INTELLIGENT LOCATION TRACKING SCHEME FOR HANDLING USER'S MOBILITY

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Abstract

Present group of mobile systems afford access to a wide range of services and permit mobile users to join irrespective of their environmental position and their roaming features. Due to growing the number of mobile users, global connectivity and the small size of cells, one of the most serious matters regarding these networks is position management. In current years, several schemes have been proposed to improve the performance of the location management. In the Proposed work a predefined geographical area is considered. For Every base station and it should maintain geographical data base such as blocking area. The base station should warn the mobile station when it moves towards the blocking area. The different speed mobile stations are safeguarded from dropping out. The high speed nodes are warned many a times before it enters the blocking area. This is carried out to reduce call dropping and encourage complete utilization of resources hence we can improve the services provided by the service provider.

Keywords: *GSM, Mobility Service, BSC, Location Management*

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1. INTRODUCTION

Wireless communication is a transfer of information over a distance without the use of enhanced electrical conductors or wires. The distances involved may be short or long. Wireless communication is generally considered to be a branch of telecommunications.It encompasses various types of fixed, mobile and two-way radios, cellular telephones, personal digital assistants and wireless networking. The first rudimentary systems found restricted use in the fields of public safety and utilities, transportation, government agencies and the like. Lack of accessible radio spectrum, inefficient transmission techniques, and immature technology made these systems expensive and not easily adaptable to mass markets. As time went on, technologic innovation allowed for the design of new mobile systems that were able to utilize heretofore unavailable radio spectrum and also allow for improved operation and reliability. Mobile radio communications raise two major problems. Mobility management emphasizes the movement of people and goods, not just motor vehicles, and so gives priority to public transit, ridesharing and non-motorized modes, particularly under congested urban conditions.

1.1 Wireless Networks

Wireless telecommunications networks are generally implemented with some type of remote information transmission system that uses electromagnetic waves, such as radio waves, for the carrier and this implementation usually takes place at the physical level or "layer" of the network. Wireless networks have had a significant impact on the world as far back as World War II. Through the use of wireless networks, information could be sent overseas or behind enemy lines easily, efficiently and more reliably. Since then, wireless networks have continued to develop and their uses have grown significantly. Cellular phones are part of huge wireless network systems. People use these phones daily to communicate with one another. Sending information overseas is possible through wireless network systems using satellites and other signals to communicate across the world. Emergency services such as the police department utilize wireless networks to communicate important information quickly [1]. People and businesses use wireless networks to send and share data quickly whether it be in a small office building or across the world. Another important use for wireless networks is as an inexpensive and rapid way to be connected to the Internet in countries and regions where the telecom infrastructure is poor or there is a lack of resources, as in most developing countries.

1.2 Types of Wireless Networks

- *Wireless Personal Area Networks (WPANs)* interconnect devices within a reasonably small area, generally within reach of a person. For example, Bluetooth provides a WPAN for interconnecting a headset to a laptop. ZigBee also supports WPAN applications.
- *Wireless Metropolitan area networks* are a type of wireless network that connects several Wireless LANs.

- *Wireless Wide Area Networks* are wireless networks that typically cover large outdoor areas. These networks can be used to bond branch offices of business or as a public internet access system. They are usually deployed on the 2.4 GHz band. A typical system is as per the one deployed by Gaiacom Wireless Networks contains base station gateways, access points and wireless bridging relays. Other configurations are mesh systems where each access point acts as a relay also. When combined with renewable energy systems such as photo-voltaic solar panels or wind systems they can be stand alone systems.
- *Mobile devices networks:* With the development of smart phones, cellular telephone networks routinely carry data in addition to telephone conversations.

