CHAPTER 4 APPROACH TO THE PROBLEM

4.1 INTRODUCTION

In this chapter it is intended to discuss how to approach the above discussed problem domain by introducing a cost-effective tracking solution using location based services (LBS) and GSM infrastructures. This solution comes as a server based solution. This chapter discusses about followings;

- The architecture of the vehicle tracking system using LBS.
- Required hardware and software components in the proposed platform.
- User inputs, outputs, functionality and features of vehicle tracking solution.

4.2 VEHICLE TRACKING USING LBS

The location based system can be applied here whilst introducing a novel concept of real-time vehicle tracking solution. The second scenario of the LBS function we recently discussed that "*Server Originated Request*" mode is applied here to retrieve required live positioning information from tracking vehicles. The following diagram (Figure 4-1) depicts the architecture of the proposed vehicle tracking system.

4.3 HOW IT OPERATES

There are three main components that can explicitly be recognized in the vehicle tracking system in proposed architecture. They are identified as follows;

1. Tracking application / Monitoring Station Machine (MSM)
2. SMSC, LBS and GSM digital cellular network
3. Car unit with tracking SIM (GSM/GPRS Modem)

In order to have a proper vehicle tracking system with this proposed setup; the above three main components should be technically incorporated. Following diagram depicts how the vehicle tracking system has been incorporated and the flow of its functionality. The following figure 4-1 illustrates the architectural view of the proposed tracking platform. This tracking application is installed on a Monitoring Station Machine (MSM) and it is centrally sited at a remote monitoring station. It has the connectivity with LBS through the Internet. The Monitoring Station acts as server

module and originates the request. The application initiates a request by sending an envelope to the car unit (modem/handset) which is far away from the central monitoring station. The tracking SIM in the car unit then processes the envelope by replying with current accessible location information. (eg:-WGS84 Coordinates).

