CHAPTER 2

LITERATURE SURVEY

The literature survey indicates that lot of efforts are done to improve the dynamic performance of location management in wireless networks. Reducing the signaling and database access costs of location management introduces significant technical challenges which have to be dealt with and constitutes an important area of research for the past two years. Several strategies have been recently proposed to improve the performance of location management.

Byung Chul Kim, et al (1995) [12] has dealt with a new location management algorithm for personal communication networks. The proposed technique reduces the database access and also simplifies the call set-up procedures. The home database manages a portable station and it is responsible for updating the location information to the home database. The portable stations are initially registered to each access network which is distributed globally. This eliminates the usage of visitor location register thereby reducing the database access. At call setup, location information is recovered once from the called user’s home database to fix on the current location area of the callee, and a paging procedure is started. The proposed technique eases the call setup procedure and also decreases the database load.

George L. Lyberopoulos, et al (1995) [29] has proposed a new paging procedure to reduce the signaling overhead in the radio link. The paging strategy used by the author is a multiple step intelligent paging mechanism. The mobile user travels in a portion of a location area which can be also called
as the paging area, at this point when a call terminates to a mobile user, paging is first done in this location area. The paging strategy projected maintains paging related information gives the information about the proper selection of the paging area. When there is a paging collapse, the called mobile user is paged into another portion of the Location area. Though the proposed approach need additional storage to store the paging related information, the database access overhead is reduced by this tactic.

Daniel O. Awduche et al, (1996) [19], a searching mechanism to locate the mobile user is described by the author. The method presented uses a history of mobility pattern which are known in the past. Based on this past information a probability mass function is computed relating to the location of the mobile user. The probability mass function is then given as an input to the statistical search theory which is used to identify the location of the target mobile station with a minimum expected cost.

Zhu Jian and Wang Jing (1998) [88], describes a three level hierarchical architecture for location management. It includes two major phases: the location registration and the call delivery phase. In the location registration phase the system keeps track of the users who move from place to place. When a call terminates to the mobile user, the call should be properly routed to the user; this is done at the call delivery phase.

Dong and Wha (1998) [24], has presented a new intelligent location management strategy based on the user’s mobility pattern. In this work they have considered two classes of user i.e the users having high mobility and users having low mobility. The mobility pattern is taken to reduce the total cost incurred by paging and location update.
Ian F. Akyildiz et al (1999) [41], a review of mobility management, location management and handoff management is made. The protocols that can be used for the mobility management in next generation wireless communication system are discussed.

Hwang et al (2000) [36], a new technique based on the direction of the mobile user is being suggested to reduce the paging cost. The location update scheme follows the line paging strategy. In this scheme, the network updates the new moving location of the mobile terminal when the direction of the mobile terminal changes. The network keeps the information about the mobile terminals moving direction. When a call is originated to a particular mobile terminal, the system pages the location area on the line of mobile terminals moving direction.

Kim et al (2000) [50], has described an enhance location management scheme for location registers in wireless ATM networks. The method proposed uses two active location registers and a dynamic scope limiting parameter. Each mobile terminal will have an individual scope value. The two active location registers are used in hierarchy (level L Location register and level S location register). When the mobile terminal is powered on, update messages are given to both the Location registers in the hierarchy. When the mobile terminal moves within the L location register, updates are done in the level L location register and when it moves within the S location register updates are sent to both the levels in the hierarchy. This scheme can reduce the average cost of location management.

Yigal and Israel (2001) [84], describes a location management mechanism for tracking the location of the mobile user using the location prediction idea in personal communication network. The mechanism is based on the traffic flow theory that people tend to live in a place for a long period of
time. The scheme combines both location area and location prediction idea. The mechanism guarantees low update and paging, reduces the computational overhead and utilizes the network resources efficiently.

