Profile Based Location Update Strategy in Mobile Computing

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----------**ABSTRACT**----------

Location management is the most important and crucial task when we talk about Mobile Computing. Sometimes it is very difficult to perform some task without knowing the exact location of the user. It is very important task in mobile computing to manage location information of each and every user. In cellular network the area is divided into cells. When the user changes location, an update occurs. The main goal of any location management strategy is to provide efficient search-updates. In this paper we have discussed profile based location update strategy in mobile computing.

Keywords - **Location Management, Location Update, Mobile Computing, Profile Based Location Update.**

I. INTRODUCTION

This is the generation where we need to do work anytime and anywhere. This is possible only through the communication power. If we talk about the world of 1970s, mobile users can only roam locally or regionally, and International roaming was possible only after 1990s [4]. With the increase of mobile user population and mobility, and more demands on quality of service (QoS), the current mobility management scheme faces new challenges.

During the last one or two decades, the field of telecommunications has experienced extraordinary development. The main idea behind this much improvement in cellular mobile network is the users need to exchange the information anywhere and anytime. i.e. under all circumstances like travelling from one place to another place. This has given a new idea to the world i.e. electronic mail. In mobile systems a user must be able to access services while moving from one location to another. This problem is known as mobility management. Mobility management has two components: location management and handoff management. In this article we discuss about location management.

Location Management is a process divided into mainly two parts i.e. (1) Location Identification and (2) Location Update. This is very important process because with this only the network can identify the attachment point of a mobile host which is necessary for call delivery or any other services. In present location management techniques it involves following terms for better understanding of the work. It includes Home Location Register - HLR, Visitor Location Register - VLR and the transmission of signaling messages over the network.

The cellular network area is divided into the various coverage areas called Location Areas (LAs as shown in figure - 1), which are sets of adjacent cells. In each cell, every mobile host (MH) communicates with a base station through wireless links. The base stations are connected to a mobile switching center (MSC) that serves the specific LA.

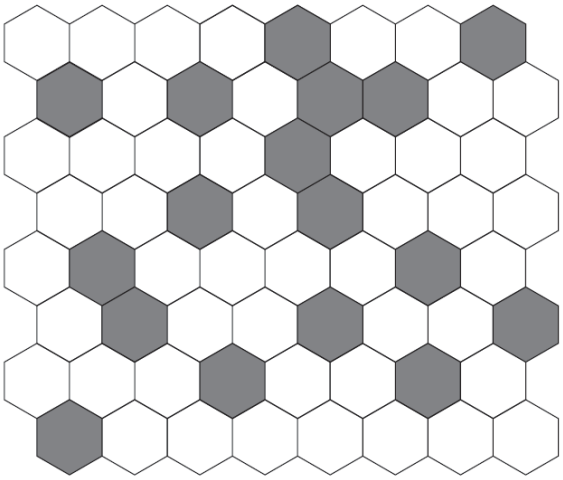

Figure - 1 : Location Areas

Location management occurs in two stages: location update and call delivery. Location Update is needed for MH and at the time of location update, it will pass the location information to the network. When another subscriber calls on given number at that time the network is queried for the location information of the called mobile. Location update occurs when a mobile moves from one LA to another. A location search procedure is performed when a mobile is called. The main goal behind the both the exercise is to find

the called mobile's current cell in the most accurate way possible.

In our routine busy life generally most of the users follow regular routines during their business hours and residing mostly at their place of work. For these kind of users, it is possible to manage their location information with significant accuracy at a particular time of day. The main aim of

profile-based location prediction schemes is to leverage off this information to reduce location and paging requests.

The mobility model of the user can be used to assist user mobility management i.e. traffic routing, useful to manage network resources i.e. resource allocation, call admission control, congestion and flow control, and also useful to analyze handoff algorithms in integrated wired/wireless networks [2]. Furthermore, a user's mobility patterns can also be useful for system recovery [1].

