Title: FLEXIBLE PAGING METHOD THROUGH A HOME LOCATION REGISTER

(57) Abstract: The present invention relates to a flexible paging method through a HLR (Home Location Register). When a location registration is requested for an MS (Mobile Station), a HLR stores additionally a current location of the MS as a final location without deleting an old location and memorizes the time when a location registration is requested. Afterwards, if a location identification is requested for the MS from an arbitrary MSC (Mobile Switching Center), the HLR considers location of the MS to be settled stably or not based on a time interval between the memorized time and the time when a location identification is requested. If considered to be settled, the HLR commands an MSC at the stored final location to page the MS, otherwise, it commands both MSCs at the stored old location and the final location to page the MS individually.
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
DESCRIPTION

FLEXIBLE PAGING METHOD USING A HOME LOCATION REGISTER

1. Technical Field

The present invention relates to a flexible paging method using a home location register, more particularly, to a method of paging a called mobile terminal located in a service zone overlapped by individual coverages of at least two mobile exchangers.

2. Background Art

Fig. 1 illustrates a block diagram of a general mobile communication network. A mobile communication network of Fig. 1 includes base stations (BTSs) 120, 220,... communicating in wireless with mobile stations (MSs) 100, 200,..., namely, mobile terminals; base station controllers (BSCs) 120, 220,... controlling several BTSs individually; mobile switching centers (MSCs) 130, 230,..., connected with several BSCs individually, for processing calls and exchanging signals; and a home location register (HLR) 300, connected to the MSCs through a local network 400, for storing and managing location information of all subscribed MSs.

Every MSC 130, 230,... includes a visitor location register (VLR) for registering MSs located within its own service coverage. Location information registered in a VLR of an arbitrary MSC is communicated with the HLR 300 to concentrate all location information on the HLR 300.

For example, if the first MS 'MS #1' that was within a coverage of the first MSC 'MSC/VLR #1' enters an overlapped zone that is also a coverage of the second MSC 'MSC/VLR #2', as shown in Fig. 2, a registration/cancellation process is conducted according to the procedure depicted in Fig. 3.

When the first MS 'MS #1' requests 'Registration' (S10), the second MSC registers the first MS in its own VLR and the registered information is transmitted to the HLR 300 (S11). Then, the HLR 300
updates location information of the first MS 'MS #1' from the first MSC to the Second MSC (S12-1) and provides all registered service information of the first MS for the VLR of the second MSC.

Besides updating location information of the first MS 'MS #1', the HLR 300 sends the first MSC 'MSC/VLR #1' a message 'REGCAN' requesting cancellation of registration of the first MS (S12-2). When an acknowledging message for the message 'REGCAN' is received (S13), the HLR 300 sends the second MSC 'MSC/VLR #2' a message 'regnot' to notify of registration (S14) to complete a registration updating process.

Afterwards, if another MS inside a coverage of the second MSC calls the first MS, the second MSC knows, from the registered location information of the first MS in its own VLR, that the called MS is within its coverage, so that it conducts a paging process to the first MS.

If another MS within a coverage of, e.g., the first MSC calls the first MS, the first MSC asks the HLR 300 where the called MS is. Then, the HLR 300, with reference to location information for the first MS, sends a call-routing request signal to the second MSC. Therefore, the second MSC received the call-routing request signal starts to page the first MS 'MS #1'.

However, if the first MS frequently changes its location to the first or to the second MSC while crossing the overlapped boundary zone between the respective coverages of the two MSCs, the aforementioned registration/cancellation processes are conducted among the HLR 300 and individual VLRs of related MSCs as frequently as the location changes. Such frequent processes cause undesirable burden to a communication network, as a result, resources of the network are used unnecessarily.

Lately, for alleviating such loads, a location updateable time window is used in an HLR. Location of an MS registered in an HLR is never updated within the location updateable time window after registration of the MS.

However, if actual location of an MS is not registered immediately in an HLR as above, the actual location of the MS and
location information registered in the HLR may be different, which causes paging fails for calls to the MS. Especially, if a called MS is located in a boundary zone between two or more MSCs, paging hit rate, or call success rate for that MS drops remarkably.