2. LOCATION MANAGEMENT

Position of organization deals with how to keep track of an active mobile station within the cellular network. A mobile station is active if it is powered on. Since the exact location ofa mobile station must be known to the network during a call, location management usually means how to track an active mobile station between two consecutive phone calls. There are two basic operations involved in position management. The paging operation is performed by the cellular network. When an incoming call arrives for a mobile station, the cellular network will page the mobile station in all possible cells to find out the cell in which the mobile station is located so the incoming call can be routed to the corresponding base station. The number of all possible cells to be paged is dependent on how the location update operation is performed. The location update operation is performed by an energetic mobile station. A location update scheme can be classified as either global or local. A location update scheme is global if all subscribers update their locations at the same set of cells, and a scheme is local if an individual subscriber is allowed to decide when and where to perform the location update. A local scheme is also called individualized or per-user-based. From another point of view, a location update scheme can be classified as either static or dynamic. A location update scheme is static if there is a predetermined set of cells at which location updates must be generated by a mobile station regardless of its mobility. A scheme is dynamic if a location update can be generated by a mobile station in any cell depending on its mobility. A global scheme is based on aggregate statistics and traffic patterns, and itis usually static too. Location areas described in and reporting centers described in are two examples of global static schemes. A global scheme can be dynamic. For example, the time-varying location areas scheme described in is both global and dynamic. A per-user-based scheme is based on the statistics and/or mobility patterns of an individual subscriber, and it is usually dynamic. The time-based, movement-based and distance-based schemes described are three excellent examples of individualized dynamic schemes. An individualized scheme is not necessarily dynamic. For example, the individualized location areas scheme is both individualized and static. Location management involves signaling in both the wire line portion and the wireless portion of the cellular network. However, most researchers only consider signaling in the wireless portion due to the fact that the radio frequency bandwidth is limited, whereas the bandwidth of the wire line network is always expandable. This chapter will only discuss signaling in the wireless portion of the network. Location update involves reverse control channels whereas paging involves forward control channels. The total location management cost is the sum of the location update cost and the paging cost. There is a trade-off between the location update cost and the paging cost. If a mobile station updates its location more frequently (incurring higher location update costs), the network knows the location of the mobile station better. Then the paging cost will be lower when an incoming call arrives for the mobile station. Therefore, both location update and paging costs cannot be minimized at the same time. However, the total cost can be minimized or one cost can be minimized by putting a bound on the other cost. For example, many researchers try to minimize the location update cost subject to a constraint on the paging cost. The cost of paging a mobile station over a set of cells or location areas has been studied against the paging delay. There is a trade-off between the paging cost and the paging delay. If there is no delay constraint, the cells can be paged sequentially in order of decreasing probability, which will result in the minimal paging cost. If all cells are paged simultaneously, the paging cost reaches the maximum while the paging delay is the minimum. Many researchers try to minimize the paging cost under delay constraints.

3. MOBILITY MANAGEMENT

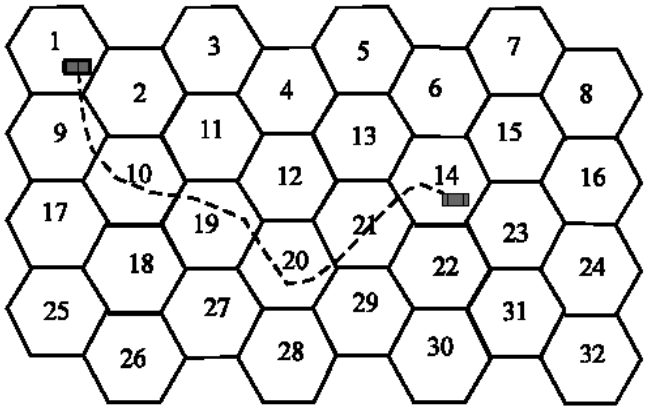

Fig.1 User movement path

The best important characteristic of wireless telecommunication systems is the ability to provide mobility to the customer. Mobility organization demands a important portion of the network assets. Thus upcoming wireless network will be challenged with the problem of how to keep

track of user locations. It mainly concentrates on intimating the user of jamming areas and to reduce the unexpected signal loss while the call is in progress. Mobility management is one of the major functions of a GSM or UMTS network that allows mobile phones to work. The aim of mobility organization is to track where the subscribers are, allowing calls, SMS and other mobile phone services to be delivered to them. A wireless system does not have the luxury of knowing where the mobile subscriber is at all times and therefore must incorporate a means to determine this information and subsequently infuse this data into this system. At the same time, a mobile station should have the ability to be able to continuously access or use the services of the system that it is connected to[2][3].

