(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 December 2008 (11.12.2008)

PCT

(10) International Publication Number
WO 2008/149867 A1

(51) International Patent Classification:
H04Q 7/38 (2006.01) *H04Q 7/20* (2006.01)

(21) International Application Number:
PCT/JP2008/060237

(22) International Filing Date: 28 May 2008 (28.05.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0710329.4 30 May 2007 (30.05.2007) GB

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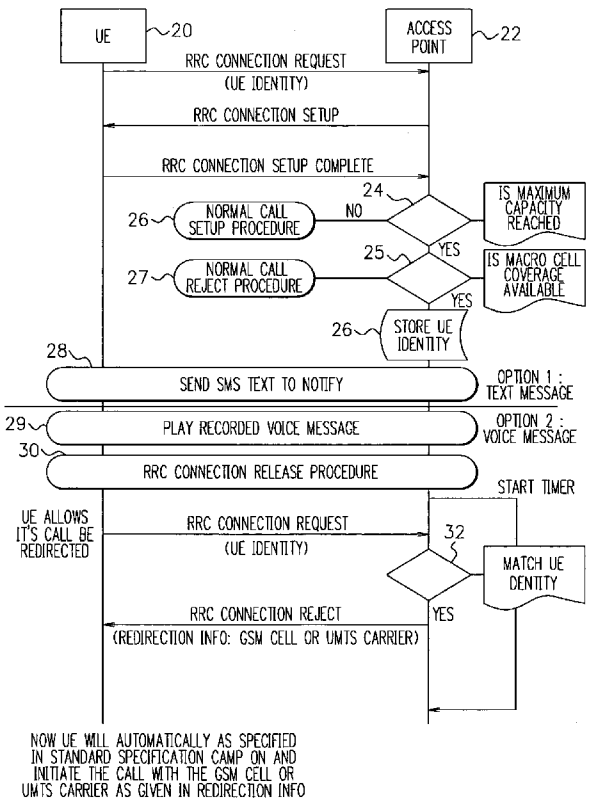
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL,

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR REDIRECTING MOBILE COMMUNICATIONS

F I G. 2



(57) Abstract: A cellular communication system is capable of supporting local access points with shorter communication ranges than macro cells within which they are positioned. When a user wishes to send a communication a request is sent to an access point. At the access point a determination is made as to whether or not the maximum capacity of the access point has been reached. If maximum capacity has been reached then a rejection signal is sent to the user equipment and the communication is redirected into the macro cell in which the access point is positioned.

WO 2008/149867 A1

NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

DESCRIPTION

METHOD AND APPARATUS FOR REDIRECTING MOBILE COMMUNICATIONS

This invention relates to a method and apparatus for redirecting mobile communication requests made to an access point within a macro cell of a celluar network.

BACKGROUND OF THE INVENTION

Mobile communication systems operate on a cellular basis in which transmission and receiver base stations coupled to a network provide transmission and reception to user equipment (UE) such as mobile telephones in each cell in a network. There is usually a single base station in each cell. The base stations themselves are usually referred to as macro base stations and the cells as macro cells.

Smaller cell sites called Pico cells have been proposed. These cover a smaller area such as a complex of buildings. Still smaller cell sites named FEMTO cells are also proposed. This is a term used by mobile operators to refer to cell sites of the type which attempt to solve the often expensive problem of providing complete in building coverage. PICO cells can have problems with low or multi-path distortion etc when they are used to provide coverage to a complete building.

A FEMTO cell is often referred to as an access point/home gateway. It is a small plug and play device which communicates with user equipment such as mobile handsets using standard 2G or 3G transmission reception. It is connected to the celluar network via a broadband service using either Xdsl (digital subscriber loop) or Wimax Technology. Optionally a FEMTO

cell can incorporate the functionality of a broadband router so that a user has a completely integrated device. It is of course essential that it integrates seamlessly with the core network of the mobile communication system so that it can be remotely managed and updated.

These access points have limited bandwidth and therefore are only able to cope with a limited number of connections from mobile communication devices before the band width is exceeded. Thus, for example, an access point may have a capacity of ten voice calls which it may handle simultaneously. It is therefore possible that access points can quickly reach their capacity in terms of the calls they can handle and when this happens other users are not able to make calls.

