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Implicit Location Registration for 3G Networks under Multipath Environment

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ABSTRACT

Different location update algorithms have been analyzed. Both Static location and movement based location schemes been analyzed with different cell sectors. Dynamic LM schemes have higher signaling traffic as compared to static LM schemes. The location updates are also measured over different cell structures. The reuse factors of cells are measured for different cell combinations with its proposed algorithm.

Key words: Static location, movement based, location management

INTRODUCTION

In wireless mobile communication systems, the exchange of information with the mobile terminals should be facilitated regardless of their locations. The problems faced due to the change in locations are paging cost, duplicated registration. By paging procedure, the MSC determines the base station under which the called party is actually located. The location management system is hard to keep track of the mobile terminal's location without using the location update mechanism called registration process. The registration process, however, consumes a significant amount of the mobile terminal battery power, air-interface bandwidth, wire line network bandwidth, system computing resource and other system resources.[1,4] Therefore, it is desirable to reduce the number of registrations to its minimal. Providing users with mechanisms which allow them to control how they want to expose their location information, and thus allow control over how to share location information with others and services, is a crucial Step for better location management for mobile devices.

In this paper, we propose new location management strategies like introducing the concept of implicit location registration. It is shown that the proposed strategy has the lower paging cost than the simultaneous paging scheme. Movement Based Schemes: Each mobile target (MT) only keeps a counter of the number of cells visited. A location update is performed when this counter exceeds a predefined threshold value. [2]

The movement based schemes are:

- Static Location Update Scheme
- Dynamic Location Update Scheme
- Improved Movement-Based Registration scheme - IMPR Scheme
- Ring Removal Movement-Based Mobility Location Update Scheme- RRMB

Hence, the design of an efficient location management algorithm is important in wireless mobile network location management has become increasingly important considering the increasing number of mobile devices. The exchange of information with the mobiles should be facilitated regardless of their locations.

Currently, for managing the locations of mobiles, the service areas are divided into a number of location areas. When a mobile moves into a new location area, it registers its new location to the network. This procedure is called location registration. On the other hand, when a mobile-terminated call occurs, the network forwards the call to called party (simply, cal lee) by the appropriate manner, which is generally called call delivery. When the mobile switching center (MSC) of the callee receives a mobile terminated call, the MSC sends a paging request message to its base stations. All base stations of the MSC then broadcast the paging signal through the wireless paging channel. If the callee replies to paging signal, the connection is setup between caller and callee. However, paging scheme increases the unnecessary consumption of the paging channels as the cell size of a base station becomes smaller in order to accommodate the increasing number of subscribers in the future wireless mobile networks. [5]. Many studies have been conducted to reduce the paging cost by introducing the new paging strategies. Hence, the design of an efficient location management algorithm is important in wireless mobile network.

CONDITIONS OF LOCATION MANAGEMENT

Without Location Management

Without location management the system does not track any mobile devices. Searching for a user is done over the complete radio coverage area and within a specific time limit. Without location management is used in - Paging systems because of the lack of uplink channel allowing mobile hosts to inform their whereabouts to the network and in small private mobile wireless networks because of their small coverage areas and user populations [5,7]. Its main advantage is that it is simple to implement because of the absence of a special database. Its main disadvantage is that it doesn't fit into large networks dealing with high number of users and high incoming data exchange rates.

With Location Management

To make a call from a mobile station, the mobile station first needs to make a request using a reverse control channel of the current cell. If the request is granted by MSC, a pair of voice channels will be assigned for the call. To route a call to a mobile station is more complicated. The network first needs to know the MSC and the cell in which the mobile station is currently located. How to find out the current residing cell of a mobile station is an issue of location management. Location management deals with how to keep track of an active mobile station within the cellular network. [1] A mobile station is active if it is powered on. Since the exact location of a 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.

$$N_{opt} = \sqrt{v \frac{C_{in}}{pi\, R C_{pg}}} \quad (1)$$

Where R is the cell radius, v is the speed of a user, C_{lu} is the LU cost, and C_{pg} is the paging cost per call. This equation states that high user speed and LU costs indicate that having a large number of cells per LA is preferable, while a large cell radius and high paging costs imply that a small number of cells per LA is optimal. Obviously, users are not homogeneous, but with sufficient data collection and analysis of aggregate user movement patterns, Fluid-Flow is a relatively successful method to optimize static LAs [5-6]

LOCATION MANAGEMENT SCHEMES

Static Location Update Scheme

Presently, most LM schemes are static due to their simplicity. In static schemes LUs occur on either periodic intervals or upon every cell change. In these static LAs, cells are constant in size, uniform, and identical for each user. A static location update scheme is known as the global scheme. 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 it mobility. A location update scheme is global if all subscribers update their locations at the same set of cells [2-3].

