Location Management Techniques to Improve QoS in Mobile Networks Using Intelligent Agent

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Abstract— Location Management (LM) is one of the major issues of mobile networks that should be taken into account for providing Quality of Service (QoS) and to meet the subscribers demand (satisfaction). Location management techniques are divided into three types (i) Updation Techniques (UT) and (ii) Paging Techniques (PT) (iii) Delivery. The LM is used for tracking where the subscribers are locate, and based on that permitting calls, Short Message Service (SMS) and other mobile phone services are delivered to them with the assistance of Intelligent Agent (IA). The Redundant Update Remove Algorithm (RURA) which is used for reducing the updation between BSC and MSC. Enhanced Temporal Updation (ETU) reduces the location updates between MS and MSC. The Performances of updation techniques are analyzed. Intelligent Agent (IA) improves QoS in Mobile Networks.

Keywords-component; Location Management;Paging; Updation;Spatial Updation; Intelligent Agent; Enhanced Temporal Updation; RUR Algorithm

I. INTRODUCTION

Location Management (LM) is one of the major functions of a GSM or other Network. The aims of LM are to track where the subscribers are so that calls can be sent to them, and to record the subscriber services.

Mobile networks to provide quality of service (QoS) is challenging for the service providers. By introducing Intelligent Agent in LM, it is possible to improve the QoS. The Location Management (LM) and Handoff Management (HM) are the types of Mobility Management. There are three types LM techniques used in mobile networks as shown in Figure 1. In Location Management, the ability to manage information about the current location of mobile nodes based on their last update is a significant issue. That enables the network to discover the current attachment point of the mobile user for call delivery. Location Management is further divided into (i) Paging (ii) Call delivery and (iii) Location updation.

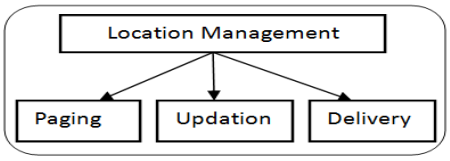

Figure 1.Types of location management techniques

An important issue in the design of mobile networks is how to manage the locations of mobile nodes and giving continuous connections to the subscribers wherever they go. The Mobile networks encompass the mobility management to provide ubiquitous and continuous communication to the subscribers, billing for the usage and further use.

II. LOCATION MANAGEMENT

The Location Management maintains the location of the mobile stations to provide services. A micro cell [12] maximum coverage area is called location of a mobile station. A group of locations is called a location area. The LM is divided into three functions, updation follows paging and call delivery. The updating function makes the mobile station to update its place to the corresponding BSC. Paging operation is performed by the BSC to track all the locations of the mobile stations (MS) at a time and periodically. Whenever the paging cost increases the cost of update is reduced considerably.

A. Analysis of Location Area

A GSM (Global System for Mobile Communication) network is a radio network of individual cells, called as base stations. Each base station covers a small geographical area which is division of a uniquely

identified location area. By integrating the coverage of each of these base stations, a cellular network provides radio coverage over a much wider area. A group of base stations is named a location area.

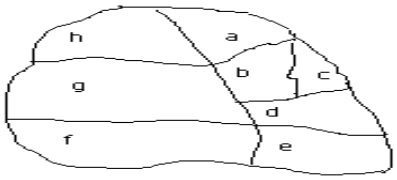

Figure 2a. Geographical location area

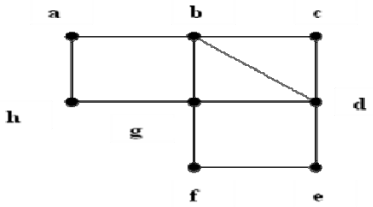

Figure 2b.Geometrical location area

Figure 2a shows the geographical representation of location area and its divisions and the geometrical representation of location area is shown in Figure 2b.

A. Paging

Paging is one of the fundamental mobility management procedures of a GSM network and also other cellular networks. MSC will request the BSC to scan all the active nodes under its coverage [1]. The BSC will send all the data to MSC after scanning all the nodes.

The Visitor Location Register (VLR) which normally knows the current location of the subscriber to the level of a location area. The VLR also knows which BSC controls cells in that location area. The VLR sends a paging request message to each of the relevant BSC. The BSC then send a paging request to every single cell within the location area. This paging request is broadcast on the cell broadcast channel to which the mobile is listening.

