CHAPTER 2 EXISTING SETUP

2.1 INTRODUCTION

This chapter discusses the problem domain of vehicle misuse and vehicle theft in the customer organization with the current operation and defines the problem in the thesis. It is also aimed to study and argue the possible methodologies and techniques that are applied in a similar undertaking.

2.2 OVERVIEW OF THE ORGANIZATION

The customer organization chosen for this exercise is *Dialog Telekom Limited.*,(DTL) which was initially setup as a fully owned subsidiary of TM (Telekom Malaysia Limited) as MTN Networks (Pvt) Limited. [Source; Press Releases 2006]

Dialog Telekom Limited (DTL) currently operates as a partially owned subsidiary of *Telekom Malaysia Sdn. Bhd.*, a regional telecommunication giant with an off-shore presence in over ten countries including South Africa, Kampuchea, Ghana, Guinea, Thailand, Bangladesh and India. Dialog Telekom Limited operates Dialog GSM, Sri Lanka's pioneer digital cellular network. Telekom Malaysia's investment in Dialog Telekom Limited currently exceeds USD 60 million (Rupees 4.0 billion), making the Dialog GSM network a flagship telecommunication provider in Sri Lanka, employing state of the art digital cellular technology. Dialog Telekom Limited's commitment to its customers and continuous improvement of technology and management practices has earned the company the distinction of becoming the first Telecommunications Company in South Asia to receive *ISO 9001* certification. Dialog GSM commenced operations in 1995, and has expanded rapidly, to cover all key urban centers in Sri Lanka. The network is strongly committed to provide innovative value added services to its customers. Accordingly Dialog GSM has scored successes in the local telecommunications industry. Having pioneered GSM technology and digital cellular in Sri Lanka, the network has been at the forefront of technology introduction and now offers mobile communication services on par with networks in the developed world. [Source; Press Releases 2006]

Dialog Telekom Limited is as the largest mobile operator in Sri Lanka with over 2.5 million subscribers representing more than 60 percent of the market share. It is also

the largest listed company on the Colombo Stock Exchange in terms of market capitalization (as of 30 June 2006) of Rs. 146 billion (US $ 1.42 billion), representing 22.77 per cent of the market capitalization on the Colombo Stock Exchange. The company has the distinction of having become the first company in Sri Lanka to achieve a market capitalization exceeding US $ 1 billion. Dialog Telekom Limited is a subsidiary of the Telekom Malaysia Group. In addition to its core mobile telephony business, the company provides international services, supporting an International Gateway infrastructure providing retail and wholesale international voice and data services under the brand name of Dialog Global. The company also provides Internet services through Dialog Internet - a fully-fledged Internet Service Provider (ISP). Dialog Telekom also operates Dialog SAT, a mobile satellite service. [Source; Asian Tribune 2006]

2.3 CURRENT OPERATION IN VEHICLE MANAGEMENT

Due to the recent geographical coverage expansion and the rapid business growth in Dialog Telekom Limited (DTL), the Transport department of the company has to be largely expanded in order to cater rising transport needs from various user divisions of the company. Apart from that, managing the transport allocation properly for a large number of staff wasn't an easy task for the Transport department. There are lot of misuses, wastages and inefficiencies. Thus the Transport department has come across a requirement of a real-time vehicle tracking system, to support their operations.

As at today, there are about two hundred and fifty (250) vehicles under the company ownership. Those vehicles have been assigned to the senior the junior management of the company while every division and branch has been allocated one or more vehicles according to their nature of work and the requirement. Apart from that, there are about fifty to eighty (50 - 80) hired vehicles running at DTL on the basis of one to two year's of contract. All these vehicles are managed by the Transport department. The Transport Department has been doing an excellent task in managing those vehicles for the last few years; but the company had encountered a couple of horrific incidents, involved in some crimes with official vehicles. Thus the company has lost four of their luxury vehicles during the recent past years. And also the transport department has detected some vehicle being misused with extra consumption of fuel by different

groups. Due to the recent hike of fuel prices, the company has to be more concerned about their budget allocation on fuel. The transport department also has to be concerned about the wastage of vehicle tires and other depreciations. The weekly budget utilization for fuel is more than Rs. 2.8 million, while tier expense exceeds Rs. 0.75 million. Therefore the Transport department needs to curtail unnecessary routes.

Moreover the department of Engineering P&D (Planning and Development) and Operation has a large number of vehicles including Cabs and Jeeps. These vehicles are normally used by the operations team including Switching Operations, Transmission Operations and Network Maintenance. These vehicles have to be utilized in every corner in the Island for site-breakdowns at BTSs (Base Station) and also for new installation of Transmission towers or BTSs. It has become an urged requirement to track these vehicles especially, when they move in to suburbs and some rural areas which are under control by Liberation Tigers of Tamil Eelam (LTTE), during the process of new site installations or a breakdown maintenance work.

