents the part of the GSM network that is covered by one MSC and which is reachable, as it is registered in the VLR of the MSC (Figure 5).

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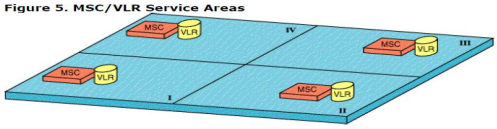
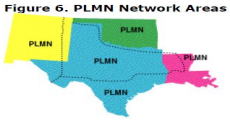
Figure 5. MSC/VLR Service Areas



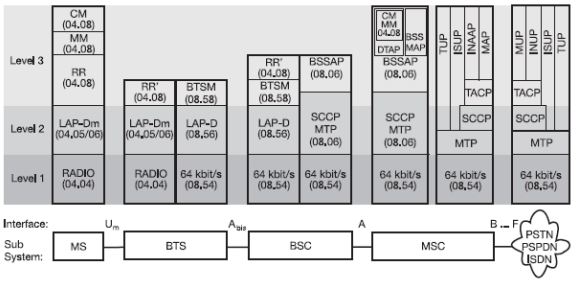
The PLMN service area is an area served by one network operator (see *Figure 6*).

Figure 6. PLMN Network Areas



Interfaces and Protocols

OSI Layer Structure in GSM



Note: Numbers in parentheses indicate the relevant ETSI-GSM Recommendations.

GPRS

GPRS is expected to profoundly change the mobile data services that GSM, CDMA and TDMA (ANSI – I36) network operators can offer. GPRS will increase opportunities for higher revenues and enable new, differentiated services and tariff dimensions to be offered (such as a charge for the number of kilobytes of data transferred). GPRS combines mobile access with internet protocol (IP) – based services, using packet data transmission that makes highly efficient use of radio spectrum and enables high data speeds. It gives users increased bandwidth, making it possible and cost effective to remain constantly connected, as well as to send and receive data as text, graphics and video.

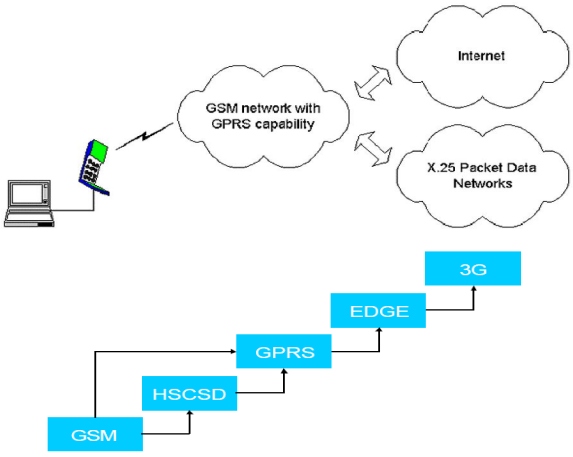
What is GPRS?

GPRS (General Packet Radio Service) is a packet – based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI – 136) networks. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet – based internet communication protocols, IP and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the internet and X.25 networks.

GPRS gives almost instantaneous connection set up and continuous connection to the internet. GPRS users will be able to log on to an APN (Access Point Name) and have access to many services or an office network and remain continuously connected until they log off, only paying when the actual data is transmitted. A physical end to end connection is not required because network resources and bandwidth are only used when data is actually transferred. This makes extremely efficient use of available radio bandwidth. Therefore GPRS packet – based services should cost users less than circuit switched services since communication channels are being shared and are on an 'as-packets-are-needed' basis rather than dedicated to only one user at a time. It should also be easier to make applications available to mobile users because rather the faster data rate means that middleware currently needed to adapt applications from fixed line rates to the shower speed of wireless systems will no longer be needed.

GPRS data speeds will range from 14.4kbps (using one radio time slot) to 115kbps (by amalgamating time slots) and offer continuous connection to the internet for mobile phone and computer users. GPRS data services are likely to average about 56kbps. The higher data rates will allow users to take part in video conferences and interact with multimedia web sites and similar applications using mobile handheld devices as well as notebook computers.

GPRS Network



GEO – FENCING

Definition

A Geo – Fence is a virtual parameter for real – world geographic areas.

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A Geo – Fence could be dynamically generated as in a radius around a store or point location. Or a geo – fence can be a predefined set of boundaries, like school attendance zones or neighborhood boundaries. Geo – Fences can also be custom – digitized as per the requirement at a particular point of time or day.