B. Call Delivery

When a mobile station tries to communicate with other mobile station, the call reaches MSC first through BSC, after that only the connection will be established to concern mobile station through BSC. Whenever the call comes from same or other network, the connection is established based on the Temporary Mobile Subscriber Identity (TMSI). TMSI is the identity most commonly sent between the mobile station and the network. An important use of the TMSI is in paging of the mobile.

C. Updation

The Location update procedure allows a mobile station to inform its active state to MSC through BSC. The updation is divided into three updates such as (i) Spatial updation (ii) Temporal updation and (iii) Enhanced Temporal Updation. This updation will be stored into the MSC through BSC. This updation process will take place periodically. The mobile station sends a message (location update request) to the network about its current location.

1) Spatial Updation

The Spatial updation allows a Mobile Station (MS) to inform to the cellular network whenever it moves from one location area to the next. The mobile stations should send updation to base station for receiving calls if any comes. When the mobile station does not send the updation it might be considered as a not reachable mobile or switched off mobile.

2) Temporal Updation

The Temporal updation is performed based on the periodic time. The setting interval time will be controlled by MSC. In the existing system the MS will inform the location of its exact place periodically. The location of the mobile node will be carried out to MSC through BSC.

Figure 3 gives the detailed operation of the existing update of the temporal updation. In this Figure 3, MS sends LU (Location Update) signal to BSC, the BSC forwards signal to MSC for updation. At the same time BSC sends Acknowledgement (ACK) to MS. After receiving signal from BSC, the MSC sends Location Acknowledgement (LA) to BSC. At last the BSC forwards the LA signal to MS. T_{LU} is time taken for single updation between MS and MSC. The operations are performed regularly by the mobile network. In this method, the update function takes place whenever the MS sends update signal. Even though the update signal is same location cell, the BSC forwards the update signal to MSC when it uses temporal updation. To solve this issue, the RURA (Redundant Update Remove Algorithm) is used. This algorithm removes the unnecessary updation between BSC and MSC.

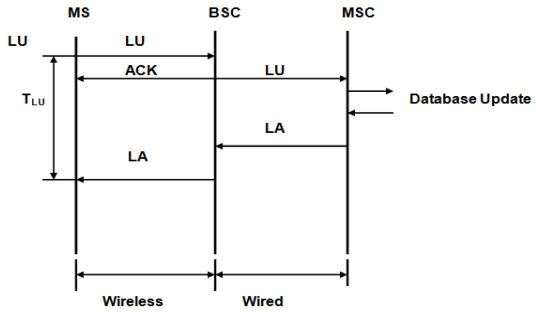

Figure 3. Existing System - Location Update

a) RURA (Redundant Update Remove Algorithm)

RURA removes the redundant update when the mobile station updates the same location. Figure 4 describes the functions of the mobile network using RURA. The BSC encompasses the RURA which never allow the same update to MSC. The Location Updation (LU) signal from MS and BSC, ACK signal from MSC and BSC are shown in figure 4.

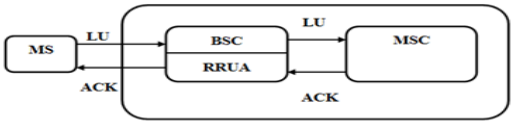

Figure 4. Functions of Updating Location using RURA

Whenever the location update takes place, the BSC will check the location symbol with existing buffer value, suppose the transmitted symbol not equal to existing symbol, it will update into the MSC otherwise it will not inform to the MSC.

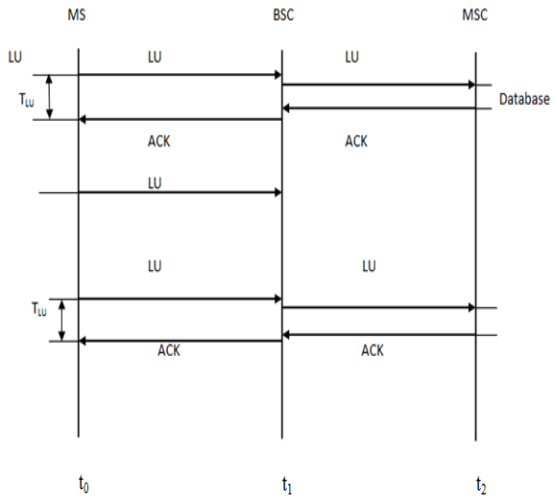

Figure 5. Location Update using RURA

In figure 5 t_0 – Starting time for updation in MS, t_1 – Time taken to reach BSC, t_2 – Time taken to reach MSC, $T_t = t_0 + t_1 + t_2$, T_t - Total time for reaching MSC, T_{LU} - Time taken for location updation with ACK, The update signal is sent to BSC from MS in t_1 time. The update signal is sent from BSC to MSC in t_2 time. When the redundant signal comes from the MS, the BSC will not respond to MSC and MS. But it will update its buffer with time stamp.

