A NEW PAGING METHOD BASED ON SERVICE CHARACTERISTICS OF DATA AND VOICE IN PCS

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Abstract – As the demand of data service increases, the data is becoming a large part of traffic in cellular system. Efficient location management for mobile stations is needed to support this demand. We propose a new paging method based on data and voice service characteristics. The new proposed paging uses a simultaneous paging for voice and a more advanced intelligent paging for data service. According to simulation results, by using low mobility and service characteristic of data mobile users in city area, the total call connection delay of voice and data could be reduced.

I. INTRODUCTION

Due to the abrupt increase of user demand and the limited radio resources, efficient location management techniques are required in future Personal Communication Systems (PCS). The key elements of location management are paging and location registration updating.

In second generation mobile communication system, finding location was important issue. [1] A whole geographical area is divided into location area (LA) to track the movement of the user to roam him when connection is required. When the user enters a new location area, a location update transaction is performed to inform the network of his new location. Several location updating methods can be implemented based on LA structure such as Periodic Location Updating, and Location Updating on LA crossing. User's location information is stored in network database. When MS crosses the boundary of LA, location information is updated. When a call arrives, the location database transaction is triggered so as to retrieve the user "location information" and update transaction is triggered. Then, LA is simultaneously paged to find the target MS. Here, LA equals to Paging Area(PA). In third generation mobile telecommunicaiton systems, an LA is defined as an area to locate a user as well as an area to page him. LA size is optimized by using two kind of methods, such as locating and paging. Based on this observation , several proposals have defined location management procedures which make use of LAs and paging areas(PAs) with different sizes[2]. An MS registers only once, when it enters into the LAs. It does not register in the case of moving between the different PAs of the same LA. For an incoming call, paging messages are broadcasted in the PAs according to a sequence determined by different strategies. In such environments, the trade-off between the location updating and paging related signaling load mainly generates optimization problem during LA planing.

Nowadays, to support muliti media service in a cellular system is main issue. The cellular networks that support both voice and data communications are being deployed based on the IS-136, IS-95, and GSM standards. A first attempt to service data was Short Message Service(SMS). SMS in wireless systems handles limited-size data messages of 48 bytes character text to and from mobile station(MS). The SMS includes messages, notification of E-mail, and FAX message. Then, SMS is provided using control channels.

In next generation mobile system to support internet service, much more data transfer is expected. Therefore, for incoming call of data, LA is paged to find the target MS from a location management point of view like voice service. 3GPP2 has defined different area concept, Location Area(LA) and Routing Area(RA) to support multimedia service[3].

II. PREVIOUS RESEARCHES

Simultaneous paging in which all location areas are paged, is a typical way to find target MS quickly, when a system demands a little amount of paging traffic[4][5][6]. However, as the amount of paging traffic increases, the load of the wireless paging resource becomes much larger and the paging delay induces a long call connection delay. Sequential paging can solve this problem. Many researches have been done about sequential paging. G. P. Pillini proposed history-based locating[7], R. Jain proposed time and distance-based location updating [8], S. Mishra and O.K Tonguz proposed the speed-based intelligent paging[9], D. Goodman, P. Krishnan, and B. Sugla proposed the method based on the history of updating information that MS was detected by the network[10]. These sequential paging methods have a drawback. It makes call connection delay increase due to the number of PA in low paging traffic condition.

Most previous works about paging have focused on how to reduce call connection delay and traffic load without regard to service types in the uniform traffic distributed system. A sequential priority paging scheme using traffic characteristics is proposed in ref[11].

III. NEW PAGING METHOD

Actually, each service has different characteristics and requirements. Voice service requires real-time delivery while data does not require real-time delivery. The call connection time is dependent on how fast to find target mobile station. Up to now, the service characteristics of voice and data are considered in handoff and call admission control. However, these characteristics are not utilized in paging methodologies.

Generally, SMS provides data service capacity, but it can not support the great demand of future data service. Therefore, to support efficient data service in present network, we proposed a new paging scheme based on service characteristics of data and voice.