It will be appreciated that it is necessary for an access point to be able to support emergency calls. This is because when an emergency call is made it is important that a user of a mobile communication device can advise the emergency services of his location. As FEMTO cells are deployed in an unregulated and uncoordinated manner, the knowledge of the location of a particular FEMTO cell in which a user is located will not be information which is known to the network and therefore it is important to speak to the person reporting an emergency.

SUMMARY OF INVENTION

Preferred embodiments of the present measure provide a method and apparatus to redirect a communication request to a macro cell when an access point has already reached its maximum capacity for calls.

Preferably embodiments sending a signal back to the piece of UE making the request from the access point advising that perhaps the threshold has been reached, and redirecting the call to a macro cell.

The message that the capacity threshold has been reached may be an SMS text message. In such a case, if a subscriber wishes the call to be redirected to a macro cell he/she again places the call request which is then redirected to on available 2G or 3G Macro cell.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described in detail by way of example with reference to the accompanying drawings in which:

Figure 1 shows schematically a 3G access point such as a FEMTO cell in communication with a number of pieces of user equipment;

Figure 2 shows a procedure which takes place when a piece of user equipment tries to make a call by an access point which has already reached capacity;

Figure 3 shows an alternative procedure to that of Figure 2 in a further embodiment of the invention; and,

Figure 4 shows the procedure when a user tries to make an emergency call

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Figure 1 shows an access point 2 which is coupled to a network. This comprises an antenna 4 coupled to, or integrated into a controller and a transmit/receive unit. In the case of a FEMTO cell, this will cover a relatively small area such as a house. User equipment such as a mobile phone 6 or a laptop with a data card 8 may be within the house and therefore capable of communication with the access point 2. In a larger area such as an office environment there may be a number of different pieces of equipment capable of communicating with the access point 2. When a piece of user equipment initially comes into range of the access point 2, it registers with the access point as being a primary access point on the network for transmission and reception of data. Thus, when the

user equipment next tries to communicate such as by making a telephone call, it will attempt to use the access point 2 to access the network.

As the access point is connected to the network typically by a conventional telephone line using a broadband connection (eg ADSL) and as it is meant to be user for residential coverage the total bandwidth (i.e. capacity to serve multiple simultaneous voice/Data cells) it is capable of supporting is considerably less than that of a base station in a macro cell in the network. It is after all designed to take communications from a localised area within a macro cell and will therefore never have been planned to be able to handle the requirements of the whole macro cell. If the access point is a home gateway device its maximum number of communications that it can handle simultaneously may be as little as 4, eg 4 simultaneous voice calls from different mobile telephones all registered with the access point. When the maximum number of possible devices using the access point is reached and another piece of user equipment or subscriber places a request to communicate via the access point, the access point then has to reject the request. This means that the subscriber cannot use the service.

In order to deal with this situation, the access point is configured to redirect a piece of user equipment which has its request rejected to use the macro cell within which the access point is positioned. However, this may be undesirable for some subscribers as higher rates may be payable in comparison to using an access point. Therefore, in a preferred embodiment of the invention, instead of redirecting and rejecting a request automatically, the system is configured to notify the subscriber that his request has been rejected such that he may chose to disallow the opportunity to have his request redirected to the macro cell.

A flow diagram showing communications between a piece of user

equipment 20 and an access point 22 is shown in figure 2. The description of this assumes that the user equipment 20 is already registered with the access point 22 and will attempt to use this for its communications.

When the user equipment wishes to make a communication such as a voice call via the access point 22 it first sends a radio resource control (RRC) connection request to the access point 22. The access point 22 and the user equipment 20 then perform an RRC connection set up which will initially establish this contact between the user equipment 20 and the access point 22. A determination is then made at 24 as to whether or not the access point has reached maximum capacity. If it has not, then the normal call set up procedure between the user equipment 20 and access point 22 is performed at 26. This does not form the subject matter of the present invention and is therefore not described here. It will be well known to those skilled in the art.