Akyildiz and Wang (2002) [42], introduces a new location management technique that consists of intersystem location update and intersystem paging. The intersystem location update technique is dynamic which finds the threshold by considering the bandwidth requirement and MT’s velocity. Call delivery is done based on the MT’s location update made. The intersystem paging mechanism uses a boundary location register (BLR), which is used to store the MT’s information that crosses the boundary

Chien-Hsing Wu et al. (2002) [16], In order to characterize the dynamic behavior of intercell movements of the mobile station a Markov walk model with six states is proposed. A probabilistic selective paging strategy concept is used for generalizing the selective paging scheme.

S.Dasbit et al. (2002) [20], developed a probabilistic location management strategy in a cellular mobile environment. In this scheme, the mobile switching center (MSC) maintains an indexed database to keep the frequency of traversals of all the visiting mobile units under it. When a call arrives for a particular mobile unit the MSC performs a location probability of the called MT and performs the best first search to find the cells where the desired MT may be located.

Lo and Chen (2002) [68], describes a dynamic region based location management system for personal communication services system. The strategy described makes use of the users’ movement pattern from the set of regions the users is most likely to visit in a time interval. A distributed HLR is used to balance the workload. The call arrival rate and the mobility rate are considered for reducing the registration cost. The strategy used dynamically
changes based on the number of regions, the degree of user mobility, and the
system parameters such as the signaling cost between HLR and VLR.

Yuguang (2002) [74], investigated an analytical model for calculating
the total cost for pointer forwarding scheme and two-location algorithm. A
general model involving various time variables are considered for analyzing
the signaling cost. The cost analysis for the move and find are analyzed more
analytically for many general cases.

Goo and Yong (2002) [31], developed a time based location
registration scheme. The MT sends its location update information for every T
units of time. If a call arrival occurs within T interval, the system pages the
MT and the MT restarts its timer. A ring structure is considered. The inner
most ring is ring 0 which is the center cell and it has only one cell. Ring 0 is
surrounded by ring 1 and then by ring 2 and so on. When the system routes an
incoming call to an MT, it first pages the center cell which is the recently
registered location of the MT. If it does not succeed in finding the MT, it
pages the next surrounded ring. The paging goes on until it finds the MT.

Alejandro Quintero and Oscar Garcia (2004) [5], has developed a
profile based strategy for managing user mobility in 3G mobile systems. In the
3G mobile systems the power of mobility on network performance must be
reduced, mainly due to the huge number of mobile hosts in combination with
the small cell size. A profile based strategy is presented to reduce the signaling
traffic thereby increasing the intelligence of the location update procedure.
User’s moving information can be used to assist the user’s mobility
management, manage network resources and congestion control.

Zuji Mao, and Christos (2004) [89], presents an integrated location
information management strategy based on the user’s call and mobility
characteristics. In the proposed strategy, the local anchor and replica are used
to deal with the location information of the mobile terminal. When the MT moves within the Local Signal Transfer Point (LSTP), its location is reported to the Local Anchor. Location update is made to the Home location register, only when the MT moves into a new LSTP region. During call delivery procedure, in order to reduce the query load in the HLR the switches with high call rate to an MT are selected as replicas of the MT.

Yang Xiao et al. (2004) [82], presents a location management scheme based on dynamic movement based location management (DYNAMIC-3G) and a static scheme (STATIC-3G) for 3G cellular networks. An optimal movement threshold is fixed thereby reducing the cost of updating Home location register, Visitor location register and gateway location register and also the cost incurred by paging. A binary search algorithm is proposed to find the optimal movement threshold.

Georgios and Sandeep (2004) [30], addresses the issue of using statically defined Registration Areas (RAs), which cannot cover the entire movement pattern of the MT efficiently. The cost of location update can be too large in static RAs. Overlapped RAs has been used to address the problem of repeated HLR updates which is caused by the movement of the MT along the boundaries of the RAs. The scheme proposed keeps track of the user’s mobility and with this mobility information it decides the degree of overlapping between neighboring RAs. Thus the overlapped RAs can reduce the number of hand-offs between two RAs and also reduces the cost of call delivery.

Javid and Albert (2004) [43], suggests a hopfield neural network (HNN) to assign location areas in the location area scheme. In the location area scheme the neighboring cells are enclosed together to form a large size cell. In this scheme, when a user enters into a new location area it updates it
current location and as long as it stays within the LA, it never updates its location again. This approach will reduce the location management cost significantly.