Location Areas in static LM are themselves static as well. They are effectively the easiest solution to physically dividing a network, providing the same LA to every user. The static LAs are set and cannot change, users may repetitively move between two or more adjacent LAs, which for many LU schemes will cause a large number of LUs with a small or zero absolute cell distance moved [3]. Three simple static Location Update schemes exist in static LM-

- Always-update
- Never-update
- Static interval based

Always Update Scheme

In Always-Update scheme each cell is a location area. Always-Update scheme involves the user updating its location upon every inter-cell movement that is a mobile station needs to update its location whenever it enters a new cell. Obviously the cost of location update is very high, but there is no paging cost because the cellular system can just route an incoming call to the last reported cell without paging.[3] This will incur significant energy and computational costs to both the network and the user, especially to the most mobile users.

This may be particularly wasteful, as if a user makes frequent, quick movements within an LA, beginning and ending at the same location, many LUs will occur that might be unnecessary, especially if few or no calls are incoming. However, the network will always be able to quickly locate a user upon an incoming call, and extensive paging will not be necessary.

Never Update Scheme

In Never-Update scheme the whole service area is a location area. This method would be to never require the user to inform the network of intercell movements, only updating on LA changes. Therefore there is no cost of location update. However, the paging cost is very high because the cellular system needs to page every cell in the service area to find out the cell in which the mobile is currently located so an incoming call can be routed to the base station of that cell.

In this scheme, resources are saved as constant updates are not required, but paging costs rise substantially. This occurs as every cell within the user's LA may need to be checked during paging due to the lack of information, which causes excessive overhead for users with a high incoming call frequency [4-5]

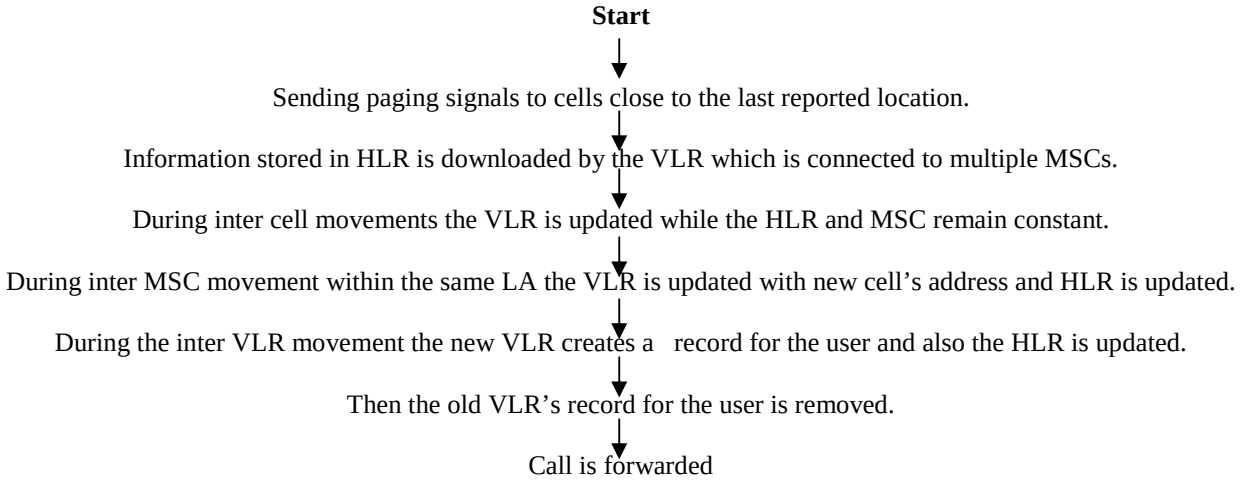
Static Interval Based Scheme

The final static LM technique discussed requires each user within the network to update at static, uniform intervals. This attempts to provide a balance between the extremes of the previous schemes, as the network will neither be overwhelmed with LUs nor wholly unaware of users' locations. However, users with rapid rates of movement may move into new LAs between update, which causes locating that user to be very difficult.

RESULTS AND DISCUSSION

Algorithm of Static Location Update Scheme

Following are the Steps for Algorithm of Static Location Update Scheme -



Improved Movement Based Registration Scheme

It uses a Mesh network topology. In this method, the MT has a cell ID buffer, S and a cell counter C.

Algorithm

Step 1:
Initially MT is at A, C=0 S= {A}
Now MT is at C, C=2 S= {A, B, C}
MT is at D, C=3 S= {A, B, C, D}
MT is at E, C=4 S= {A, B, C, D, E}

Step 2:
Now MT is at B, C=5 cell ID B exists at S.
The buffer is to be updated, C=5 S= {A, B, C, D, E}
So, C=5 S= {A, C, D, E, B}

Step 3: Now C=5=d (threshold) so location update initiated

Step 4: Reset C=0 clear S except H S= {B}

Ring Removal Movement Based scheme (RRMB)

It uses a Mesh Network Configuration. This procedure removes the rings in the terminal's movement path and, thus reduces the effect of localized movements on location update. In this method, the MT has a counter *C* and a cell ID buffer, *S* Fig. 2.

