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Distance Based Location Updation -"Graphical Method Using Cell Cordinates"

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Abstract. The two basic components mobile terminal and base station in the wireless network of a mobile communication system (MCS) play an important role in the Location Management. Mobile Terminals are devices used by Mobile Units (MUs) communicate with others through the MCS. Base stations are usually installed in fixed locations. Mobility management is an important issue in mobile communication systems like cordless systems, cellular systems and mobile satellite systems. There are two tasks related to Location Management based on which component initiates the LM procedures. They are Location Updating (LU), which is initiated by Mobile Terminal and Paging, which is initiated by Base Station. The existing scheme depends on cell ID assignment and network topology. The proposed scheme is using the cell co-ordinate approach is using distance based strategy because of its ability in reducing network traffic and independency of size, shape of cells and network topology. In this paper I have proved that the proposed scheme is cost effective and have better performance than the existing schemes.

Keywords – Mobile Communication System, Location Updation, Paging Mechanisms.

1. Introduction

Location management enables the network to track the user's location and their terminals between call arrivals. A distance-based LM strategy is used to adjust the size & shape of the location area for each individual mobile terminal according to the current speed and direction of movement. Location update & paging are the operations for locating a mobile terminal in networks.

In location update, the mobile terminal initiates a registration process by updating its new location. The location update is performed when the distance between its current location and the last reported location exceeds a threshold value. In a paging process the new system initiates a search process to find the mobile terminal to deliver an incoming call.

Among all the LM strategies being reviewed, the distance-based strategy fulfills most of the above requirements, except its implementation is very difficult and location prediction is not considered. In this paper, a simple approach is introduced to implement the distance-based LU strategy by using the coordinates of centers of cells in calculating the physical distance traveled for comparing with the threshold distance.

2. System Structure

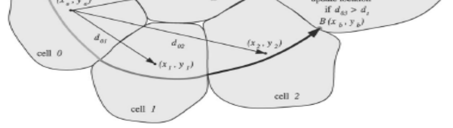

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Fig 1: Cell Coordinates System For Distance Based Location Updating

Measuring distance, d

$d = (xi\text{-}xo)^2 + (yi\text{-}yo)^2$ **(1)**

Here (xi, yi) is cell coordinates and (xo, yo) represents the last reported location of the cells. If $d > d_t$, the MT performs a location update, where d_t is the threshold distance. The threshold distance varies from location area to location area, according to the last reported location.In the distance-based LM strategies proposed in reference [1] and [5], an MT has to keep track of its direction of movement and distance moved in terms of number of cells

I define the physical location of cell i as the cell coordinates (CC),(xi, yi) for that cell. Each MT will store the CC (x0, y0) of the last reported cell 0 and the threshold distance d_t in its storage. When it enters a new cell i, it calculates the distance d_{0i} of cell i from cell 0 by the sizes of cell groups.

Here the location updating is done in two ways. They are

- Circular Location Area (CLA)
- Elliptic Location Area (ELA)

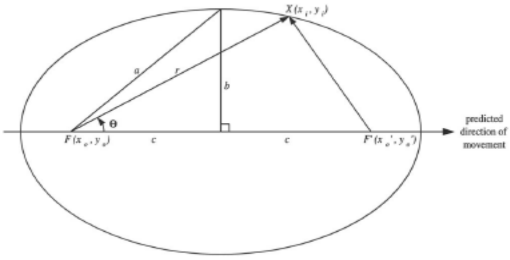

Fig. 2: Location Area With Location Prediction

3. System model

A system model has been developed to evaluate the performance of LM strategies using the cell coordinates system. This model assumes Poisson arrival of incoming calls for the MU. The parameters of the system are as follows:

λ – call arrival rate

τ – mean conversation time

C_u – unit location update cost

C_p – unit paging cost

A_c – average cell size

κ – paging rate

A – size of location area

η – mean time between location updates

m (v, Θ) – joint probability density function of speed v and Θ direction of movement.

where m (v, Θ) { ≥ 0 v≥0, -π < 0 < π

{= 0 otherwise **(2)**

3.1. Circular Location Area (CLA)

In the CLA the LA is circular in shape with

$r(\Theta) = R$ (d_t for location update) **(3)**

we have,

$\eta = R\omega$

$A = \pi R^2$

$C_t = \kappa (C_u/\lambda R\omega + C_p \pi R^2/A_c)$ **(4)**

In CLA, the CC of its last reported cell (xo, yo) and its current threshold distance d_t =R is stored. Here we took the radius, R of the circle as the threshold distance. When an MT detects a change in the CC it performs location update.

If (xi-xo)2+ (yi-y0)2>dt2 **(5)**

where (xi,yi) is the new CC detected.

The advantage of CLA is the simplicity in implementation since the MT only needs to calculate the distance from the last reported location.

3.2. Elliptic Location Area (ELA)

Since OLA is difficult to implement ELA is considered, because it gives the same performance as the OLA.