3. Disclosure of Invention

It is an object of the present invention to provide a flexible paging method using an HLR that determines whether location of a called MS is settled around a boundary zone formed by a plurality of MSCs, and pages the MS through a single MSC, in which the MS is registered finally, or through all the plurality of MSCs, based on the determination result.

A method of registering location of a mobile terminal in accordance with a flexible paging method using an HLR of the present invention, when a request of location registration of a mobile terminal is received, stores a current location, for which location registration is requested, as a final-location of the mobile terminal while preserving previous location information thereof, and also stores the time when the request of location registration is received.

A flexible paging method using an HLR in accordance with the present invention, when a signal asking current location of a mobile terminal is received, determines whether or not location of the mobile terminal is settled, if at least two pieces of location information have been stored for the mobile terminal, and requests a single mobile exchanger, in which the mobile terminal is registered finally, to page the mobile terminal or requests at least two mobile exchangers, associated with said at least pieces of location information respectively, to page the mobile terminal all together, based on the determination result.

The flexible paging method characterized as above improves a paging success rate for an MS remarkably even though the MS roams about two or more service areas of a plurality of MSCs while frequently crossing their boundary zone.

4. Brief Description of Drawings

Fig. 1 illustrates a block diagram of a general mobile
communication network;

Fig. 2 illustrates an overlapped boundary zone between two coverages by two mobile exchangers and movement of a mobile terminal across the boundary zone;

Fig. 3 is a procedure to show location registering/canceling process when a mobile terminal changes a service area;

Fig. 4 shows a procedure to update location information of a mobile terminal in accordance with the present invention when the terminal moves into another service area; and

Figs. 5a and 5b show respective procedures to conduct a single- and a multi-paging based on whether location of a called mobile terminal is determined settled or not.

5. Modes for Carrying out the Invention

In order that the invention may be fully understood, a preferred embodiment thereof will now be described with reference to the accompanying drawings.

Fig. 4 shows a procedure to update location information of an MS in accordance with the present invention when the MS moves into another service area.

If the first MS 'MS #1' enters a service area of the second MSC 'MSC/VLR #2' under condition that the first MS 'MS #1' has been registered in the first MSC 'MSC/VLR #1', it requests registration to the second MSC 'MSC/VLR #2' (S20).

Then, the second MSC 'MSC/VLR #2' registers the first MS in its VLR and sends the HLR 300 a message to notify of local registration and to request central registration (S21). The HLR 300 updates final-location information of the first MS 'MS #1' from the first to the second MSC and downloads various service information registered for the first MS to the second MSC. At this time, the HLR 300 does not delete information of previous-location, namely, the first MSC to preserve previous-location information. Thus, two pieces of location information are present temporarily in the HLR 300. In addition, the HLR 300 does not send the first MSC a message 'REGCAN' requesting cancellation of registration of the first MS. Instead, it memorizes the time 't_reg' when the
registration is requested from the second MSC (S22). Afterwards, the HLR 300 sends the second MSC an acknowledging message 'regnot' for acknowledging registration request to notify of successful registration of the first MS (S23). Thus, registration updating procedure ends.

Figs. 5a and 5b show a paging procedure under condition that both of previous- and final-location information and the registration-requested time of a called MS have been stored as above.

If an arbitrary MS 'MS #k' within a coverage of an MSC 'MSC/VLR #n' calls an MS, e.g., the first MS 'MS #1' of which previous- and final-location information have been stored (S30), the originating MSC 'MSC/VLR #n' sends the HLR 300 a message 'LOCREQ' asking where the first MS 'MS #1' is (S31).

Then, the HLR 300 memorizes for the first MS 'MS #1' the time 't_loc' when the message 'LOCREQ' for location identification is received, subtracts the time 't_loc' from the previously-memorized time 't_reg', and compares the difference 't_diff' (= 't_loc'-'t_reg') with a predetermined registration-restriction time window 'T_set' (S32). If the difference 't_diff' is greater than the threshold time 'T_set', the HLR 300 regards that the called MS 'MS #1' has a weak movability in a boundary zone, namely, that the location of the first MS 'MS #1' is somewhat settled within a coverage of the second MSC 'MSC/VLR #2', so that it deletes the previous-location information (S33) of the two pieces of location information.