The company has already taken some risk mitigation plans and action plans against these frauds and vehicle crimes. But the requirement of vehicle tracking system has not been satisfied yet. In the current setup there is no way to track a vehicle if it really needs to be tracked. There is a good vehicle management system in Dialog Telekom Limited at present, but it can not guarantee the security of vehicles. Currently no such vehicle tracking system or burglar detection system has been introduced to Dialog Telekom Limited (DTL). Furthermore, there are occasions where, official vehicles being misused by different people. There is no proper way or mechanism to track these exploitations with the current setup. Thus, it is really worth citing this problem by introducing a proper system to track vehicle movements while ensuring the security of fleet at DTL.

2.4 APPROACHES ATTEMPTED IN LOCATION TRACKING

Through out the literature survey, it has been identified that different technologies have been used to approach the task of real-time location tracking. Those approaches vary from county to county based on technology availability, technology advancements, and cost involvement and as well as type of application used. Among those several feasible technologies, following are the commonly used;

1. The satellite GPS based tracking system
2. Cellular infrared based approach
3. Generic GSM cell based approach
4. Mobile network terrestrial based approach

2.5 WHAT IS GPS

GPS has been developed and is operated by the U.S. Department of Defense [Source; GPS Guide for beginners]. It offers two levels of service. One is a Standard Positioning Service (SPS) and the other is a Precise Positioning Service (PPS). SPS is available world-wide free of charge and provides the capability to obtain a horizontal positioning accuracy of within 100 meters and a vertical positioning accuracy within 140 meters. Most of this spread is due to noise (called Selective Availability, SA) introduced by the operator in order to safeguard its national interest. The PPS is a more accurate service but restricted to military use [Geier 1996]. The GPS system consists of 24 satellites in six orbital planes with a 12-hour interval. They are positioned so that between five to eight of them are visible from any point of the earth. Monitor Stations and Ground Antennae control them [Gregory 1996].

2.5.1 PRINCIPLE OF FUNCTION IN GPS

Each of the satellites continually broadcasts time information derived from their internal atomic clocks along with data of their present position. The GPS receiver, which typically contains a multi-channel radio receiver, can measure the time it takes for the signal to traverse the distance from the satellite to the receiver. This method is known as time of arrival (TOA). If the distance to three satellites is known, it is possible to calculate the three dimensions of the receiver's position. Hence, the signal from a fourth satellite is needed to provide the exact time. If only a two-dimensional

position is required, signals from three satellites are sufficient [Gregory 1996], [Geier 1996].

2.5.2 COVERAGE AND ACCURACY OF GPS

In order to get any kind of position, at least three visible satellites are required. While satellite radio signals are very resistant to interference, they are reflected from buildings and windows. Therefore, GPS cannot normally be used indoors. Further, GPS sightings tend to be more inaccurate in built-up areas since reflections may lengthen the path from satellite to receiver. In certain areas the amount of visible sky may also be restricted, thus reducing the probability of finding the required number of satellites [Gregory 1996].

2.5.3 ACCURACY ENHANCEMENTS IN GPS

If additional information about the movement of the receiver is available (such as knowledge of the fact that the receiver is stationary), SPS sightings can be made more accurate by statistically eliminating some of the error. Radically improved accuracy can be obtained by employing Differential GPS (DGPS). DGPS uses a fixed GPS receiver with known position. Therefore, the SPS noise can be identified. By broadcasting this knowledge other receivers can eliminate the SA noise from their measurements and get improved sightings. DGPS is typically offered as a value-added commercial service and employs radio broadcasts to transmit the DGPS information. DGPS cannot remedy distortions due to signal reflections or obstructed signal paths as experienced in built-up areas [Geier 1996].

2.6 ADDITIONAL TECHNIQUES IN LOCATION TRACKING

Some of most common technologies are designed by contribution of different groups. But those techniques can vary widely with regard to their cost and accuracy.

2.6.1 CELLULAR INFRARED BASED NAVIGATION

The main incarnation of this location-tracking technology is the Active Badge system (developed by Olivetti). An Active Badge location tracking system consists of a network of fixed infrared transmitters and receivers (badge sensor), and a number of mobile infrared enabled computers, or badges [Harter and Hopper 1994]. Badges can

be worn by people or attached to equipment (such as computers). Each badge periodically (typically every 10 seconds) emits a radio beacon carrying its own identity [Geier 1996].

If a sensor picks up the radio beacon, the location of the badge is known. The system typically allows for room-level resolution since infrared waves cannot pass through walls. When combined with low-energy radio fields the system can also provide more accurate measurements. Infrared networks have the great advantage of not requiring a part of the precious radio spectrum. On the other hand, the short effective range of the transmitters makes comprehensive deployment outdoors impractical. [Harter and Hopper 1994]

2.6.2 THE ACTIVE BADGE SYSTEM

Building on the Active Badge technology, researchers at Olivetti have proposed and implemented architecture for a distributed location service [Harter and Hopper 1994]. Their design follows a client-server approach. "*The Active Badge system provides a means of locating individuals within a building by determining the location of their Active Badge. This small device worn by personnel transmits a unique infra-red signal every 10 seconds. Each office within a building is equipped with one or more networked sensors which detect these transmissions. The location of the badge (and hence its wearer) can thus be determined on the basis of information provided by these sensors.*". "*This picture shows four generations of the Active Badge. Bottom left, the first version, with a unique five bit code. Bottom right, the second version, with a ten bit code. Top left the third, current, version, with a forty-eight bit code, bi-directional capabilities, and an on-board 87C751 microprocessor.*" [Source; CUCL] Refer figure 2-1 below.

