정보학연구 제5권 제4호 2002년 12월(pp.165-171)
The Journal of Information Technology, Vol.5, No.4

차세대 멀티미디어 이동통신 망에서의 이동성 제어 방법

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요 약

본 논문에서는 이동통신망에서 동적 위치등록 관리 방안을 제시한다. 동적 위치등록 방안을 제어하기 위해서 VLR내에 가입자마다 동적인 원형 위치등록 방법을 이용한다. 가입자가 새로운 위치영역으로 이동시 시스템은 현재의 원형 위치정보에 포함되어 있는지를 판단하고 이전 VLR과 새로운 VLR에 가입자의 위치정보를 갱신하게 된다. 아울러 가입자의 위치정보를 동적으로 관리하기 위해 발신호 설정시 현재의 가입자의 위치를 통보한다. 제안된 방법을 이용하여 이전의 방법 보다 HLR에서의 위치등록 트래픽을 줄일 수 있음을 보여준다.

I. Introduction

The Interim Standard-41 (IS-41) and Global System for Mobile Communication (GSM) ([1], [3]) based mobility management scheme which records all the movements of terminals in a centralized DB, home location register (HLR), is questionable considering that keeping track of lots of users in real time is not a simple task. This scheme has been the bottleneck problem on HLR which occurred in due lots of signal transfer between one HLR and many VLRs and Ping-Pong effect which arise frequently in the boundary of registration area (RA) because of the terminals Zig-Zag movement. Accessing the DB, and frequent transmitting the signaling message cause the HLR bottleneck and burden the WC with a heavy load [2]. In this paper, we propose DCLR scheme to reduce location traffic in WC. This scheme can be expressed shortly like this. All VLRs have the IDs of VLRs inside its pre-given circle (k-circle) . When a terminal is turned on, the VLR where the terminal is located becomes the DCLR and the latest location of terminal is sent to DCLR while terminal change its registration area (RA) in k-circle area.

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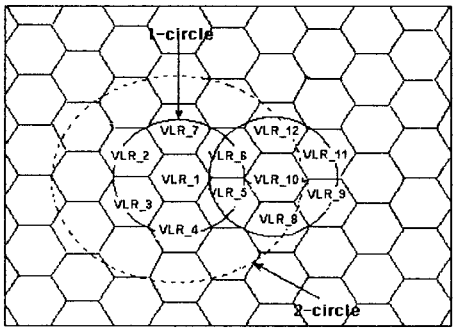
II. Proposed Scheme

2.1 DCLR scheme

This state is maintained as long as the terminal is located in the current k-circle area.

When the terminal moves to new VLR

from the current DCLRs k-circle, the new VLR becomes the DCLR of the terminal. By this manner, the k-circle of the terminal can be changed dynamically. This mechanism can be performed easily by comparing VLR_ids which current DCLR has with the VLR_ids where terminal moved. For example Fig. 2.1, suppose the 1-circle which consists of seven VLRs and it has VLR id-1, 2, 3, 4, 5, 6, 7 where current DCLR is VLR_1 and others are VLRs which are included in 1-circle area. And let assume that the terminal is located in VLR_5 now. If the terminal moves to the new RA, VLR_6, DCLR isnt changed. So, VLR_6 sends the terminals new location information to VLR_1, current DCLR. If terminal moves to VLR_10, the current DCLR of VLR_1, has no ID of VLR_10. Thus the DCLR is changed. VLR_10 belongs to the new DCLR of terminal.



(Fig.2.1) Example of DCLR Concept

2.2 Location registration algorithm

```
DCLR LEGNOT ( )
{
  Terminals current DCLR id, VLR_xxx,
        received from old VLR
  Compare VLR_xxx with MY_DCLR_entry;
  If VLR_xxx exist in MY_DCLR_entry;
  then SEND terminal_CURR_LOC to DCLR;
  else {WRITE TID to MY_DCLR_AREA;
    //become a new DCLR of the terminal
    SEND terminal_CURR_LOC to HLR;
    SEND REGCANC to VLR_xxx;
    //REGCANC is registration cancel
        message
    }
}
```

III. Performance Evaluation

3.1 Call Cost for Performance

Cost sets for performance analysis are defined using the following formulas. To performance analysis, we define using signaling costs, h_i as follows.

h_1 = Message transmission cost from one VLR to another VLR through

HLR = $2(A_I + L + D + R + V_Q) + A_r + H_Q$

h_2 = Message transmission cost from one VLR to another VLR through

RSTP = $2(A_I + R + D + R + V_Q) + R$

h_3 = Message transmission cost from one VLR to another VLR through

LSTP = $2(A_I + V_Q) + L$

A_i = T_x / R_x message transmission cost

between SSP and LSTP on A-link.