Yang Xiao (2003) [83], describes a movement based approach for location management in PCS networks. Cost functions are derived for the location update and paging. An optimal movement threshold is fixed by an effective algorithm. This scheme is adopted when the call to mobility ratio is higher than the movement threshold. This optimal movement threshold reduces the total update cost in the HLR, VLR and paging cost.

Haider Safa (2001) [34], has described a new model for reducing the signaling and database access costs. A built in memory is used in the mobile terminal, where the information about the Mobile unit’s location area address is stored as in HLR. A pointer is used between the location area and the MT’s current LA. When the MT is called, its HLR is queried for its current location area, if the MT no longer resides in that LA then its current LA is reached by traversing a single pointer. This approach significantly reduces the location update and paging costs.

Javid and Albert (2007) [44], has proposed a dynamic location management scheme by combining both clustering and location area scheme. The users’ movement behaviors are collected and they are clustered using statistical clustering and k-means clustering algorithm. A pattern table is generated and it is fed into the users’ mobile terminal. If the user follows the same pattern in the pattern table no updates are done. Moreover future paging decisions are made using the users’ movement history. This reduces both the paging and update cost significantly.
Amal Elnahas and Noha Adly (2000) [7], has presented several location management techniques to deal with the signaling and database access cost. Location management is a challenging task in third generation mobile systems due to smaller size cells and high user population. Several strategies are discussed by the author for reducing the lookup cost and update cost. The paging cost are reduced using the techniques like replication, caching and selective paging and update cost is reduced by techniques like forwarding pointers, learning based techniques and prediction based techniques.

Guo-Hui Li et al (2004) [33], has presented a cost reduction location management technique based on the distance based update method. An optimal distance threshold is chosen to minimize the total location management cost. When the mobile terminal moves from a previously residing cell to the current cell an update is made in the location database if the distance between the two cells is greater than a predefined threshold. This location database of different cells is organized into a tree like structure to facilitate the search of mobile terminals. The tree structure is dynamically adapted to the changing users’ mobility behavior thereby reducing the location management cost.

Assouma et al. (2006) [1], describes a location management for heterogeneous networks which supports global mobility. This is guaranteed using a special architecture equipped with a location register and internetworking gateway (LR-ING), which interconnects the HLR of adjacent subsystems. The LR-ING has a database which has information about the user profile and also the users who change the subsystems. During the paging process, the LR-ING uses its database to retrieve the mobile terminal in the visited subsystem, which enables us to decrease the paging delay during the intersystem handoff.
Daisuke Senzaki et al. (2006) [17], proposed an individual pattern based mobility management scheme which avoids frequent updates by the mobile terminal and also reduces the paging cost. Location Management will be more proficient if the system has the current information of the MT. Most of the MT travels the same route most of the time. The movement pattern is saved by the MT until a clear pattern is evolved.

Ma and Fang (2005) [75], presents a pointer forwarding based local anchoring (POFLA) scheme for location management which reduces the signaling traffic and also checks the paging delay. In this scheme, two pointers are used and some VLRs are selected as Mobile Agent (MA). The pointers between different MA are level_1 pointer and between VLRs in the same charging area as the MA are level_2 pointers. The major advantage is using POFLA scheme is only one MA is needed in the pointer chain at any given time. Here, when a user crosses a RA boundary and enters a new RA under the control of a different VLR, a pointer is set up from the old VLR to the new one without updating the MA.

Alenjandro Quintero (2005) [4], used a User Profile Learning Strategy (UPL) to reduce the overhead in both location update and paging in UMTS networks. Users will follow a regular routine most of the time. Based on the regularity of the users daily routine the mobile users are classified into different classes. The UPL strategy associates with each user a list of location area where he is likely to be located at a particular time. Update does not happen when the user moves within the location in the list. The list is stored in the intermediate location database associated with the Mobile Switching center and the user’s mobile terminal. An Artificial Neural Network is used to learn the profile of the user.
Chuon et al. (2005) [14], uses an individual profile graph (IPG) for each user for location management in PCS networks. The main intend of using IPG is to predict and code the users daily routine. The IPG is a sub graph of the existing network graph with all network cells as vertices and edges representing physical adjacencies of cells. This IPG is applied to update and paging strategy to reduce the location management cost. The proposed method is a long term profile that has been developed from a lengthy period of observation and remains static after formation.