If maximum capacity has been reached then a determination is made at 25 as to whether macro cell coverage is available. If it is not then a call rejection procedure will be performed at 27. If macro cell coverage is available then the access point 22 stores the identity of the user equipment which has made the request at 26. The access point 22 then sends a SMS message to the user equipment 20 at 28 or a voice message at 29 to notify a subscriber that the call request has been rejected and should he/she wish to again place the call request it will be directed to the macro cell. The user equipment 20 and the access point 22 can then perform an RRC connection release procedure at 30. This disconnects the user equipment from the access point 22. A redirection procedure can then be selected by the subscriber on his user equipment. In this, he sends a further RRC connection request to the access point 22. At the same time the access

point has started a timed period during which it will in response to an RRC connection request from that piece of the attempt to match the user identity of the user making the RRC connection request with the user identity stored at 26. This is done at 32. If the user identity is matched, the RRC connection request is rejected and "redirection information" (which contains the GSM Cell information and UMTS frequency Information) is sent back to the user equipment. In response to this, the software running in user equipment redirects the call into the appropriate macro cell using, for example, the GSM or UMTS frequency band as specified in "Redirection information".

It will be appreciated from the above that the user equipment is configured to respond to an RRC connection request which includes "redirection information" to transmit the call into the appropriate macro cell. This functionality can be implemented in software in a piece of user equipment by those skilled in the art.

The procedures described above can be used with all 3GPP Release99 and future release compliant handsets.

A flow diagram showing the events which take place in a system using 3GPP Release6 and above compliant handsets is shown in figure 3. The first part of the procedure between the user equipment and access point 22 is the same as that described in relation to figure 2 as far as the determination as to whether or not the maximum capacity of the access point has been reached at 24. If maximum capacity has not been reached, then the normal call set up procedure is entered at 26. If it has been reached, then the access point sends an SMS message at 28 to the user equipment 20 to notify it of the connection rejection or sends a voice message at 29. The access point 22 then commences a RRC connection

release procedure with the user equipment 20 which causes the user equipment 20 to automatically register with the relevant macro cell, the information for which may be provided in the "redirection information". The user can then make his call via the macro cell. It is assumed in Figure 3 and Figure 4 that macro cell coverage (either GSM or UMTS) is available. If it is not then obviously the redirection procedure cannot be initiated by Access Point. As in the previous embodiment, the system can be configured such that no SMS message is sent by the access point to the user equipment whereby the user equipment will automatically try to use the macro cell if the connection request is rejected.

Figure 4 shows a modification of the system which can be used with the systems of either Figure 2 of Figure 3. In this, if the user equipment tries to make an emergency call by using a recognised emergency number (eg 999 in the United Kingdom) the user equipment instantly sets up an RRC connection request to the access point 22. A determination is made at 40 as to whether or not the connection request is for an emergency call or not by checking the "cause value" specified in RRC CONNECTION REQUEST message. If it is not, then it can enter normal set up procedure at 42. This will entail going through the process of Figure 2 or Figure 3 to determine whether or not the access point has reached its maximum capacity. If the call is an emergency call, a determination is made at 44 as to whether or not macro cell coverage is available. If it is not, then the normal call set up procedure is entered at 26. This is equivalent to the normal call set up procedure of Figure 2 and 3. If macro cell coverage is available, it is preferable for the call to be routed via the macro cell and therefore an RRC connection rejection is sent back to the user equipment 20 with redirection information for the relevant macro cell. The user equipment is configured to respond automatically to this to redirect the call to the macro cell, thereby ensuring that the emergency call is made.

In order to implement the above embodiments, an access point must be arranged to check whether or not its maximum capacity limit has been reached and thus be capable of notifying user equipment about the status of maximum capacity and the possibility of redirection to a macro cell. The access point must be able to determine if macro cell coverage is available. User equipment must be configured to be able to redirect the calls to the macro cell, either using data already stored in the user equipment or data provided by the access point when a RRC connection request is rejected. For emergency call handling the access point must be able to determine whether or not an emergency call has been made and be able to redirect the emergency call to the macro cell if macro cell coverage is available. All these function can be implemented in software in the user equipment and the access point in a manner that will be well known to those skilled in the art.

CLAIMS

1. A method for redirecting communication requests made by user equipment to an access point in a cellular communication system wherein the access point has a shorter communication range then a macro cell in the system, the method comprising the steps of:

sending a communication request from user equipment to the access point;

determining whether the access point has reached a maximum capacity;

sending a communication rejection signal to the user equipment if the access point has reached capacity; and

redirecting the communication request into the macro cell in which the access point is positioned.

2. A method according to claim 1 in which the communication request rejection signal comprises an SMS message in response to which a user may select whether or not the communication should be redirected into the macro cell.