The new proposed paging uses a simultaneous paging for voice and a more advanced intelligent paging for data service.

In actual Cellular system, mobile users are not uniformly distributed. The distribution is dependent on time and area. In the large city, time zone generally exists. For example, there are rush hours, busy hours, and so on. Geographically, city area is separated into city center ,urban area, suburban area, and rural area. Most of working people stay together in office building or factory of city area at busy hours and day time, and they are in suburban at night and in the early morning. According to ref[12], 60% of mobile users are working people and most of them have low mobility. Working users utilize data service to get much information and to cowork. If data users have high mobility, then they do not expect to get high quality of data service.

Based on a result of previous work, simultaneous paging is good choice to find the target MS for voice service which requires real-time connections, while sequential paging is good one for data service which does not require real-time connection. Moreover, the higher paging success rate is, the higher possibility finding target MS for data service by using working user information is. Here, to deliver real time connection for voice traffic, request of voice call connection has higher priority than that of data call connection. Figure 1 shows the simulation procedure of proposed paging scheme. When a paging is requested, it is checked whether data user is paged or voice user is paged. For voice service, then all PA are paged, that is, LA is simultaneously paged. However, for data service user, one PA is chosen and paged according to history information. The history contains success rate of each

PA. According to success rate, PA is sequentially paged until the target MS is found. If PA finds target, then the PA updates the success rate history. If not, the request is dropped.

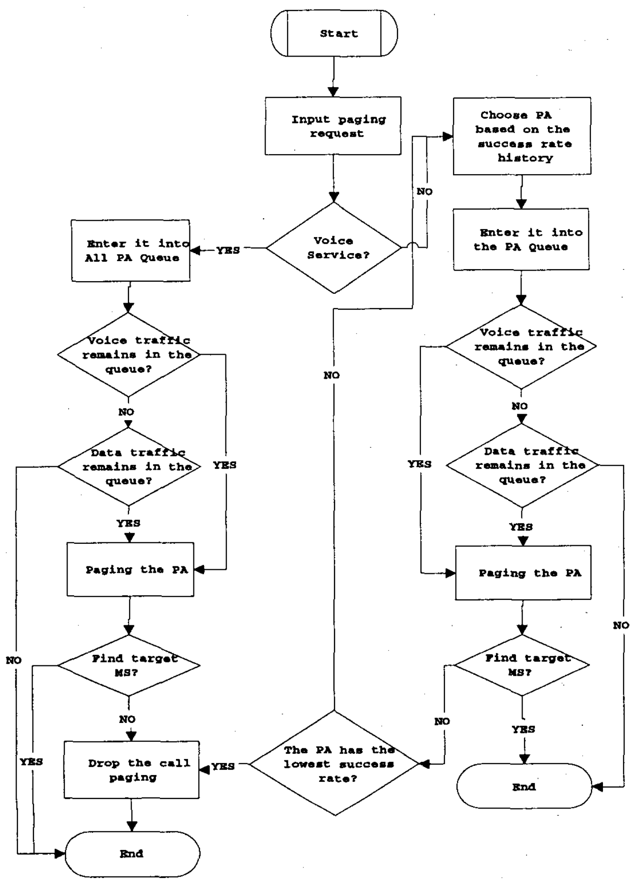

Figure 1: Paging flow chart for proposed paging scheme

IV. SIMULATION AND RESULTS

We compare two schemes. One is a typical simultaneous paging for voice and data service. The other is a new proposed paging scheme where we use simultaneous paging for voice service and proposed intelligent paging for data. The simulation in this paper represents a typical city centre modeled as a Menhatan grid(i.e,. buildings are squares and streets form a regular grid). Figure 2 shows simulation circumstance. One LA is consisted of several PAs and cells.