The table II shows the movement records [6] of a single mobile station, for three hours using the temporal updation. The updation takes place every 10 minutes once. It updated 21 times for three hours. The table 2 shows the movement records of a single mobile station using RURA; it needs only six updates for three hours. The updation takes place every 10 minutes once. Whenever use RURA, the updation cost is reduced only between BSC and MSC. Now, between BSC and MSC traffic is reduced due to this RUR Algorithm. But the aim is to reduce updation cost between MS and MSC. So that only IAUP Protocol is used to predict the updation of the MS. After the prediction of the updation it is informed to MSC by the IA.

TABLE I UPDATING RECORDS USING TEMPORAL UPDATION

Time Minutes-AM	Micro Cells																			
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
7.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.20	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.30	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.40	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.50	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.10	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.20	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.30	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.40	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.50	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE II UPDATING RECORDS USING RURA

Time Minutes-AM	Micro Cells																			
	a	b	c	d	e	f	g	h	t	j	k	l	m	n	o	p	q	r	s	t
7.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.20	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.30	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.10	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.30	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.40	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

```
/* RURA Algorithm*/
/* set timer=600 seconds*/
label1:
if(timer = =600)
if(MS-signal != BSC-buffer)
{
MSC-update=MS-signal;
database=MSC-update;
go to label1;
}
else
BSC-buffer= MS-signal;
go to Label1:
```

Figure 6. RURA Algorithms

Figure 6. explains the RURA algorithm. The MS signal is checked with existing BSC buffer, whether equal to or not. If the MSC signal is not equal to BSC buffer value, the MS signal will be stored into the BSC buffer as well as the MS signal will be forwarded to the MSC.

III. ENHANCED TEMPORAL UPDATION

The Enhanced Temporal Updation (ETU) is a temporal updation technique which is performed based on (i) RURA and (ii) IA (Intelligent Agent). The RURA removes the redundant location updates. The MSC encompasses IA which has an IAUPP (Intelligent Agent Update Prediction Protocol). This protocol predicts the updation of the MS. When the MS updation has to take place, when the MS updation has to not take place and how long the updates are needed? And how long no need? For these questions are answerable based on the movement history [3] of MS. The IA analyses the each MS movement history using data mining [[6],[2],[11]]

process. IA advises the MSC when MSC has to send update-lock-temp signal to MS. The MSC temporarily stops the MS updates using update-lock-temp signal. This signal will be sent from MSC to MS through BSC based on IA advice. This update-lock-temp signal will be released automatically after ending the fixed time. Whenever the update-lock-temp signal released, the MS will inform to MSC. This information also will be analyzed by IA for future use. Enhanced Temporal Updation=IA+RURA.

A. An Implementation and Results

The Table III shows the comparison of different updation techniques. Here the updation of packets compared with each technique. The ETU technique reduces the updation of packets than other techniques.

TABLE III COMPARISON OF DIFFERENT UPDATION TECHNIQUES

No. of MN	Updates		
	Spatial Update (packets)	Temporal Update (packets)	Enhanced TU (packets)
20	1204	2108	998
40	2180	3120	1804
60	3210	4056	2909
80	4213	5108	3906
100	5107	6101	4806
120	6205	7284	5908
140	7106	8103	6806

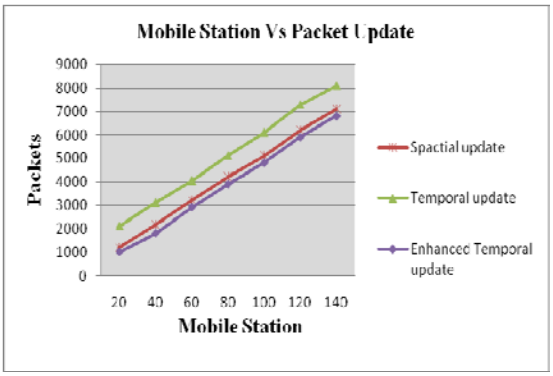

Figure 7. Mobile Station Vs Packet Update

Figure 7 shows the Comparison of Different Updation Techniques, the graph plotted for Mobile Station Vs Packet Update, The Enhanced Temporal technique reduced the updates more than other techniques.