3. A method according to claim 1 further comprising the method steps of:

determining whether or not the communication request is for an emergency call to be made;

determining whether or not macro cell coverage is currently available; and,

redirecting the call to a macro cell if the result of the determination is that it is an emergency call, and macro cell coverage is available.

4. A method according to claim 1 in which the communication

request rejection signal comprises a voice message which is played back to the user and in response to which the user may select whether or not the communication should be redirected to the macro cell.

5. A method according to claim 2 or 4 including the step of determining whether or not macro cell coverage is available prior to sending a communication request rejection.

6. A method according to any preceding claim including the step of storing the identity of a user who has had a connection request rejection when maximum capacity has been reached, and setting a time limit for the connection request to be redirected to a macro cell.

7. A system for redirecting communication requests made by user equipment to an access point in a cellular communication system wherein the access point has a shorter communication range than a macro cell in the system, the system comprising:

means for sending a communication request from user equipment to an access point;

means for determining whether the access point has reached a maximum capacity;

means for sending a communication rejection signal to the user if the access point has reached maximum capacity; and,

means for redirecting the request into the macro cell in which the access point is positioned.

8. A system according to claim 7 in which the communication request rejection signal comprises an SMS message in response to which a user may select whether or not the communication should be redirected into the macro cell.

9. A system according to claim 7 further comprising:

means for determining whether the communication request is for an emergency cell to be made;

means for determining whether macro cell coverage is available; and,

means for redirecting the call to a macro cell if the result of the determination is that macro cell coverage is available.

10. A system according to claim 7 in which the communication request rejection signal comprises a voice message which is played back to the user and in response to which the user may select whether or not the communication should be redirected to the macro cell.

11. A system according to claim 8 to 10 including means for determining whether macro cell coverage is available before the means for sending a communication request reject signal.

12. A system according to any of claims 7 or 11 including means for storing the identity of a user who has had a connection rejected when maximum capacity has been reached, and means for setting a time limit for the connection request to be redirected to a macro cell.

13. An access point for use in a macro cell of a cellular communication system comprising means for receiving communication requests from user equipment;

means for determining whether the access point has reached a maximum capacity;

means for sending a communication rejection signal to a user if maximum capacity has been reached; and

means for sending data to the user to redirect the communication

into a macro cell.

14. A cellular communication device comprising means for sending communication request to access points within a macro cell;

means for receiving communication request rejections; and,

means for redirecting communications into the macro cell in response to such rejections.

15. A method for redirecting communication requests substantially as herein described with reference to the accompanying drawings.