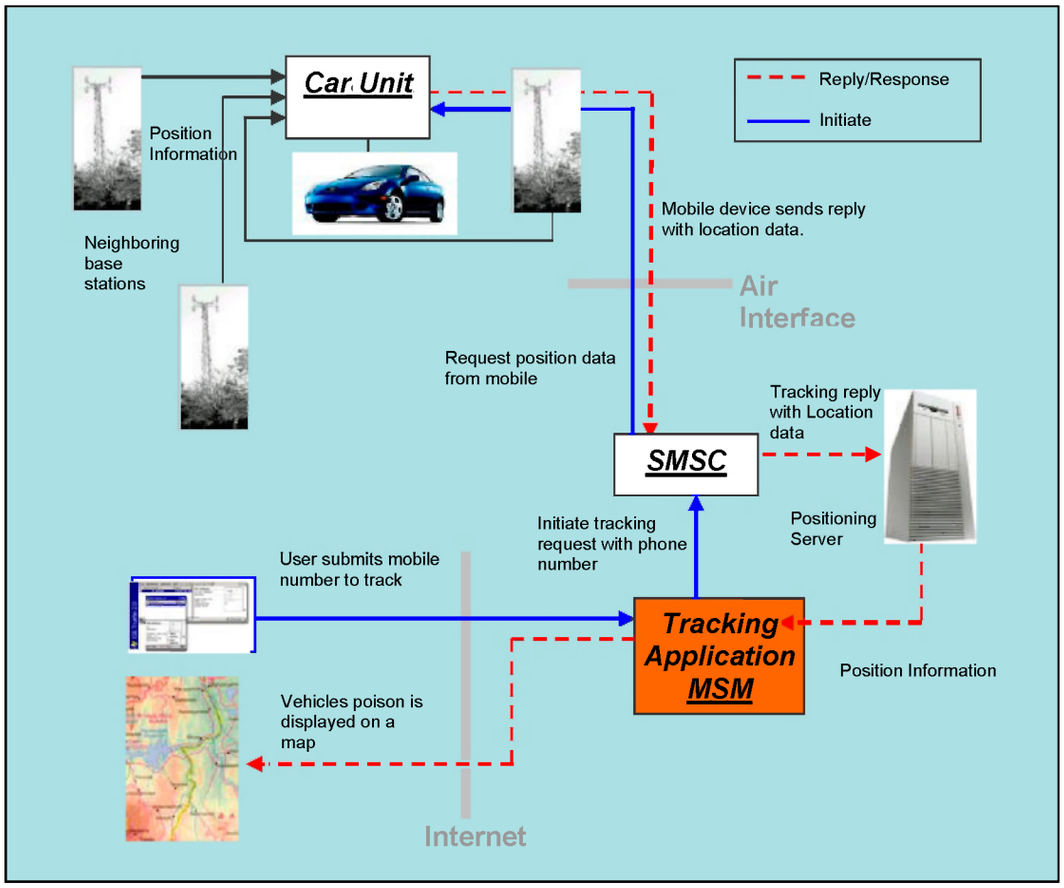

Figure 4-1: Vehicle tracking using GSM digital cellular network

The Monitoring Station Machine (MSM) consists of a geographical map and it real-time plots the current location of tracking vehicle on the map based on the information it receives from the car unit. The time taken to receive location information to the central server will depend on several factors such as GSM network conditions, network congestion, performance in SMSC, performance of the LBS and the Internet connection etc. The LBS acts as the middle tier of the entire system. The request and the reply both go via the LBS interface. The LBS is in responsible for calculating the longitude and the latitude of tracking vehicle based on the information it receives from the car unit. Then it passes to the tracking application to plot the map.

Every tracking vehicle must have a car unit on it, in order to be tracked by this tracking application. This car unit could be either dual band GSM/GPRS modem designed for data, fax, sms & voice applications or a standard type mobile phone that, properly fixed on every tracking vehicle. This device must operate at output power of around 2W at 900MHz and 1W at 1800MHz bands respectively for an invariable performance. The input voltage of this car unit should be between 5V– 32V which can be easily fixed with vehicle battery.

4.4 FUNCTIONALITY OVERVIEW

The functional flow of the proposed tracking solution can be illustrated as in the above figure 4-1. The request paths are indicated in solid lines while the reply responses are in dashed lines.

An intended tracking user will log-on to the vehicle tracking system by entering his/her credentials (username/password). Then the tracking user will be authenticated by the system against the username and the password. The tracking user then enters a mobile number (MSISDN) of a particular tracking vehicle that he/she wishes to track by the system. Subsequently the tracking application initiates a tracking request with the phone number (MSISDN) of particular car unit. This specific request is made by accessing a unified resource locator (URL Address) through the tracking application. One mobile number (MSISDN) represents a one tracking vehicle. Then the request goes to Short Message Service Center (SMSC). Then the SMSC send an envelope requesting available positioning information to tracking SIM which is located in tracking vehicle far away from the monitoring station.

Subsequently, tracking SIM gets that envelope, processes it and replies to that with accessible location information. In the meantime positioning server receives the reply to the request from the tracking SIM with available location information. Once the positioning server has received the reply from the car unit with location information, network measurement result (NMR), channel list and timing advance (TA) those information will be decoded at the positioning server and it performs a calculation to predicts the location of the tracking car.

Then the tracking application gets those positioning information from the positioning server via the Internet. The tracking application performs required calculations to plot the most accurate location of the tracking vehicle on the map according to the positioning information it has received.

4.5 COMPONENT OVERVIEW OF TRACKING SYSTEM

The following diagram (figure 4-2) shows that the proposed vehicle tracking system as in a component view. It also demonstrates the flow of operation and message passing among the sub systems such as MSM, LBS and SMSC etc. The sequence of the operation is explained underneath. An arrow head denotes the direction of message passing between sub components while numbers remain the sequence of steps in the proposed tracking platform.