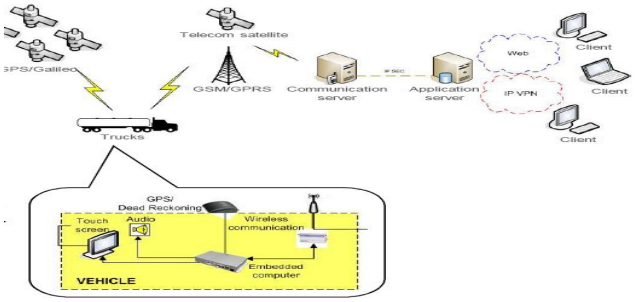
When the location described device of a Location Based Service (LBS) user enters or exits a pre defined Geo – Fence, and then the device receives a generated notification. This notification might contain information about the location of the device, and the geo – fence notification is sent to the defined mobile telephone or an email account or can be raised as a pop up at the Central Station of the server system.

Impacts of Geo – Fencing

Geo – Fencing is a powerful technique that enhances the security levels in many applications:

- Restrict some mobiles (vehicles, persons) from accessing restricted areas.
- Having full control over the entire Fleet.
- Making fleet more flexible and operate more safely.
- Avoid dangerous material intersections in the same area.
- Alerts are triggered when a driver exceeds an established speed threshold (say, Threshold Speed < 50kmph max).
- Alerts are triggered when a vehicle crosses a forbidden area (residential area, city centre for big trucks).
- Inform drivers and managers of highway delays or closures on planned routes as conditions change.

Architecture of Geo – Fencing Communication Systems



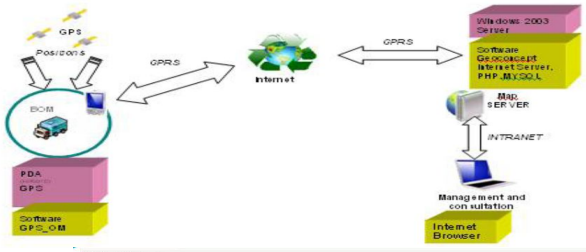
The interaction between all architecture components is made according to the following basics:

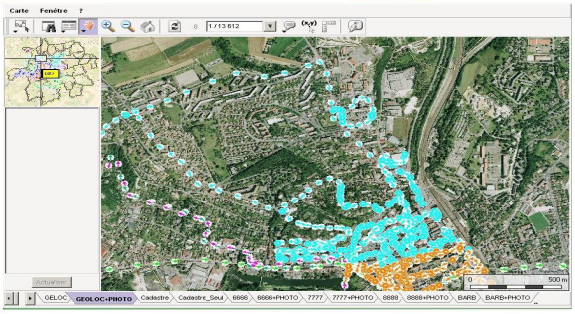
- Real Time Positioning using GNSS (GOS/Galileo, EGNOS)
- Bi – Directional communication system between the vehicles and management centre (GSM/GPRS/3G, Wireless Technologies).
- Databases and software: Computer algorithms, GIS etc.
- Network Security: access control, alert in real time.

Test Scenario Architecture

- A vehicle equipped with an LCD screen and GPS/GPRS module in order to display its position on a map.
- Embedded calculator running Windows XP.
- Programming done in Python Scripting Language (General Purpose, high level programming language).
- Graphical User Interface.

Test Scenario Architecture



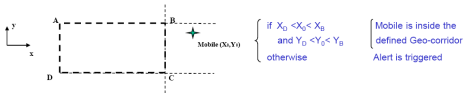


Methodologies & Approaches

➢ Definition of Geographical Areas

> Circle method

> Rectangle method



➢

➢ Areas with Slots

- The supervision of a geographic area is accompanied with slots.
- The behavior of the Geo – Corridor will evolve over time.

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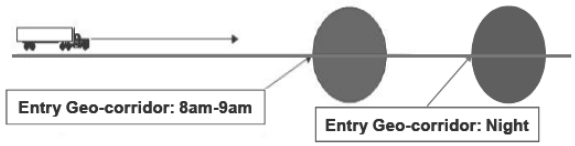
- Geo – Corridor is activated on a given slots (ex: 8 AM – 9 AM) and inactivated for the rest of the Day.



SECURITY APPLICATIONS

SOS Panic Button

A Panic Button is an electronic device assigned to assist in alerting somebody in emergency situations where a threat to person or property exists. SOS stands for "SAVE OUR SOULS" which is an international Morse code expressing the feeling for distress. So from this we can draw that Panic Button is served as the medium to express the feeling of distress.

A panic alarm is frequently but not always controlled by a concealed panic alarm button. These buttons can be connected to a monitoring center via a silent alarm or an audible bell/siren. The alarm can be used to request emergency assistance from local security, police or emergency services. We can also fix a Closed – Circuit Camera & Television to record or assess the event. Panic alarm buttons get locked on when pressed, and require a key to reset them.