4. SOME TECHNOLOGIES IN WIRELESS NETWORKS

4.1 Global System for Mobile Communications (GSM)

The GSM network is divided into three major systems: the switching system, the base station system, and the operation and support system. The cell phone connects to the base system station which then connects to the operation and support station; it then connects to the switching station where the call is transferred to where it needs to go. GSM is the most common standard and is used for a majority of cell phones [4][5].

4.2 Personal Communications Service (PCS)

PCS is a radio band that can be used by mobile phones in North America and South Asia. Sprint happened to be the first service to set up a PCS.

4.3 D-AMPS

Digital higher Mobile Phone Service, an upgraded version of AMPS, is being phased out due to advancement in technology. The newer GSM networks are replacing the older system.

4.4 Cellular Networks

A cellular network is a radio network made up of a number of radio cells (or just cells) each served by at least one fixed-location transceiver known as a cell site or base station. These cells cover different land areas to provide radio coverage over a wider area than the area of one cell, so that a variable number of portable transceivers can be used in any one cell and moved through more than one cell during transmission. Cellular networks offer a number of advantages over alternative solutions:

- Increased capacity
- Reduced power usage
- Larger coverage area
- Reduced interference from other signals

4.5 Structure of the Cellular Network

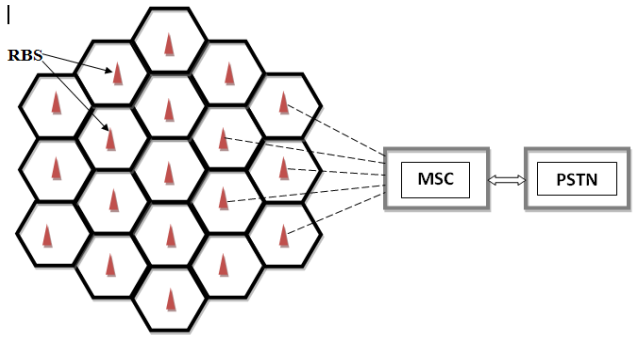

Fig.2 Basic structure of cellular network

A easy arrangement of the cellular mobile-radio network consists of the following:

RBS: Radio base station
MSC: Mobile Switching Centre
PSTN: Public switched telephone network

The thought of cells consists of mobile network equipment providing a cellular network for mobile station (MS) and PSTN users. This network is the foundation of the GSM system network. There are many functions that are performed by this network in order to make sure telephone customers get the desired service; some of them include mobility management, registration, call set up, and handover. Any MS connects to the network via an RBS in the corresponding cell which in turn connects to the MSC. The MSC allows the connection of other networks apart from mobile networks. The link from an MS to the RBS is called an uplink while that from an RBS to the MS is termed downlink. Radio channels effectively use the transmission medium through the use of the following multiplexing schemes: frequency division multiplex (FDM), time division multiplex (TDM), code division multiple (CDM), and space division multiplex (SDM). Corresponding to these multiplexing schemes are the following access techniques: frequency division multiple access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA), and space division multiple access (SDMA)[6].