Here $r(\Theta)=b^2/a\text{-}c\cos\Theta$, where

2a=major axis

2b=minor axis

2c=distance between foci

Eccentricity (e)=b/a,

where a>=b **(6)**

For uniform distribution of g(Θ)

G = 1/2π

The ellipse becomes a circle in this case and both ELA and CLA have the same performance and have the same size and shape. To implement ELA, an MT needs to store the CC of its last reported cell, (x0,y0), the predicted location, (xi,yi), and the threshold distance, dt = 2ã. The predicted location is calculated by

$xi= x0+ 2 (a^2\text{-}b^2)^{1/2}$ Cos ø **(7)**

$yi= y0 +2 (a^2\text{-}b^2)^{1/2}$ Sin ø **(8)**

where ø is the predicted direction of movement of the MT;

i.e. the mean of g(Θ)

When the MT enters a new cell with CC being (x1,y1),it performs a location update if

((x1-x0)2+ (y1-y0)2)1/2 +

((x1-xi) 2+y1-yi) 2)1/2 > dt **(9)**

In ELA the MT has to store the CC of its last reported cell (xo, yo), the predicted location(x1, y1) and the threshold distance, dt=2R.Here the eccentricity, e is considered as the threshold distance.

3.3. Location Management

- 2 stage process
- Enables network to discover the current location of mobile user

3.3.1. Process Stages

3.3.1.1. Location Registration

3.3.1.2. Registration Process

- The MT enters a new LA and transmits a location update message to the new BS.
- The BS forwards the location update message to the MSC which launches a registration query to its associated VLR.
- The VLR updates its record on the location of the MT. If the new LA belongs to a different VLR, the new VLR determines the address of the HLR of the MT from its mobile identification number (MIN). This is achieved by a table lookup procedure called global title translation. The new VLR then sends a location registration message to the HLR. Otherwise, location registration is complete.

- The HLR performs the required procedures to authenticate the MT and records the ID of the new serving VLR of the MT. The HLR then sends a registration acknowledgment message to the new VLR.
- The HLR sends a registration cancellation message to the old VLR.
- The old VLR removes the record of the MT and returns a cancellation acknowledgment message to the HLR.

3.3.2.Call Delivery

3.3.2.1.Steps In Call Delivery

- The calling MT sends a call initiation signal to the serving MSC of the MT through a nearby BS.
- The MSC determines the address of the HLR of the called MT by global title translation and sends a location request message to the HLR.
- The HLR determines the serving VLR of the called MT and sends a route request message to the VLR. This VLR then forward the message to the MSC serving the MT.
- The MSC allocates a temporary identifier called temporary local directory number (TLDN) to the MT and sends a reply to the HLR together with the TLDN.
- The HLR forward this information to the MSC of the calling MT.
- The calling MSC requests a call set up to the called MSC through the SS7 network.

4. Performance
ANALYSIS

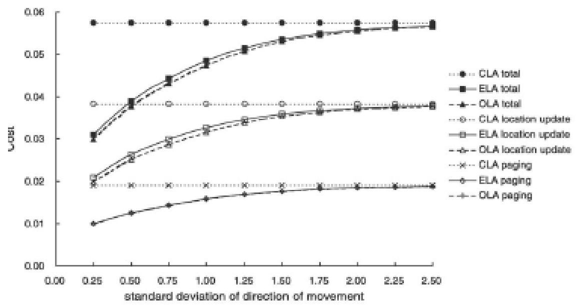

Fig 3: Performance Analysis Graph

The performance of ELA is much better than CLA when σ_{Θ} is small (about 50% of improvement for σ_{Θ} = 0.25).The performance of ELA has only a few percents of degradation.

The above fig. is calculated using the following values.

$\lambda = 0.0005s^{-1}$ (one call per 30 minutes),

$\tau = 120s$, $C_u = 5$ cost units, $C_p = 1$ cost unit, $Ac = 90000m^2$, $\mu_v=10\ ms^{-1}$,

and $\sigma_v=3ms^{-1}$ **(10)**

5. Paging Schemes

Paging Schemes can be defined by specifying the shape, location and size of each PA within a LA.In order to efficiently minimize the paging cost at the expense of additional paging delay, the probability of locating the MT in the first paging attempt should be high while keeping the size of the first PA to minimal.

In specifying the shapes and locations of PAs, we have two different techniques for dividing an LA into PAs.They are the expanding distance search based on last reported location (L-search) and the expanding direction search (D-search). In L-search, the boundaries of PAs are of the same shape as the LA but with different sizes.

The advantage of using this approach over the existing one is independent of the size, shape and distribution of cells and the distance threshold. In addition to these the performance improvement is done by predicting the current locations of mobile users according to their speeds and directions of movements.

6. Vi Acknowledgement

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7. Conclusion

I defined a system model for evaluating the performance of location management strategies using cell coordinates approach. The ELA-D paging methods have the lowest location management cost for mobile users moving in more predictable directions and more random directions, respectively. The paging methods for the Elliptic Location Area have a better performance than other previously proposed schemes like the shortest distance based location updating.

Index Terms used in this paper:-

MCS- Mobile Communication System

BS – Base Station

ELA – Elliptical Location Area

CLA – Circular Location Area

MT – Mobile Terminal

LA – Location Area

PA – Paging Area

LM – Location Management

MU – Mobile Unit

BT – Base Terminal

LU – Location Update

CC – Cell Co-ordinates

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