Perspectives of Panic Alarm Buttons

- A button in a critical system (such as a Nuclear Weapons Systems) used to activate an extreme measure to mitigate an emergency situation.
- A red button integral to key fobs which activates a car alarm's siren.
- A device given to elderly individuals in order to maintain their independence outside of an Aged Care Facility, medical emergency that renders them immobile, like fall, injury or illness. Such a device can also be referred as an Emergency Medical Alert (EMA) button and can be fitted as either a pendant or a bracelet worn by the user.
- A button used in convenience stores, gas station or other establishments staffed with a single employee during late hours. Often located under the counter near the cash register or safe, the button can be pressed in times of distress (such as robbery, disruptive or threatening behavior, or a situation which may warrant assistance), triggering a silent alarm. If the button alarms a private security company, a fee may be charged for each time the button is used. This prevents mis – use, and often aids in the employees judgment of the situation, whether or not it warrants the fee to have help to deal with the situation.
- Similarly these panic buttons are also used in the transportation systems, like in a car or a bus or train etc. When these alarms are raised, a trigger is raised at the Central station of the Server, and they take the necessary action like calling to the people or the driver in the vehicle, then take an appropriate action and inform to the nearest police station for any security assistance. This is explained in detail in the operational part.

Monitoring Services

The Monitoring Service is a Central Station (Call Center) facility that is staffed at all times to receive calls from the system console. Monitoring service centers that are approved by Underwriters Laboratories (UL) have internal backup systems to add redundancy. Some monitoring services employ trained operators enabling them to better evaluate the severity of help requests. In most less developed countries however, response to panic alarms are slow.

Ignition Monitoring

Ignition Monitoring or Ignition Controlling feature is a dependent function, which is operated in high emergency services when an SOS Panic Alarm button is raised. Depending on the severity of the problem the authorized person at the Central Station will try to turn off the vehicle remotely. Then locating the geographical location of the vehicle he informs to the nearest police station to the vehicle arising the security alerts then sends the team to get control over the vehicle.

The above process of Ignition Control cannot be implemented all of a sudden as this stopping the vehicle in this process might lead to traffic jams or accidents etc., so here the control over the vehicle is taken in such a way that it is stopped in next few hundred meters, so that the driver psychologically drives the vehicle to a side of the road. On emergency stopping of the vehicle it also produces a siren which alerts the surrounding people and the police personnel in order to meet the security measurements.

Ignition control is done through the process of delimiting the fuel supply to the vehicle, this results in phase down of the vehicle which leads to slow down and eventually stops completely in a few hundred meters long. This is a complete hardware arrangement, where a regulator is placed at the fuel supply point to the engine. The setup is shown in the below figure, here the regulator is fixed at the fuel pumping pipe, a sensor is also connected on the

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other side of the regulator which gets activated with a signal released at the Central Station, on receiving the signal, the sensor gets triggered and releases a pressure which stops the fuel supply to the engine.

The released air pressure obstructs the fuel supply by which the engine is forcedly stopped so that the control of the vehicle is taken by the authorized person at the Central Station. He then alerts the people in the vehicle to board down from the vehicle or suggest taking an appropriate step. If it is found any illegal move in the vehicle, the authorized person will inform to the nearest Police Station to the vehicle, to take the necessary security moves. Then the authorized person is arrived to the location and then the regulator is released free and the vehicle is set to the normal condition.

Siren

A Siren is generally a buzzer which produces loud noise alerting the people in the surroundings so that a misconception has risen. Here in our scenario a siren produces the sound in many areas. They are:

- Whenever the vehicle has crossed its Geo – Fencing Co – Ordinates
- When a SOS/Panic alarm is raised
- For any inappropriate environment in the vehicle captured on the camera and observed at the Central Station, here siren is raised from the remotely located Central Station.
- A wrong passenger or customer identified.

OPERATIONAL PROCESS

The entire GPS module is fixed in a vehicle; it is connected to the engine with the available I/O ports on the module. As we discussed earlier, there is an embedded GSM module serves as the communication medium between the vehicle and the central station, Camera SOS/Panic button to this GPS kit, where every single unit has got its own function which are discussed in detail.