For example, on the assumption that the restriction-restriction time window 'T_set' is 5 minutes, if the message 'LOCREQ' is received at 13:15 and the registration is requested at 13:05, the time difference (10 minutes) is greater than the threshold 'T_set'. Therefore, the HLR 300 considers that the finally-registered location is settled because movability of the first MS becomes weak, so that it deletes previous-location information, the first MSC, of the two pieces of location information.
Next, the HLR 300 sends a call-routing request message ‘ROUREQ’ to the second MSC ‘MSC/VLR #2’ (S34) that requested registration of the first MS finally and also sends a registration-canceling request message ‘REGCAN’ to the first MSC ‘MSC/VLR #1’ (S35) that was previous location of the first MS.

The first MSC ‘MSC/VLR #1’ deletes all registered information about the first MS from its VLR and then sends an ‘ACK’ message ‘regcan’ to the HLR 300 (S36). The second MSC ‘MSC/VLR #2’ received the message ‘ROUREQ’ transmits a paging signal for the first MS through its controlling BTSs (S37).

If the first MS ‘MS #1’ responds to the paging signal, a communication path between the originating MSC ‘MSC/VLR #n’ and the terminating MSC ‘MSC/VLR #2’ is established to connect the caller ‘MS #k’ and the called MS ‘MS #1’.

However, if the time difference ‘t_dif’ is smaller than the threshold ‘T_set’, the HLR 300 considers that the concerned MS still has high probability to move around or across a boundary zone, namely, that the location of the MS is not settled (S43).

In this case, the HLR 300 sends a call-routing request message ‘ROUREQ’ to the first MSC ‘MSC/VLR #1’, which is previous location of the first MS, as well as the second MSC ‘MSC/VLR #2’ which is final location (S44). Thus, both MSCs ‘MSC/VLR #1 and #2’ page the first MS ‘MS #1’ simultaneously (S46). The first MS within either zone of both MSCs receives the paging signal and responds to the paging signal of either MSC. As a result, a communication path between the called ‘MS #1’ and the caller MS ‘MS #k’ is established.

During the simultaneous paging operation, if the HLR 300 receives a paging completion signal from either MSC, it stops unnecessary paging operation of the other MSC.

In addition, the HLR 300 settles final-location information to the MSC that completed paging, thus it deletes the other previous-location information or preserves two pieces of location information because the concerned MS may have high movability in a boundary zone. In latter case, the HLR 300 memorizes the paging-completed time as the registration-requested time ‘t_reg’.

It will be apparent to those skilled in the art that
various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.
CLAIMS

1. A method of registering location of a mobile terminal in a home location registering apparatus, comprising the steps of:
(a) receiving a request of location registration of a mobile terminal; and
(b) storing a current location, for which location registration is requested, as a final-location of the mobile terminal while preserving previous location information thereof, and storing the time when the request of location registration is received.

2. The method of claim 1, wherein said step (b) does not request registration-canceling to a mobile exchanger that has a service area covering the previous location of the mobile terminal.

3. A flexible paging method using a home location registering apparatus, comprising the steps of:
(a) receiving a signal asking where a mobile terminal is;
(b) determining whether or not location of the mobile terminal is settled, if at least two pieces of location information have been stored for the mobile terminal; and
(c) requesting a single mobile exchanger, in which the mobile terminal is registered finally, to page the mobile terminal or requesting at least two mobile exchangers, associated with said at least pieces of location information respectively, to page the mobile terminal all together, based on the determination result.

4. The method of claim 3, wherein said step (b) determines that location of the mobile terminal is settled if a time difference between a location identification requested time and a final location-registered time is greater than a predetermined threshold time, and determines that location of the mobile terminal is not settled if not.

5. The method of claim 4, wherein the predetermined threshold time is a time window to restrict location updating within in order to prevent frequent update of location information of a mobile
terminal.