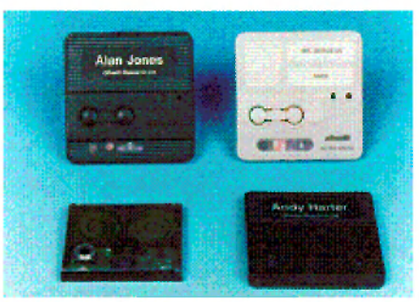

Figure 2-1: Badges (Source; CUCL)

2.6.3 GSM BASED RADIO NAVIGATION

Cell-based radio networks include the categories of cellular telephone networks such as GSM [Mouly and Pautet 1992] and wireless local area networks such as WaveLan [Geier 1996].

In such systems, the cell base stations send out regular radio beacon signals. This enables the mobile station to monitor the signal quality of available cells. Based on the measurement of the strength of those radio beacon signals, the station decides when to switch to a new cell. The switching process is called hand-off or hand-over. During hand-off, location information on the fixed part of the network is updated if necessary [Mouly and Pautet 1992].

The tracking mechanism employed by those systems is the converse of the strategy employed by the Active Badges. There, the mobile unit sends out radio beacons, which are picked up by the network. Here, the mobile unit listens for radio beacon signals and thus knows where it is. A significant distinction of the latter approach is that all the location measurements are performed at the mobile end. However, this may conflict with resource limitations on the mobile unit.

Radio cells are typically larger than the infrared cells described above, facilitating outdoor deployment, especially in rural areas with low subscriber density. However, this also means that typical radio cells can be too big for effective positioning (depending on the needs of location aware applications) [Mouly and Pautet 1992].

2.6.4 CELLULAR BASED TERRESTRIAL NAVIGATION

The positioning principle used by GPS can also be used with a set of terrestrial rather than satellite-based radio transmitters. The common techniques are time of arrival (TOA, used by GPS), angle of arrival (AOA) and time difference of arrival (TDOA).

The necessary calculations can be performed either by the mobile unit or by a server on the fixed network. This technology has recently gained momentum with the requirement of the U.S. Government that mobile phones must provide a “push-button" emergency service with caller location (wireless E911). The caller must be located within a radius of 125m in 67% of all cases [Zhao 1997]. Since the radio cells of current mobile telephone systems are mostly bigger (500m to 20km), an additional location technology is required. GPS may not be suitable since it does not work very

well in urbanized areas. On the other hand, the existing base stations of mobile telephone networks can be used for terrestrial radio navigation.

In the wireless E911 application, the mobile terminal would try to measure its current position with respect to three or more base stations when demanded. Then, the terminal can send the short message along with its coordinates to a central answering point [Zhao 1997]. As a result of this, mobile telephones may become aware of their own physical location, thus enabling other location based applications and services.

2.7 SOLUTION TO THE PROBLEM

Although there are several methods available for location tracking, all of them are required to be examined carefully when introducing a best match and feasible solution to the above problem domain. The original GPS based location tracking system has a great accuracy in positioning, but considering setup and operational costs involved in such system, it cannot be easily used by most of the local organizations. Satellite based GPS location tracking solution could be well suited for organizations in US or Europe but not for one in Sri Lanka.

Thus the above mentioned high cost solutions will not be well suited for small and medium-sized enterprises (SMEs) in a country like Sri Lanka. Therefore, it has to be thought twice before allocating a large investment on such deployments. Furthermore, an appropriate method has to be chosen depending on the application going to be used. Mainly when it comes to a vehicle tracking solution, the precise location of tracking vehicles would not be a major concern for the main objective. If there were an infrastructure already available for an alternative, it would be astute to get the advantage of it.

Considering those factors, it is decided to evaluate GSM cell based tracking for the proposed application. It is planed to use Dialog Telekom Limited's *Location Based Service* (LBS) which was already developed based on the GSM digital cellular network, in order to get positioning information to the proposed application [Sharad and Sandeep 2003].

2.8 SUMMARY

The organization structure of the company, current operation and issues faced during vehicle management in the intended organization was discussed in this chapter. And it was also deliberated most of the available methodologies and techniques in positioning, before electing a best match for the proposed solution. In this chapter we discussed about currently available tracking technologies and their effectuation in different environments. Considering all factors in next chapter we will discuss about introducing an alternative tracking solution based on GSM digital cellular network and the location based service (LBS) with reference to why it is applicable to solve the problem.

In the next chapter will discuss about the technology and the concept behind in the location based service and GSM digital cellular infrastructure, in order to assess the feasibility of using that technology for real-time vehicle movement tracking.