II. CLASSIFICATION OF LOCATION UPDATE SCHEME

A location update scheme can be classified as either static or dynamic [3]. A location update scheme is said to be static if there is a fix set of cells from which the location update can be generated. This procedure is totally independent or transparent of its mobility. The static location update scheme further divided into Location Area Scheme and the Reporting Center Scheme. The Location Area scheme further divided into various extensions like Two area Location scheme, The Overlapping scheme and the Virtual Layer scheme. The location area scheme has a better overall performance than the reporting center scheme. A scheme is dynamic if a location update can be generated by a mobile station in any cell depending on its mobility.

The second type of scheme is Dynamic Schemes which includes Time Based, Movement Based and Distance Based Location Update Schemes. The classification of location update schemes is shown in figure 2. In today's cellular networks Time Based and Movement Based Location Update Schemes are generally used. If they will use proposed profile based scheme in combination with the traditional scheme at that time it may produce good results when it comes to location management cost and signaling load. The mobility rate and call rate of a user determine the number of location updates and paging operations performed.

Through various surveys it had been checked that majority of users perform their activities only at specific locations for limited period of time. The geographical behavior of an individual is found to be stable over long periods of time. This stable geographical behavior of the user can be useful in predicting the location of the user where the user spends most of the time of his / her time and the path taken to get that location. Further we can identify specific periods of a day when a user is more likely to receive a call than others.

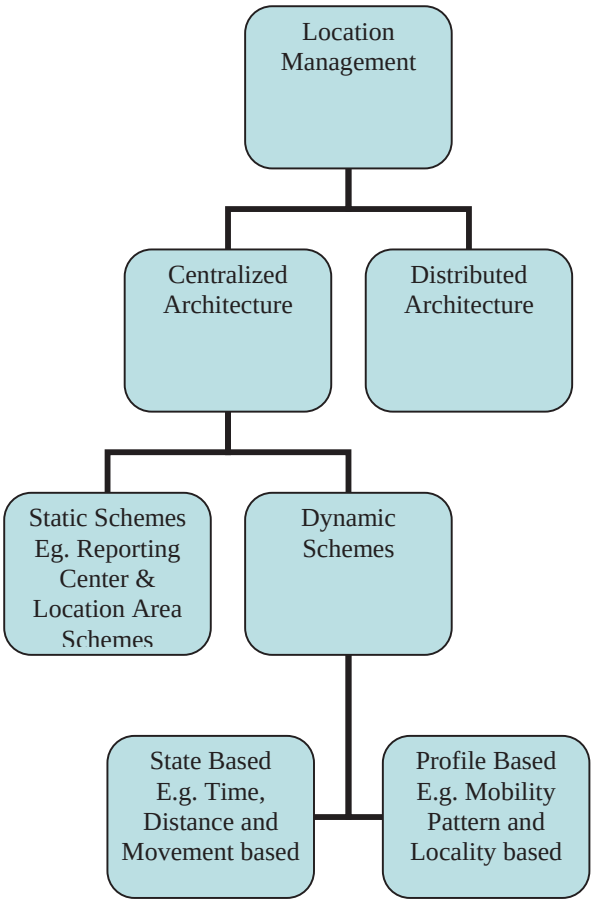

Figure - 2 : Classification of Location Update Scheme

III. LOCATION UPDATE PROCEDURE

When a user moves from one LA to another LA, a location update is performed. Each user is assigned a list of likely LAs. This information can be gathered from its past history, and the network updates it regularly. These areas are always kept in one list. The list is stored on the MT, to allow it to know when it leaves or enters the list and hence when to perform a location update, as well as within the network. When any user moves to a new LA, that may be either intra-ILD or inter-ILD, a location update is performed. At this point of time if the new and old Las are under the same LSTP then it is known as intra-ILD move and if both are under different LSTPs then it is known as inter-ILD move. It is the responsibility of MT to maintain anchor LA to be defined within MT through which the location information has been updated at the HLR level