Table IV shows the Comparison of Different Updation technique delay. The Enhanced temporal technique makes very less delay than other techniques.

TABLE IV COMPARISON OF DELAY IN DIFFERENT TECHNIQUES

No. of MN	Delay(millisecond)		
	Spatial Updation	Temporal Updation	ET Updation
20	0.45	1.54	0.36
40	0.48	1.59	0.38
60	0.59	1.64	0.42
80	0.63	1.69	0.46
100	0.69	1.73	0.42

Figure 8 a graph plotted for Mobile Station Vs Delay, The Enhanced temporal technique makes very less delay than other techniques.

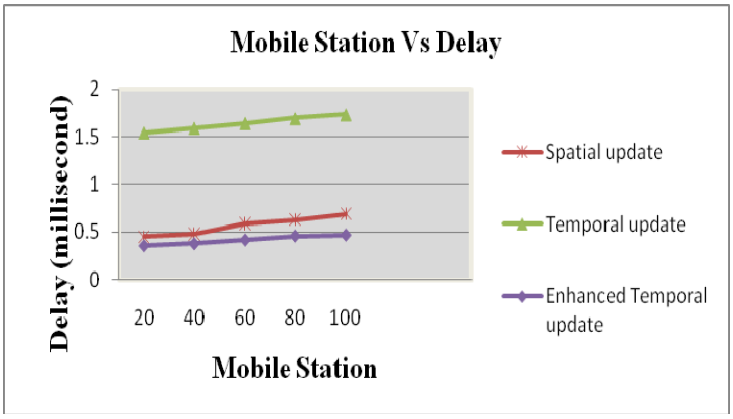

Figure 8. Mobile Station Vs Delay

IV. CONCLUSION

The Location management techniques discussed to provide QoS in mobile networks. In this work, RUR Algorithm, Intelligent Agent and ETU are used. In coming years, Intelligent Agent will play major role in decision making in mobile computing. The Intelligent Agent decision making protocols will be adapted with existing protocols without making any difficulties. Of course, numerous protocols may be created to improve QoS but the requirement of the subscribers necessity may be varying based on the technological advancement.

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REFERENCES

[1] Abhishek Roy, Archan Misra and Sajal K. Das (2007), "Location Update versus Paging Trade-Off in Cellular Networks: An Approach Based on Vector Quantization", Vol 6, pp. 1426 – 1440.
[2] Abraham Silberschatz, Henry F.Korth and S.Sudarshan(2006), MC Graw Hill Highe Education publication, "Database System Concepts" pp. 723-753.
[3] I.F. Akyildiz et al. (2007), "Mobility Management for Next Generation Wireless Systems" Proc. IEEE, Vol. 87, No. 8, pp. 1347-1384.
[4] Ian F.Akyildiz and Wenye Wang (2002), "A Dynamic Location Management Scheme for Next Generation Multitier PCS Systems", IEEE Transactions on Wireless communications, Vol. 1, No. 1.
[5] Jiawei Han and Micheline Kamber (2001), "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers (An imprint of Elsevier).
[6] Jin Soung Yoo, Shashi Shekhar. (2009), "Similarity-Profiled Temporal Association Mining" IEEE Transactions on Knowledge and Data Engineering.
[7] Jochen H.Schiller(2006), "Mobile Communications" Pearson Education, Ltd.
[8] Ning Zhang and Jack M.Holtzman (1996), "Analysis of Handoff algorithms using absolute and Relative measurements" IEEE transactions on Vehicular Technology, Vol. 45, No. 1.
[9] Patricia Serrano-Alvarado, Claudia Roncancio, Michel Adiba, (2004), "A Survey of Mobile Transactions", Source Distributed and Parallel Databases archive Vol. 16 , Issue 2 .
[10] Shiow-yang Wu and Hsiu-Hao Fan (2010), "Activity-Based Proactive Data Management in Mobile Environments" IEEE Transactions on Mobile Computing, Vol. 9, No. 3.
[11] The Ns Manual http://www.isi.edu/nsnam/ns/nsdocumentation.Html
[12] Theodore S. Rappaport (2007), "Wireless Communications Principles and Practice" Prentice-Hall of India Private Ltd. New Delhi.

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