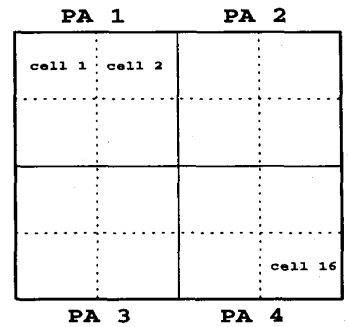

Figure 2: Cells and paging area within location area

To achieve a realistic population distribution, various types of environments have been defined. Each type is characterized by the percentage of total area it covers and the corresponding population density. In this paper, we assume three kinds of areas such as Business area, Domestic area, and Others. Table 1 summarizes the percentage of three area.[13]

Table 1: Simulation Environment

Enviroment	Coverage Percentage
Business area	70%
Domestic area	25%
Others	5%

The call arrival rates of services are assumed to be Poisson distribution. We use the simulation parameters of call arrival rate as shown in Table 2. [13]

Table 2: Call Arrival Rate of Voice and Data Services

Service Type	Call Arrival Rate(Calls/User/Hr)
Voice	3.0
Data	2.78

We assume that the number of voice user is slightly larger than that of data users. The simulation parameters of users are shown in Table 3. In this simulation, the number of voice mobile users in LA is 250, and that of data mobile users is 107.

Table 3: Distribution of Mobile user

Service Type	Percentage of Mobile Users(%)
Voice	70%
Data	30%

In proposed paging scheme, paging for data service follows the sequences based on the history of data success rates of each paging area.

The call connection delay of voice and data services is plotted in Figure 3 and 4 for the two cases of paging scheme, i.e,. simultaneous paging scheme and proposed paging scheme. As the call connection traffic is increased, the call connection delay of voice and data is increased. When the paging traffic load is light, the delay of two schemes is almost the same. However, the larger traffic request, the bigger difference. In Figure 3, the difference of voice connection delay is not large because voice traffic has higher priority than data traffic. In view of real-time service, this result is reasonable. For data service, Figure 4 shows that the delay exponentially increases as traffic density increases. On the whole, we find that the intelligent paging scheme has less call connection delay than typical paging not considering service type. And, the delay of voice is much lower than data service, that is, voice service is paged in real-time.

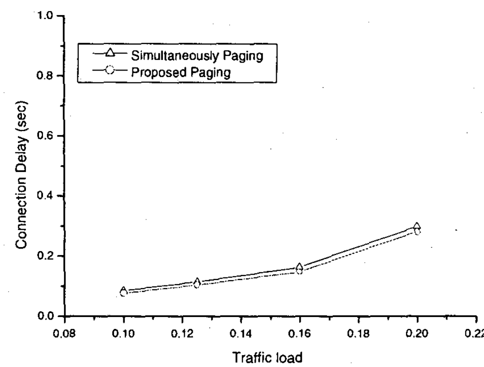

Figure 3: Delay of voice user vs. traffic load

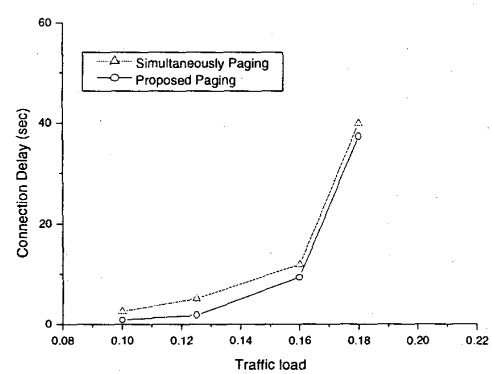

Figure 4: Delay of data user vs. traffic load

V. CONCLUSIONS

Various paging strategies have been suggested to reduce delay and cost of location update and paging. In this paper, we propose a new paging scheme to provide more efficient paging in the consideration of service types. We use the characteristic of non-real time service and real time service, pattern information of mobile users, and data paging success rate. Using low mobility and service characteristic of data mobile users in city area, the total call connection delay of voice and data could be reduced. Furthermore, we will study the performance of proposed scheme when the number of PA is varied and the number of data uses is increased.

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