Yi-hua Zhu et al. (2007) [85], illustrates a reinforcement learning algorithm for location management in PCS Networks. The proposed strategy is mainly intended for reducing the paging cost. Each cell in the LA is given a preference and it is initialized to zero. Mobile terminals are searched by paging the cells that has the highest preference and at time lower preference cells are also paged to keep track the mobility of the users. Reinforcement learning has the advantage of learning from the environment by interacting with the environment and it does not require predefined knowledge.

Morris and A. Aghvami (2007) [18], describes a novel location management approach for overlay networks. An Inter overlay mapping algorithm is used for reducing the signaling cost in location management. The proposed LM approach gives the LA information maintained by the UMTS network to the entire idle MTs. A mapping is made between the MT’s UMTS LA to the cell in the Digital Video Broadcast (DVB) network on receiving a connect request to the DVB interface.

In order to deliver the calls to the destination users and to utilize the network resources more efficiently Ramon M (2007) [66], has proposed a movement based location management scheme based on renewal theory. It includes a variety of probability distributions for modeling cell residence times.
(CRT) in hyper exponentially distributed location area residence times and exponentially distributed intercall times.

Yi-hua Zhu (2007) [86], presents a movement based paging mechanism for location management. A movement threshold is fixed and each mobile will count the number of cell boundary crossing and initiates the location update when the threshold is reached. The total cost is reduced with the help of sequential paging schemes, in which a group of cells is paged in non increasing order of location probabilities, are optimal in that they minimize the average number of cells paged per call arrival. The MTs movement statistics is analyzed and based on this an optimal sequential paging is activated which substantially reduces the total signaling cost.

Hassan, W. H et al. (2008) [37], uses an intelligent multi agent system also known as agency to give the location management information according to specific requirements and preference. The intelligence is provided to the IP-based network as an overlay to provide mobility services. The overlay has three layers: information layer, service layer and user layer. The information layer is connected to the database and all the three layers are responsible for giving control and signaling information for location management.

Li Song et al. (2008) [53], describes a location management scheme for GEO mobile satellite system (GMSS) using mobility pattern. Like cellular networks, the GMSS has large beams and fewer resources hence, efficient location management algorithm are needed. A restraining LU strategy will be applied to the low velocity Mobile Earth Station (MES). As for the high velocity MES, a LA visiting list is set up based on the information theory, taking the routine segments from the list using Association Rule Mining Algorithm. Due to exploiting the mobility pattern of the MES, the signaling cost of a MES which has a regular routine will be reduced remarkably.
Lin and Ho (2008) [39], presents a distributed location management strategy for wireless networks. The location information databases (LID) which are numbered continuously are arranged in frames. The traffic for finding and updating the mobile terminals location are distributed among all LIDs. When a mobile host enters the network for the first time, a frame of LIDs is randomly selected to store its location information. When the mobile host moves into a new LA, its new location information is stored in the next frame of LIDs. The strategy is known as sliding frame strategy.

Almeida-Luz (2008) [6], suggests a differential evolution (DE) algorithm to minimize the cost incurred in reporting the location of the cells. The main objective of DE algorithm is function optimization. The reporting cells scheme chooses a subset of cells as the cells reporting cells and others as non reporting cells. The MT performs a location update when they change their location and move to one reporting cell. If an incoming call should be directed to a mobile terminal then the search can be restricted to the last reporting cell. The DE algorithm is used to choose the reporting cells by setting up an initial population of cells.

Ae Hyang Park et al. (2008) [2], proposed an analytical model for movement of MT with multiple interfaces and paging algorithm to reduce the number of cells in paging area in MWAN environment. We propose an enhanced paging algorithm to send paging message to overlapped area of multiple PAs in MWAN environment. The global location register (GLR) generates the overlapped area then, it sends paging message to designated cells in overlapped area.