D = T_x / R_x message transmission cost on . D-link.

A_r = T_x / R_x message transmission cost between RSTP and SCP on A-link.

L = Message routing and its handling cost by LSTP.

R = Message routing and its handling cost by RSTP.

H_Q = HLR access cost.

V_Q = VLR access cost.

We evaluate the performance according to the relative values of h1, h2, and h3 in the table 1 which are needed for location registration and location tracking. Intuitively, we can assume $h_3 \leq h_2 < h1$. Even though it is difficult to determine the exact values.

3.2 Cost for location registration (CReg)

We analyze the proposed scheme compared with the IS-41 scheme in location registration and call tracking. Whenever a terminal moves into a new RA, it is registered at the HLR. The registration cost computed as follows.

$C_{IS-41,Loc.Reg} = 2h_1$

<Table 1> Cost parameter set

Set	h_3	h_2	h_1
1	1	1	1
2	1	2	3
3	1	2	4
4	1	3	5
5	1	3	6
6	1	4	7
7	1	4	8

3.2.1 The proposed scheme

Registration cost is the sum of the costs where a terminal moves inside 1-circle area and changes its DCLR.

- Cost for terminal movement inside 1-circle area :

The cost for terminals which moving inside 1-circle area is a half of six VLRs which are located on ring_1 and one VLR on ring_0. All messages between VLRs are transferred through LSTP of RSTP. This takes place three cases.

$$C_{Lo.\,Reg} = \frac{(\frac{6}{2}+1)}{7} \times 4h_3 = \frac{16}{7} \times h_3$$

$$C_{Md.\,Reg} = \frac{(\frac{6}{2}+1)}{7} \times 2(h_2 + h_3) = \frac{8}{7} \times (h_2 + h_3)$$

$$C_{Re.\,Reg} = \frac{(\frac{6}{2}+1)}{7} \times 4h_2 = \frac{16}{7} \times h_2$$

- Cost for terminal movement where the terminal changes its DCLR :

The cost for terminals which move outside 1-circle area is half of six VLRs which are located on ring_1 and messages are transferred via LSTP

6

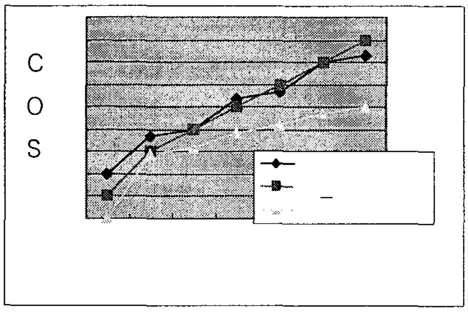
$$C_{Lo.\,Re\,g.noCg} = \frac{2}{7} \times 2(h_1 + h_3) = \frac{6}{7} \times (h_1 + h_3)$$

6

$$C_{Re\,.\,Re\,g.noCg} = \frac{2}{7} \times 2(h_1 + h_2) = \frac{6}{7} \times (h_1 + h_2)$$

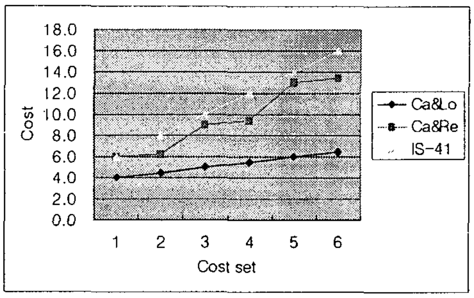
or RSTP. This takes place two cases.

Total cost is the average of these cases, which are worst case and best case.



(Fig.3.1) Location registration cost

In Fig.3.1, we can see that proposed method has lower cost than IS-41 scheme, even though it is a worst case of DCLR method provides mostly same cost as IS-41. The worst case takes places when ratios of six cases are same. In other word, it occurs when LSTP connected with very few RAs (less then three VLR/MSC). But we know that an LSTPs coverage is more than that of three RAs generally. The worst case of DCLR seldom occurs in actual networks. We know that next generation wireless system will adopt smaller RA. It means that a LSTP will cover more wide registration area. This DCLR scheme is more improved performance than IS-41 scheme.