4.6 Mobile Phone Networks

The most common example of a cellular network is a mobile phone (cell phone) network. A mobile phone is a portable telephone which receives or makes calls through a cell site (base station), or transmitting tower. Radio waves are used to transfer signals to and from the cell phone. Large geographic areas (representing the coverage range of a service provider) may be split into smaller cells to avoid line-of-sight signal loss and the large number of active phones in an area. In cities, each cell site has a range of up to approximately ½ mile, while in rural areas, the range is approximately 5 miles. Many times in clear open areas, a user may receive signals from a cellsite

25 miles away. All of the cell sites are connected to cellular telephone exchanges "switches", which connect to a public telephone network or to another switch of the cellular company. As the phone user moves from one cell area to another cell, the switch automatically commands the handset and a cell site with a stronger signal (reported by each handset) to switch to a new radio channel (frequency)[7][8]. When the handset responds through the new cell site, the exchange switches the connection to the new cell site. There are a number of different digital cellular technologies, including: Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), Code Division Multiple Access (CDMA), Evolution-Data Optimized (EV-DO), Enhanced Data Rates for GSM Evolution (EDGE), 3GSM, Digital Enhanced Cordless Telecommunications (DECT), Digital AMPS (IS-136/TDMA), and Integrated Digital Enhanced Network (iDEN).

4.7 Base Station

The base transceiver station or system, BTS consists of a number of different elements. The first is the electronics section normally located in a container at the base of the antenna tower. This contains the electronics for communicating with the mobile handsets and includes radio frequency amplifiers, radio transceivers, radio frequency combiners, control, communication links to the BSC, and power supplies with back up. The second part of the BTS is the antenna and the feeder to connect the antenna to the base transceiver station itself. These antennas are visible on top of masts and tall buildings enabling them to cover the required area. Finally there is the interface between the base station and its controller further up the network. This consists of control logic and software as well as the cable link to the controller. BTSs are set up in a variety of places. In towns and cities the characteristic antennas are often seen on the top of buildings, whereas in the country separate masts are used. It is important that the location, height, and orientation are all correct to ensure the required coverage is achieved. If the antenna is too low or in a poor location, there will be insufficient coverage and there will be a coverage "hole". Conversely if the antenna is too high and directed incorrectly, then the signal will be heard well beyond the boundaries of the cell. This may result in interference with another cell using the same frequencies [11].

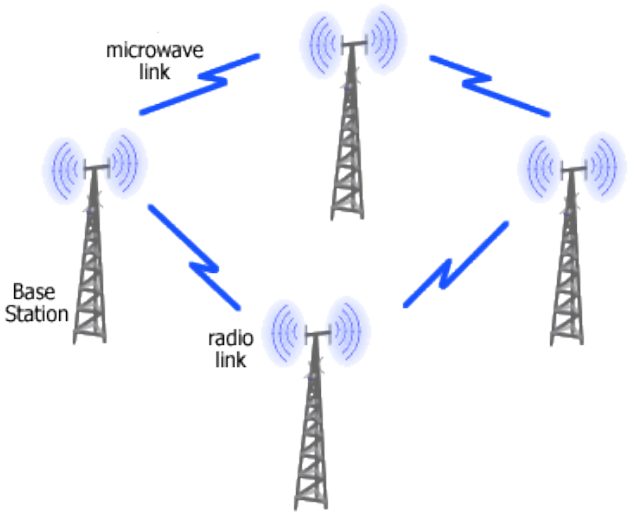

Fig.1.3 Base station model

The antennas systems used with base stations often have two sets of receive antennas. These provide what is often termed diversity reception, enabling the best signal to be chosen to minimize the effects of multipath propagation. The receiver antennas are connected to low loss cable that routes the signals down to a multicoupler in the base station container. Here a multicoupler splits the signals out to feed the various receivers required for all the RF channels. Similarly the transmitted signal from the combiner is routed up to the transmitting antenna using low loss cable to ensure the optimum transmitted signal[12].

4.8 Node

Fig. 1.4 mobile node

In communication networks, a node (Latin nodus, 'knot') is a connection point, either a redistribution point or a communication endpoint (some terminal equipment). The definition of a node depends on the network and protocol layer referred to. A physical network node is an active electronic device that is attached to a network, and is capable of sending, receiving, or forwarding information over a communications channel. A passive distribution point such as a distribution frame is consequently not a node. Here, we consider the mobile stations as a node [9][10].