Yang He et al. (2008) [81], proposed a location service optimizing algorithm based on mobile location agent. We name it mobile location agent (MLA) algorithm. MLA algorithm employs the location agent (LA) for each
node and maintains the node location information in the LA. Instead of the node location, the LA location will be updated and maintained in the node’s LS. Unlike other existing location service protocols, in MLA, besides using the node location information, the source node can also deliver data packets according to the LA location of the destination node, and this will improve the validity of the location information caching in the network significantly.

Xian Wang et al. (2008) [78], presents an analytical model for the movement-based location management with HLR/VLR architecture. The new model can precisely portray location updates that are caused by the movement between cells and the movement between LAs. Under a general assumption on the distributions of the cell and LA residence times, we derive closed-form analytical expressions for the costs of HLR and VLR location updates and the cost of paging.

Vicente and Pablo (2009) [71], describes a mobility model with a certain directionality. This directionality provides information about the MT’s position. The key point is to use this information in the location management procedure. In this sense, it is expected that the network, based on this information, could predict the mobile’s location at cell level. The look ahead strategy is formulated and illustrated in one dimensional scenario by means of a like- Brownian motion mobility model.

Melodia et al. (2008) [59], a new location management scheme is proposed to handle the mobility of actors with minimal energy expenditure for the sensors, based on a hybrid strategy that includes location updating and location prediction. Actors broadcast location updates limiting their scope based on Voronoi diagrams, while sensors predict the movement of actors based on Kalman filtering of previously received updates. The location management scheme enables efficient geographical routing, and based on this
an optimal energy-aware forwarding rule is derived for sensor-actor communication.

Qinglin Zhao et al. (2009) [64], optimization of the dynamic location-update area (LA) for the per-user distance-based scheme in personal communication service (PCS) networks is discussed. Two main contributions are done (1) under the general and popular one-dimensional (1-D) continuous-time random walk (CTRW) mobility model, we propose a novel framework to analyze the location update cost; (2) with this framework, the impact of call arrivals and the initial position of the mobile terminal (MT) on the position of the LA is investigated.

Bhadauria et al. (2009) [72], propose a cost effective and efficient LM scheme based upon the mobility information and RSS value of mobile terminals. In the proposed algorithm, in order to handle the above situation, the MT is configured to work as follows: The MT on finding its RSS value lower than a minimum required RSS value informs MSC not to page it until it comes out of bad coverage area. Doing this, the paging cost of the system is reduced.

Wenchao Ma et al. (2007) [76], presented the UMP scheme to minimize the location update and paging traffic burden. The basic idea is to incorporate the time information in the mobility pattern profile; thus, different location updates and paging schemes can be used based on the different user states. The registered history data are used to construct a search tree for the user. User mobility pattern (UMP) is found or created based on the user’s movement, and the probability that the user is in a cell is also derived based on the pattern.
Barba. A et al. (1993) [9], presents a comparative study of security aspects between Universal Mobile Telecommunication System (UMTS) and the Future Public Land Mobile Telecommunications Systems (FPLMTS). The security for location management in UMTS network has been done in two aspects: interrogation and paging and location registration, location updating and user registration. An authentication scheme is adopted for location registration and location update. Authentication is required between the user, service provider and the equipment.

W. Van Den Broek et al (1993) [69], describes the functional models of UMTS and their mobility management procedures are specified using specific functional models. The specific models are mapped onto a generic functional model. This generic model can be considered as the integration and unification of the specific models. Its structure reflects two important implementation aspects. First, the integration of UMTS into future networks for fixed telecommunications is anticipated. Secondly, the application of the intelligent network architecture for the implementation of the UMTS mobility procedures and service provision is assumed.

Henry and Siu (1996) [38], a new location management algorithm is adopted whose configurations are done using regular graphs. The cost function is a convex combination of the number of the maximum size of the paging area, in terms of the number of moves of the mobile user. A movement based algorithm is adopted for finding the cost function.