GPS

1) It receives GPRS Packets to analyze and transfer the data through.
2) All the GPRS packet data received at the Central Station may contain the GPS Co – Ordinates, so with the services of Google Earth these Co – Ordinates are converted into Map Locations.
3) All the Co – Ordinates are needed to be gathered and a map line is to be drawn and archived it in the Track History of the vehicle for future reference. History is maintained and can be retrieved as per the requirements within the specific times and dates.
4) We can obtain particular and respective co – ordinates of the vehicle when ever required at any point of time for emergency.
5) Inter linking b/n GPS and GPRS should be done so that the transfer of packet data is done in regular intervals (user defined and must be customized).
6) And some other applications which are also to be transferred to the server for maintenance purpose
    a. *Distance to specified waypoints*
    b. *Your Speed and Direction of travel*
    c. *Trip odometer and trip time*
    d. *Max and Avg. speed*
    e. *Co – Ordinates of cities and towns and many more as per requirement.*

SOS/PANIC BUTTON

1) A Panic button is pressed in emergency alerting someone (say authorized personnel) for assistance. So when an alarm of the panic button is raised, it should alert the authorized person at the monitoring service (Central Station) or say simply a call center who keeps tracking down the vehicle from the server.
2) Immediately after the alert the person at the server who is monitoring the vehicle should obtain the GPS co – ordinates to track down the vehicle.
3) After a panic button is raised, the authorized person should communicate with the driver immediately to know what is all going on in the vehicle.
4) If the driver is not responding, track the information about the passengers in the vehicle and call them to understand the situation.
5) For any disordered emergency activity in the vehicle the person at the remote server passes the information to the nearest Police Station/Fire Service/Ambulance etc.
6) Then the Panic button alarm is set free or disables and the respective actions are taken manually according to the situation.

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FOR GEO FENCING

1) The Geo Fencing is designed individually based on the different types of the routes.
2) These routes are given with the fencing based on the GPS Co – Ordinates, whenever the vehicle has crossed the co – ordinates anywhere it is said to be out of the fence and an alarm is raised.
3) As soon as the alarm of a vehicle is raised the person at the remote server will call the driver of that vehicle and records the reason for crossing the defined Geological Orbit.
4) Then an operation is done manually, like if the driver is found guilty/if the vehicle has undergone with some thefts, kidnapping or any other illegal activities the authorized person should downshift the vehicle and eventually stop it and inform the nearest Police Station regarding the issue and take an appropriate action.
5) Even now, when a vehicle has crossed its defined orbit, the GPS triggers the camera to send the pictures of the environment in the vehicle, so as to maintain a record of what is happening.

Note: If any of these products are missing are misplaced, even then an alert should be given automatically to the remote server and call for any assistance required. This may be prior to the start of the trip or during the trip or after the trip, it is to be informed to the remote server.

//if the vehicle is still vacant the driver is asked to inform at the server management so that they can try filling the seats but the driver is not allowed by himself to fill the vehicle, this is because of chances for an unauthorized person may get access of the system//

PASSIVE RFID

A passive RFID reader along with the tags is used to identify the authorized person. Every registered person is given a passive RFID tag which contains the information about the passenger, say name, contact details and balance funds in the card to travel, also we can have the information of the customer when and where he/she uses the services, like the times and places etc. This is a general explanation of an RFID with respect to our usage.

When coming to technology, RFID serves in many different ways, all the possible services of an RFID along with its operation is explained below.

1. Collects large amounts of data for tracking and identifying physical objects along with their history.
2. While RFID observations are simple primitive events (like consisting of RFID readers EPC code, observed tag ID and the observation of time stamp). RFID observations stream from multiple readers from complex event patterns – mostly temporal in nature to represent business application logic.

This posse a significant challenge for RFID data processing for the following requirements of:

1. Automatically filtering, interpreting & transforming raw RFID observation data into semantic business logic data.
2. Real Time Monitoring & Querying physical objects and their environment
3. The capacity to process high volume RFID data into existing business applications and convenient interfaces for end users

The important of RFID data streams processing is also exhausted by the newly released RFID Application Level Event (ALE) standard: a common interface to process new RFID events, including data filtering, windows based aggregation and reporting.

CONCLUSION

The combination of different technologies in one loop, will certainly improves the security system, as discussed above, all the data recorded in the vehicle is transferred to the central station where every single bit of data is stored for future purposes if it is to be submitted to the Police Officials for any misconceptions occurred. The GPRS system is used to transfer the data using the mobile data services, through a GSM device embedded in the GPS module.

The vehicle's path is tracked on a website which is designed specially integrating with the Google Maps, we can track all the vehicles irrespective to the number, so multiple vehicles can be operated with the Geo – Fencing Technology in parallel. At the same time, a using a RS – 232 transforms several data, like user information in the vehicle who is boarding it and where did they arrived, and we can also implement additional applications like, Fire Sensing, Panic Alarm and etc.

With all the discussions made above, I can clearly say that, there is enough technology present around us, but everyone fails in using it, some of the advanced nations

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like the USA, UK, Sweden, Norway, Dubai, Germany, Australia and developing nations like, Singapore, China, Japan etc are already using this technology to a level and are providing better security to their society. I wish even in India this technology becomes in regular use to provide a better security to the society resulting a happy life.