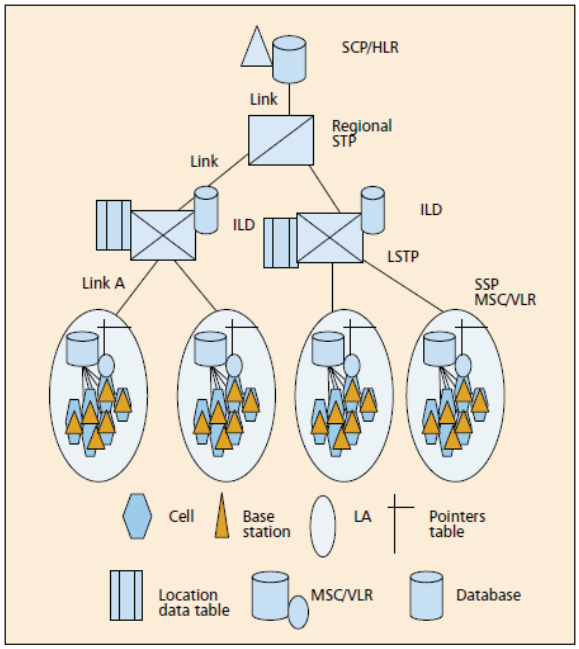

Figure - 3 : Network architecture

If the user moves between two zones within the available list, at that time no update will be performed; but if it is global, the current LA (Location Area) is registered at the ILD (Intermediate Location Database).

On the other hand if the user moves between two zones which are not available in the list, we assume that the MT (Mobile Terminal) has its anchor LA (registered in a built-in memory) transferred to the ILD and the location data tables (Fig. 3):

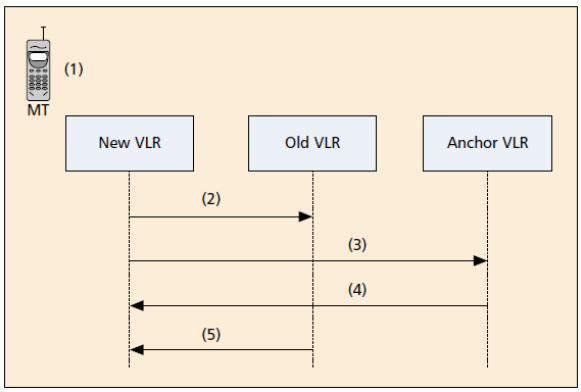

Figure - 4 : Updating Procedure for an intra-ILD move outside the list

1. In this first step the MT moves into a new LA and transmits location update registration request message to the new MSC (Mobile Switching Center) / VLR (Visitor Location Register)

2. In second step the MSC of the new LA will register the MT and its anchor LA, and sends a special message to detach the MT from the old MSC.

3. In the third step the new LA also sends a connecting message to the anchor LA so that it can create a pointer towards it. No update is performed at the current ILD. This is one of the advantages of using an anchor LA.

4. In the fourth and last step the new LA receives an acknowledgment message from the old MSC and the anchor LA.

IV. LOCATION SEARCH PROCEDURE

In this procedure the major aspect involved is the identification of the current LA and to find cell where the user is roaming (Fig. 5). Here we can think for four different possibilities so that we can apply proposed location management strategy.

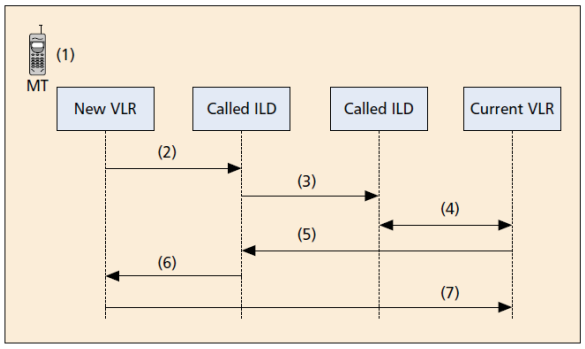

Figure - 5 : Location Search Procedure

Possibility - 1 : It will address to the case in which the called MT and the calling MT are roaming under the same are of ILD and called MT is roaming in its anchor LA :

1. When a call has been initiated to an MT and forwarded to the MSC of the calling unit.
2. Then the MSC sends a message for location request to the ILD which is useful to determine the anchor LA of the called MT.
3. Then the ILD will forward the message to the anchor MSC of the called MT.
4. After that the anchor MSC assigns a temporary location directory number (TLDN) to the called MT and forwards it to the calling MSC.
5. The calling MSC sets up a connection to the called MSC using this TLDN.