Lin and Ho (2010) [40], proposed a distributed location management strategy called weighted sliding-frame strategy for wireless mobile networks in which the processing speeds of the location information databases (LIDs) are heterogeneous. In the proposed strategy, a number of consecutively numbered location information databases are arranged into a frame. A frame
of location information databases overlaps with the next frame except one database. Each frame is assigned a weight which is used to distribute the location information of the mobile hosts among the frames. The number of mobile hosts whose location information are stored in a frame is proportional to the weight assigned the frame. A nonlinear convex programming problem is formulated and solved numerically in order to find the set of weights that minimize the average database response time. The numerical results showed that the proposed weighted sliding-frame strategy is able to properly distribute the location information of the mobile hosts among the frames such that the average database response time is significantly lower.

Fan Hu, Lidong Zhu et al (2010) [27], has dealt with Selective Paging Schemes for LEO Satellite Network Based on Dynamic Location Area. Location management is one of the key points of movement management in low orbit satellite. Comparing with static location area, dynamic location area can reduce the cost of movement management, which is determined by the characteristic of user movement. In fact, each user only keeps two counters, one is the distance moved and another is the time passed. A location update is performed when this counter exceeds a predefined threshold value. Selective paging strategy is an optimized one which can significantly reduce the paging cost and time delay.

Mangues Bafalluy et al (2010) [48], has presented the experimental performance evaluation of the distributed Virtual Home Region Multi-Hash Location Service (VIMLOC) for wireless mesh networks. In this work, the author has focused on the location management problem, i.e., the mapping between a node identifier (node ID) and its current location address (L.A.) The main challenge is how to distribute and to obtain accurate location information in a scalable and robust way. Scalability is determined by the efficiency of the scheme in terms of overhead introduced in the network and state volume in the
nodes to achieve two main goals. First, a certain level of robustness must be offered. This is understood as the ability to make accessible the location of a given node even in the presence of impairments in the network. And second, accurate location information in terms of space and time must be provided. Finally, VIMLOC provides robustness across a range of different workload environments. Besides, it also has much better scaling properties. Overall, this renders VIMLOC a promising solution for location management when wireless mesh networks are used to provide broadband wireless access.

Dharmishtha L et al. (2010) [23], has dealt with Investigating Caching Strategies in Personal Communication Services. Personal Communication Services Systems provides global roaming and improved quality of services irrespective of the location of its users. One of the important and challenging issues in personal communication services systems is location management, which keeps track of the movement of the users. The existing user location strategies used for location management suffers from high signaling traffic in locating the mobile users. Caching - auxiliary strategy is used which helps to reduce the overhead on the basic location strategies.

Gao Qian et al. (2010) [28], the authors dealt with a Location Area Design for GEO Mobile Satellite System. The GEO (Geostationary Earth Orbit) mobile satellite system extends terrestrial GSM (Global System for Mobile Communications) cellular system coverage. In mobile satellite systems, location update and terminal paging are the two inseparable contents of location management. In fact, location management research is to find a balance point between the location update strategy and the terminal paging strategy, which is based on the research of them respectively. Its objective is to minimize the combined cost generated by the two wholly. Therefore, the cost of system signaling is the most important indicators to evaluate the mobile satellite system location management strategy comprehensively. The
authors concludes that for lower-speed mobile terminals such as foot passengers, vehicles and trains, along with the increase of beam amount belonging to the location area, the cost of location management also increases. For higher-speed terminals such as aircraft, missiles, along with the increase of beam amount belonging to the location area, the cost of location management reduces. In this system, because of the majority of low-speed terminals and the minority of high-speed terminals, the scheme that a beam coverage area is a location area which we suggest confirms reasonable. Aiming at the characteristics of high-speed terminals, a special management scheme can be used. To improve the static triggering scheme so as to reduce the cost of location management.

Momeni Akbar, Karim Khazaei, Aghil Essmaeili et al (2010) [61], dealt with a scheme called Cellular Aggregated Location Management (CALM). It scales well in large mobile ad-hoc networks. Location service for adhoc networks named CALM and explains it. This method supposes that nodes moves around and relay each other packet in a circular environment.