Algorithm

Step 1: Initially MT is at A, C=0 S= {A}
Now MT is at C, C=2 S= {A, B, C}
MT is at D, C=3 S= {A, B, C, D}
MT is at E, C=4 S= {A, B, C, D, E}

Step 2: Now MT is at B
C=5 cell ID B exists at s
The MT concludes that a ring has been formed and the ring removal procedure has been initiated.
C=5-3 S= {A, B, C, D, E} so, C=2 S= {A, B}

Step 3: MT moves from B to H so 3 more additional movements so c=2+3 s= {A, B, F, G, H}
Now c=5=d (threshold) so location update initiated

Step 4: Reset c=0 clear s except H s= {H}

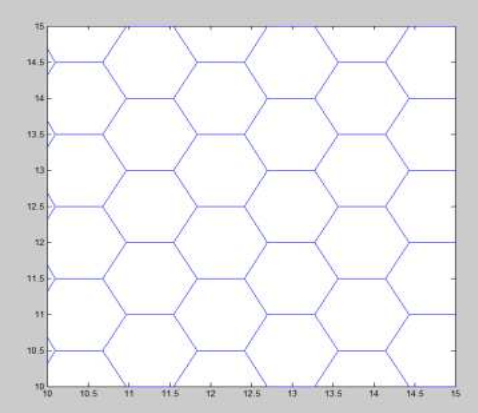


Fig. 1 Cell Design

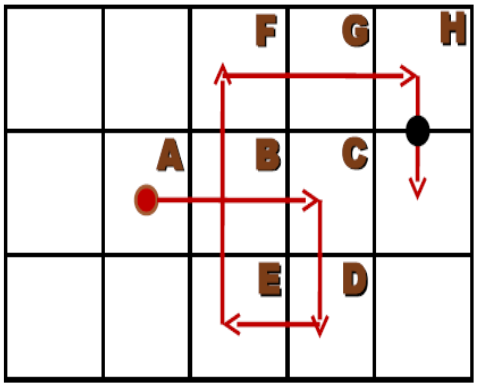


Fig. 2 RRMB Scheme

Table- 1 Comparison between Major Static LU Schemes

LU Scheme	Update Cost	Paging Cost	Major Drawback
always update	high	low	no. of updates is too high
never update	low	high	whole la needs to be paged
static interval based	constant	constant	unnecessary updates by stationary users

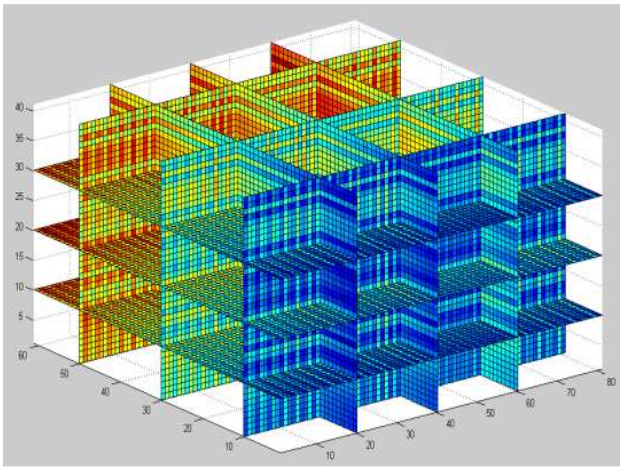


Fig. 3 Sectors of location updates

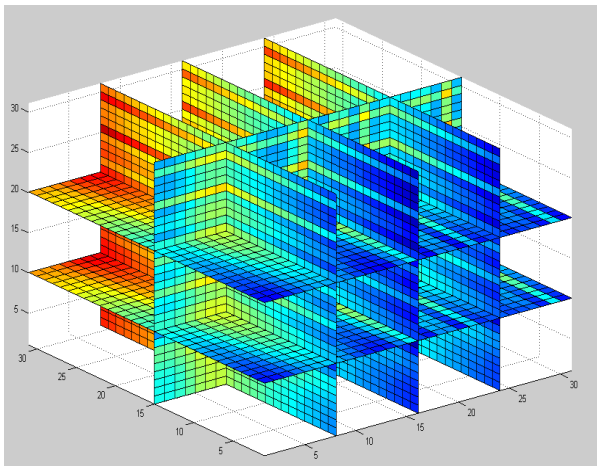


Fig. 4 Large area location sectors

CONCLUSION

A LM scheme is not preferred if it requires high computational capabilities. Dynamic LM schemes have higher signalling traffic as compared to static LM schemes. The total signalling cost of the dynamic LM schemes is greater than that of the static LM schemes. This is the reason for the wide acceptance of simple static LM schemes over high performance dynamic LM schemes.

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