6. The method of claim 3, wherein said step (c) requests the mobile exchanger, in which the mobile terminal is registered finally, to page the mobile terminal if location of the mobile terminal is determined settled, and requests said at least two mobile exchangers to page the mobile terminal all together if location of the mobile terminal is determined not-settled.

7. The method of claim 3, wherein said step (c) further conducts an operation to delete all location information except final location information if location of the mobile terminal is determined settled.

8. The method of claim 3, wherein said step (c) requests registration-canceling of the mobile terminal to mobile exchangers other than the mobile exchanger in which the mobile terminal is registered finally, if location of the mobile terminal is determined settled.

9. The method of claim 3, further comprising the step of setting final location of the mobile terminal to either mobile exchanger that has completed the requested paging operation, and deleting all location information except the final location information, in case that paging of the mobile terminal is requested to said at least two mobile exchangers all together.

10. The method of claim 3, further comprising the step of updating final location-registered time to a time when a signal indicative of paging completion is received from either mobile exchanger, in case that paging of the mobile terminal is requested to said at least two mobile exchangers all together.
FIG. 3

Movement from MSC #1 to MSC #2

S10
Registration
S11
REGCAN
S12-I
update location information to MSC #2
S12-2

FIG. 4

Movement from MSC #1 to MSC #2

S20
Registration
S21
REGNOT
S22
register two pieces of location information such that previous = MSC #1 and final = MSC #2, store final register location-registered time (t_reg)

regnot
S23
FIG. 5a

- S30: Call Origination
- S31: LOCREQ
- S32: \( t_{\text{loc}} - t_{\text{reg}} > T_{\text{set}} \) ?
  - YES
- \( T_{\text{set}} \): registration-restriction time
- \( t_{\text{loc}} \): location identification-requested time
- \( t_{\text{reg}} \): final location-registered time
- S33: determine present location to MSC/VLR #2
- S34: ROUREQ
- S35: REGCAN
- S36: pacing
- S37: setup a communication path
**FIG. 5b**

- **MS #1**
- **MSC/VLR #1**
- **MSC/VLR #2**
- **HLR**
- **MSC/VLR #n**
- **MS #k**

Call Origination S30

**S31**

**LOCREQ**

**S32**

$t_{loc} - t_{reg}$

$> T_{set}$?

**NO**

$T_{set}$: registration-restriction time

$t_{loc}$: location identification-requested time

$t_{reg}$: final location-registered time

**S43**

unstable state (mobile terminal is determined not-settled)

**ROUREQ**

**S44** (Multi)

**roureq**

**S46**

setup a communication path

**paging**

**roureq**
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC H04Q 7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC H04Q 7/36

Documentary searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

KIPASS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US 5,212,822 A (NTT CO.) 18. 05. 1993. abstract, column 3, line 49 - column 5, line 7, figure 11</td>
<td>1-10</td>
</tr>
<tr>
<td>A</td>
<td>JP 2000-50349 A (LG INFORMATION AND TELECOMMUNICATION CO.) 18. 02. 2000. abstract, paragraph no.28 , paragraph no. 62 - 68, figure 1</td>
<td>1-10</td>
</tr>
<tr>
<td>A</td>
<td>US 5,408,683 A (MOTOROLA INC.) 18. 04. 1995. abstract, column 7, line 41 - column 8, line 39, figure 4B</td>
<td>1-10</td>
</tr>
</tbody>
</table>

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel and/or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

21 OCTOBER 2002 (21.10.2002)

Date of mailing of the international search report

21 OCTOBER 2002 (21.10.2002)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

MIN, Boung Joon

Telephone No. 82-42-481-5746

Form PCT/ISA/210 (second sheet) (July 1998)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 5,212,822 A</td>
<td>18. 05. 1993</td>
<td>JP 03-080790 A</td>
<td>05. 04. 1991</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 439628 A</td>
<td>07. 08. 1991</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 9103138 A</td>
<td>07. 03. 1991</td>
</tr>
<tr>
<td>US 5,408,683 A</td>
<td>18. 04. 1995</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>