Possibility - 2 : Here it will address the case where the called MT and calling MT are in the areas covered by the same ILD but the major thing is called MT is not roaming in its anchor LA. So that the pointer has to crossed to reach the current LA, which assigns a TLDN to the call and transmits it to the calling MSC.

Possibility - 3 : Here in third possibility is like when there is a pointer at the calling ILD pointing to the called unit. The called MT is in roaming in its anchor LA and is out of its associated list. The distant pointer is crossed to reach the ILD that has the information on the MT.

Possibility - 4 : Here when the called unit is outside the list but is pointed to by a distant pointer at the location data table of the calling ILD. The called mobile is not roaming in its anchor LA.

V.PROFIEL BASED APPROACH

There are mainly four strategies available for Location Management namely : (1) Time Based (2) Distance Based (3) Movement based and (4) Profile Based. In Profile Based Approach it uses built-in memory method that reduce the location update signaling cost by increasing the intelligence of the location update procedure.
The main objective behind using this kind of strategy is to use of the strategy given behind the work behavior of the humans. In this approach we will learn the process to derive a list from which we can find the places (exact cells) in which the Mobile Terminal (MT) resides the most of the time of any day. This learning process is able to derive such list after learning the behavior of a particular user by viewing the activity for a certain period of time.
For this purpose we associate a pattern learning process. So that when the learning process gets complete, we are able to decide the mobile user's behavior with possible location of LAs.
We can built a table based on profile that we have collected based on his / her day to day activity (as shown in Table - 1) When a call arrives for a mobile, we can page it sequentially in each location within the profile. The major benefit here is when the user moves between the LAs available within the given table no location update is required. This profile table is stored at the HLR as well as in the user's MT.

Sr. No.	Profile Number	LSTP ID	LA ID	Number of Visits
1	0	1	6	20
2	0	1	12	40
3	0	1	9	15
4	0	3	6	22
5	0	1	12	20
6	1	1	9	19
7	1	2	20	8
8	1	1	22	7
9	2	3	10	1

Table : 1 - An example of a user's LA profile

In Profile Based System, if the position of the user is always known in advance then the major benefit is registration is necessary and the optimum LA is a single cell that minimizes the paging cost. [5]. This scheme is most useful when most of the users are stationary for a particular period of time in their day to day routine. It is also possible to divide the people group into various categories based on their daily routine. Fix users who have a very high probability of being in an area known in advance by the system. Some users with a probability that he / she will be available at given location is high but low compare to above type of users and at last the random users whose position at a given movement is unpredictable. [5].

Here the cost reduction is totally depends on the behavior of each class of user and the probability that the user found in a given list of probable LAs. It is also expected that when the user follows its fix routine behavior, location update cost will be definitely reduced.

In this scheme we can define the local list as the set of LAs that are all under the coverage of one local signal transfer point (LSTP). The prepared list is to be stored at the intermediate location database (ILD) which is directly associated with the LSTP. For further improvement we can also define the global list as a set of LAs which belongs to different LSTPs and that list can be stored in HLR. The LA where the called mobile is roaming is stored at the ILD, while the HLR stores the list of ILDs (Fig. 2). Each MSC is assigned to one ILD.

VI. SOME ASSUMPTIONS

For the above mentioned procedure to work smoothly we need to assume that the link costs and database access costs are not taken into consideration.
We also need to consider the cost for list update and maintenance while comparing the strategy with other strategy because we have consider only the following maintenance cost.
(1) Processing the billing information of the user to create the list.
(2) Transfer of the list to the place where it will be stored
(3) Notification of the modifications in the list to the MT
The system should have two kinds of information, as stated in [4]:
(1) The system will store long-term information in a relatively static list. This list must be updated with new updated movement patterns detected by the system for proper output.
(2) The system also needs to store short-term information changes depends on the recent behavior of the user which is done by the user in last few hours of the day.

VII. CONCLUSION

In this article we have discussed something about Location Update procedure, Location Search Procedure and Profile

based Location Update Strategy. We have given one example table for discussing the profile based location update procedure. The scheme is based on the each user to predicate the user's movement. Though this strategy have some assumptions but also it proves to be good strategy when the day to day behavior of the user and daily routine activities of the user is fix. It will definitely help in reducing the Location Update Cost.

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