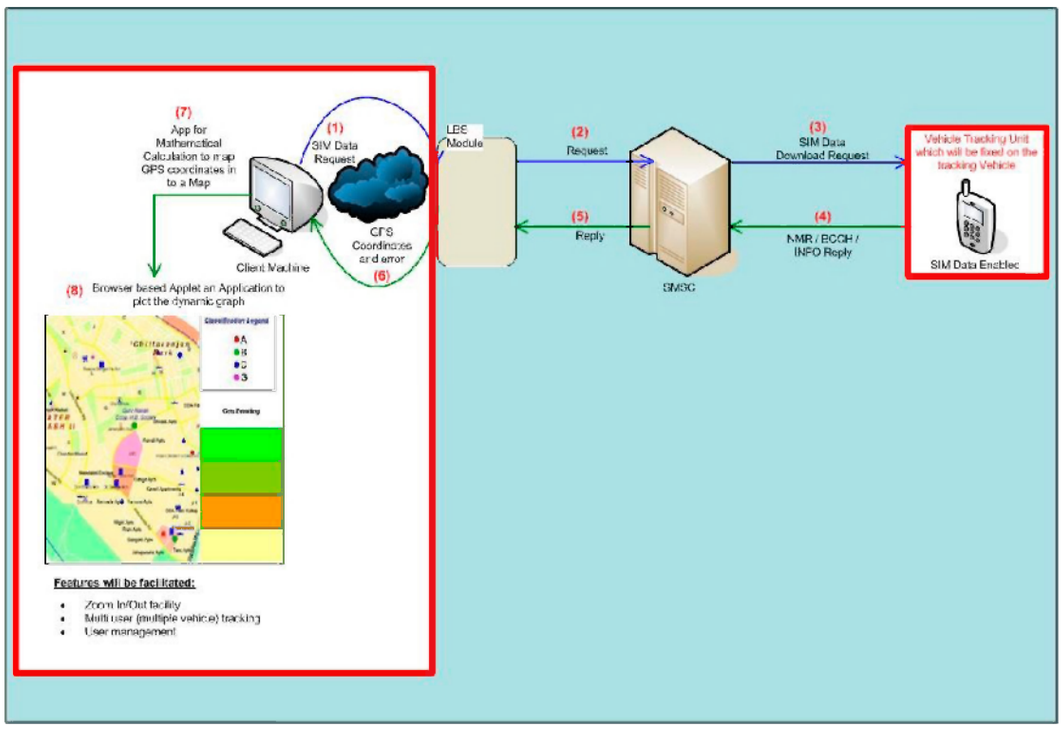

Figure 4-2: Component Overview of tracking system

1. The tracking application initiates a request by posting a URL with the MSISDN to the LBS via Internet.
2. Then the LBS system picks that request and passes that request to the Short Message Service Centre (SMSC) asking it to send an envelope to the car unit.

3. The SMSC then continues the request by sending an envelope to the car unit asking available location information.
4. The special tracking SIM which is in the car unit will then gather the relevant positioning data regarding the serving and surrounding base stations and sends the reply back to the SMSC.
5. SMSC then passes that information to the LBS.
6. LBS positioning server will decode the data and return the estimated position to the application.
7. MSM which is the tracking application then receives that positioning information via the Internet and calculates the appropriate location on the base map.
8. Finally it will plot the result over the base map.

4.6 INPUTS OF THE SYSTEM

- The tracking application takes the *Mobile Station Integrated Services Digital Network* (MSISDN) of every tracking SIM, as an input parameter to make a positioning request.
- The positioning information fed in to the system upon each and every request is made by the application. This information is saved with the system in order to maintain the history.
- ArcGIS geographical vector maps are utilized with different layers, in order to plot the vehicle's location.

4.7 OUTPUTS OF THE SYSTEM

The final output of the system must provide a minimum functionality to track the physical locations of tracking vehicles in real-time or near real-time. It is intended to plot the ground location of the tracking vehicle on the base map with acceptable accuracy. The proposed vehicle tracking system offers following features as its secondary outputs.

4.8 FEATURE OF THE SYSTEM

The tracking application consists of feature such as analyzing the current position of vehicles and feature of tracking multiple vehicles at the same time. This will enable

companies to track any number of their vehicles through a centralized system. The tracking user can distinguish vehicles by their vehicle number and different color codes which uniquely represent each tracking vehicle on the base map.

Zoom in /out feature on the map allows tracking user to have a clear view of the tracking vehicles and their location on the base map including road layout, places layout, grid layout and boundary layout.

Geo-fencing is an innovative feature with the proposed system, where it provides the facility of alerting, when a vehicle is being entered in to unauthorized geographical areas. Using this feature, the tracking user is given the facility of defining the restricted areas (Geo-area) on the base map. Whenever a particular tracking vehicle goes into one of those geo-areas (restricted area) then the tracking application will popup a notification to the tracking user with sufficient information.

The Magnifying (Magnifying glass feature) feature also enables tracking user to have a closer look on the base map and available map layers. The tracking application allows tracking user to add and remove vehicles on the tracking list. This also has the facility of adding and removing geo-areas on the control panel. The tracking application can recall history of particular tracking vehicle.

4.9 SUMMARY

In this chapter we discussed how to implement a least cost tracking solution based on location based services (LBS) and GSM digital cellular network. It was also discussed what are the main components used in such implementation and overview of the functionality of the system including inputs, outputs and some preferred features to be included with the final product. The next chapter is analysis and design. In that chapter we will discuss about the top level design of the proposed system.