(Fig.3.2) Call tracking cost

As illustrated Fig.3.2, we can see that the call tracking cost can be reduced very much if callee terminal is located in the local position. If the terminal is located in the remote position, the cost is similar in case that h_2 is almost same as h_1.

3.3 DCLR Traffic

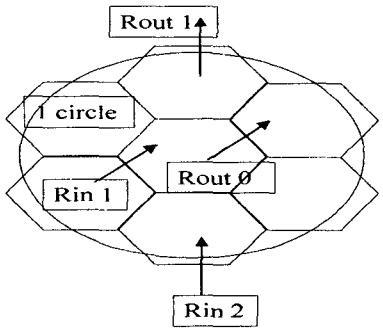
Suppose DCLRk which use k-circle. When we adopt DCLR1 (See Fig.3.3), All input signaling traffic to VLRs inside 1-circle (50% of traffic) are only 2 Cases. One is the traffic caused by VLRs which have the DCLR on the 1-circle line, (Rin1). The other is the traffic caused by the VLRs which have DCLR outside 1-circle, (Rin2). All output signaling traffic to VLRs (50% of traffics) are two cases too. One is the traffic caused by the VLR which is the DCLR of the center VLR, Rout0. The other is the traffic caused by VLRs on 1-circle line (Rout1). Here, Rin1 and rout0 do not cause the HLR Only Rin2 and rout1 cause the location update traffics to HLR. This is shown in Fig. 3.3.

If input rate and output rate of terminal are

same in the cell, signaling Traffic ti HLR will decreases. Table 2 shows the analytic results of DCLR Scheme in comparison with IS-41 standard scheme.

3.4 Traffic Rate According to K-circle Size

Fig. 3.4 illustrates the results of HLR update (HLR_u), HLR Query (HLR_q), and total HLR access traffic per VLR of DCLR compared with total HLR access traffic in IS-41.

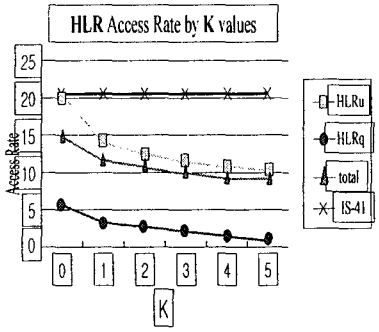


(Fig 3.3) DCLR1 structure

<Table 2> Analysis of DCLR traffic

	HLR Upd.	VLR Upd.	HLR Que.	VLR Que.
Reg.	20.5	81.9	20.5	41
Reg. Canc.		41		
Call Gen.				60.9
Call Setup			60.9	60.9
Total	20.5	122.9	81.4	162.8

We see that increase of k-value shows decrease of the traffic between VLR and HLR. In $DCLR_K$, the number of VLRs which locate on the k-circle line are 6k and number of VLRs which are included in the k-circle except VLRs which locate on the k-circle are $3(k^2 - k) + 1$. So total VLRs in the k-circle are $3(k^2 - k) + 1$.



(Fig.3.4) Comparison of HLR Access Rate

IV. Conclusions

In this paper, we proposed DCLR scheme, which is effective for smaller cell and more frequent terminal moving pattern. As we mentioned before, each VLR has a given fixed circle registration area around itself and has ids of other VLRs which belong to the circle in proposed method. VLR only computes whether the terminal is located in the current DCLR area or not by comparing the old VLR id with its ids. Then it sends a recent location information of the terminal to the old or new DCLR according to computing results. The proposed scheme solved the HLR bottleneck problem and terminals Ping-Pong effect efficiently with little overhead and

reduced location traffic compared with the IS-41scheme.

References

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Mobility Control in the Next Generation Multimedia Wireless Communication Network

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Abstract

We propose Dynamic Circle Location Register (DCLR) scheme where each visiting location register (VLR) has a given fixed circle registration area around itself and has IDs of other VLRs in this circle area. Whenever a terminal moves to another registration area (RA), system computes whether the terminal is located in the current DCLR area and sends the recent location information of terminal to the old or new DCLR according to computing results. Also, according to change DCLR circle dynamically, we can track terminal location by querying DCLR of the current terminal when a call originates. The our scheme solves the HLR bottleneck due to the terminals frequent RA crossings and distributes the registration traffic to each of the local signaling transfer point (LSTP) area in wireless communications (WC)

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