5. RESULT ANALYSIS

Simulation is carried out to evaluate the performance of the proposed model. The performance of our intelligent mobility management model is evaluated with respect to the considered geographical scenario with the base stations defined. The advantage of this proposed work is the enhancement of the service provided by the service providers. Without this model all the nodes entering the blocking area would end up in call drops, which would cause inconvenience to the mobile subscribers. This project aims at reducing these call drops, and hence enhance the performance of service providers.

5.1 Simulation Parameters

Parameters	Values
Mobility model	Random waypoint
Simulation area	15km*15km
Slow speed	0.5kmph
Medium speed	5kmph
High speed	30kmph
# of base stations	9
# of nodes	Random
Traffic type	Constant bit rate
Pause time	Random
Distribution of nodes	Random

5.2 Results

5.2.1 Percentage of Calls Accepted

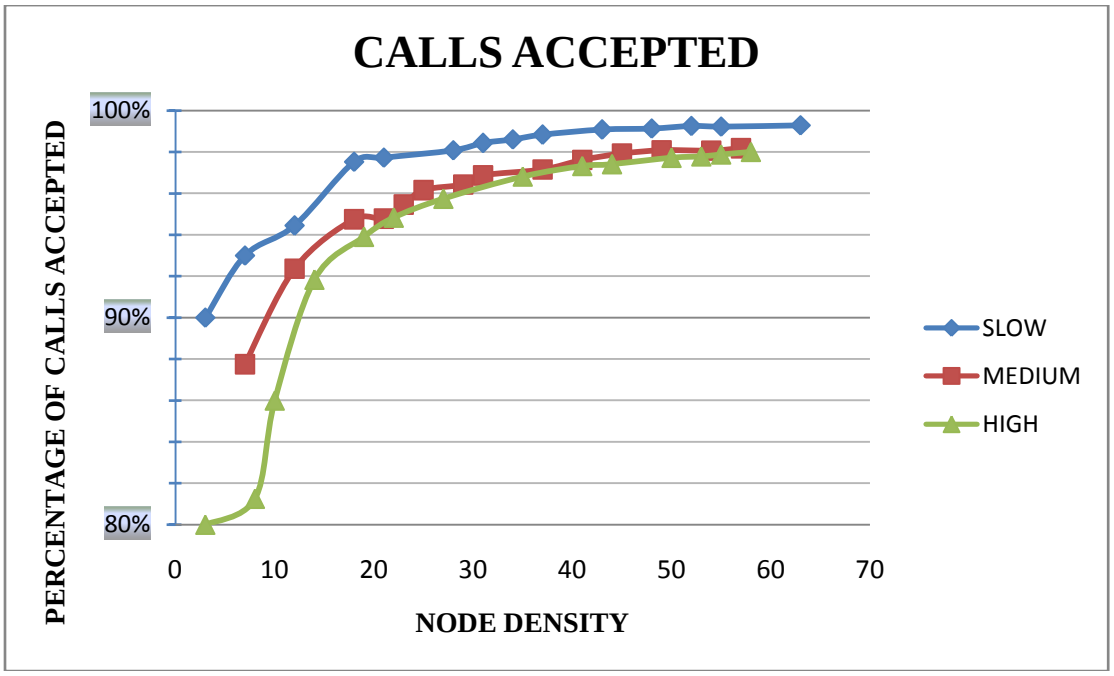

Fig 5.2 Call Accepted

The above graph gives the comparison of the percentage of the calls accepted with the nodes at different speeds versus the node density. Considering the different node speeds, we can observe that the calls with lower speeds are accepted with larger percentage than those with medium and higher speeds. This is quite natural as the mobile nodes with slow speed can be controlled easily compared to higher speeds, hence the percentage of calls getting blocked/dropped can be prevented efficiently.

5.3 Percentage of Calls Dropped

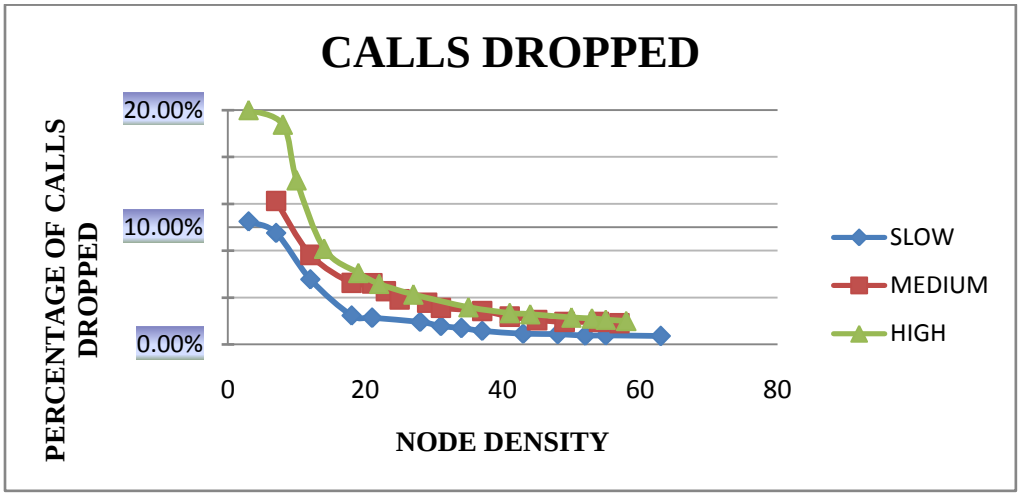

Fig 5.3: Calls Dropped

The above graph gives the comparison of the percentage of the calls dropped with the nodes at different speeds versus the node density. Considering the different node speeds, we can observe that the calls with lower speeds are dropped with lower percentage than those with medium and higher speeds. This is quite natural as the mobile nodes with high speeds cannot be controlled easily compared to lower speeds; hence the percentage of calls getting blocked/dropped is more with the higher speeds.

5.4The Overhead For Sending Alert Messages

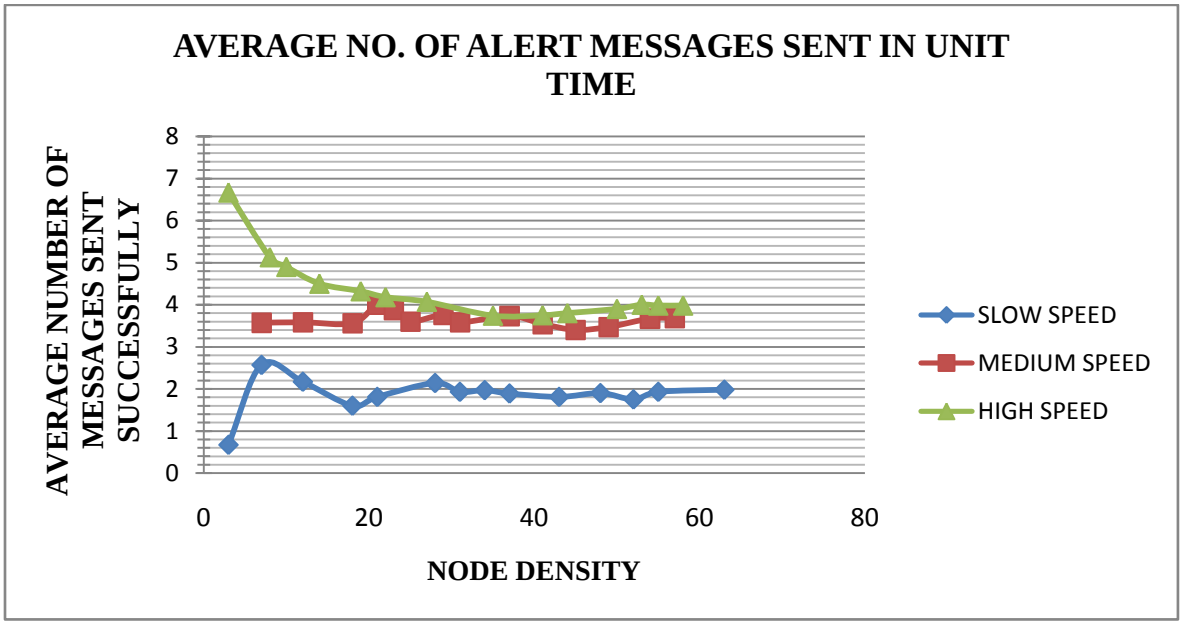

Fig 5.4: Average no of alert messages sent in unit time

The above graph plot gives the comparison of the average number of alert messages sent to the mobile nodes moving with different speeds versus the node density. Considering the different node speeds, we can observe that the alert messages sent to nodes with lower speeds are less compared to those with medium and higher speeds since the nodes with lower

speeds can respond in time with less number of messages. Also we can observe that the number of average messages decrease with the node density since there is more possibility of the failure of messages reaching the nodes as the number of nodes increase in the given locality.

6. CONCLUSIONS

With the implementation of this project, we can intimate the users about the blocking areas and thus the number of calls getting dropped can be reduced.This is carried out to reduce call dropping and encourage complete utilization of resources, hence enhancement of the services provided by the service provider. The project focused on problem faced by the users during their journey. The signals faded as they moved away from base station and towards the blocking area. But the user was unaware of entering the blocking area and hence lost the signals which leadto disconnection in his network. He was intimated about the blocking area, so that he could stop, complete his conversation and move ahead; thus, avoided theproblem. Even the users with high speed will also be benefitted by these alert messages and are provided with the flexibility in movement when the call is in progress.

REFERENCES

[1] Zhuyu Lei Christopher Rose, "Profile Based Location Tracking Approach for Mobility Management of Personal Communications Systems" Dept. of Electrical &Computer Engineering, Rutgers University.

[2] Marcelo Dominguiez,"Adaptive Profile strategy for tracking mobile users",Bogota, Colombia-2007.

[3] SherliaY.Shiand Jonathan Turner,"Routing In Overlay Multicast Networks",Washington University In St.Louis.

[4] Marvin McNett and Geoffrey M. Voelker Amar Pratap Singh, V.K. Govindan, "Intelligent Location Tracking Strategy for Managing User's Mobility In UMTS Networks", Medwell Journals, 2007.

[5] Syed Affan Ahmed, Amir Qayyum, "Profile Based Mobility Management for Wireless Networks", National University Of Sciences and Technology, Pakistan.

[6] I.F. Akyildiz, J. Mcnair, "Mobility Management in Next Generation Wireless Systems," Proceedings Of The IEEE, Aug. 1999.

[7] I. Ramani, S. Savagee,"Practical Fast Handoff For 802.11 Infrastructure Networks", In: Proceedings Of IeeeInfocom 2005.

[8] "Access and Mobility of Wireless Users", Department of Computer Science and Engineering University of California, San Diego.

[9] Pahlavan, K., " Trends in Wireless Sensor Networks", IEEE CommunicationsMagazine, 1995.

[10] Jan Kraaier, Ulrich Killat, "The Random Waypoint City Model User Distribution in a Street Based Mobility Model for Wireless Network",SimulationsDept. of Communication Networks, Hamburg University of Technology 21071 Hamburg, Germany.

[11] GeethaJayakumar and GopinathGanapathi," Reference Point Group Mobility and RandomWaypoint Models",Hindawi Publishing Corporation Journal of Computer Networks and Communications, Volume 2008.

[12] BhavneetSidhu, and Hardeep Singh, "Location Management in Cellular Networks", World Academy of Science, Engineering and Technology 25 2007.