16. A system for redirecting communication requests substantially as herein described.

FIG. 1

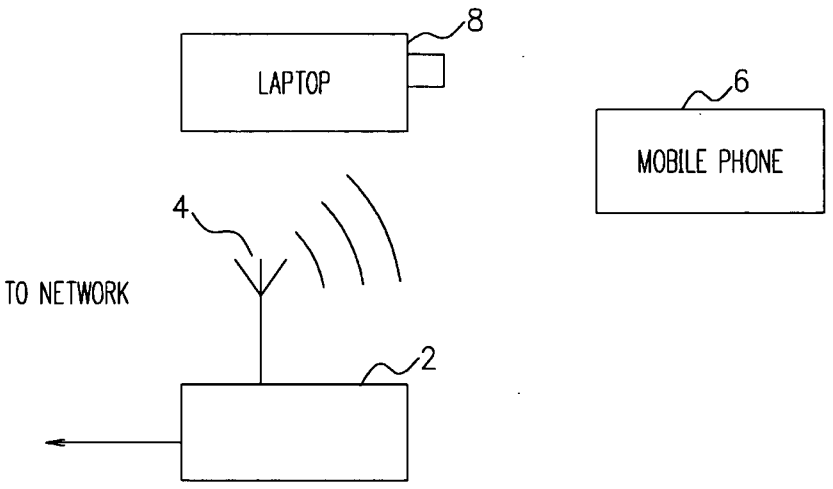


FIG. 2

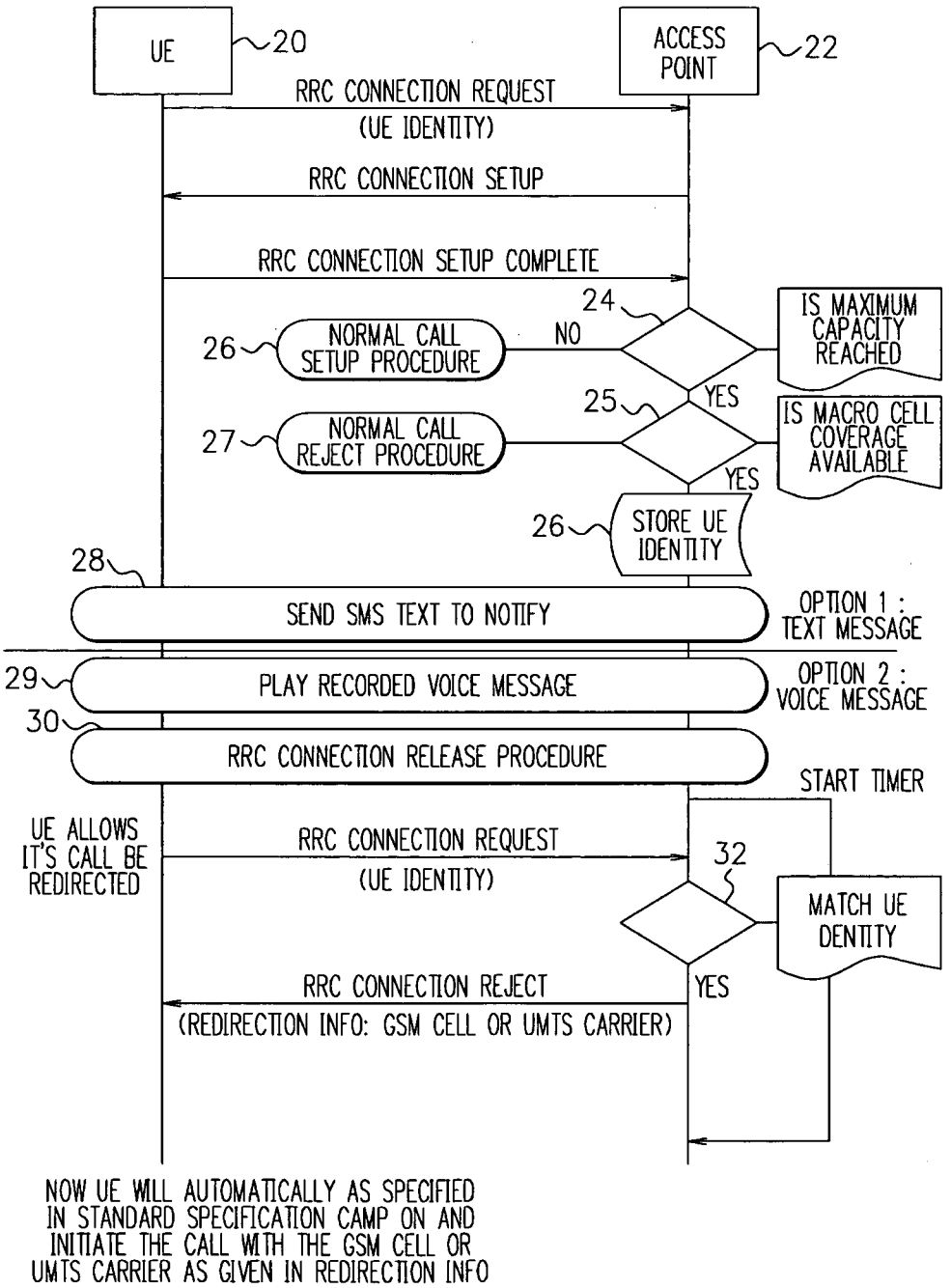

UE
20
ACCESS POINT
22
RRC CONNECTION REQUEST
(UE IDENTITY)
RRC CONNECTION SETUP
RRC CONNECTION SETUP COMPLETE
24
IS MAXIMUM CAPACITY REACHED
NO
26
NORMAL CALL SETUP PROCEDURE
YES
25
IS MACRO CELL COVERAGE AVAILABLE
27
NORMAL CALL REJECT PROCEDURE
YES
26
STORE UE IDENTITY
28
SEND SMS TEXT TO NOTIFY
OPTION 1 : TEXT MESSAGE
29
PLAY RECORDED VOICE MESSAGE
OPTION 2 : VOICE MESSAGE
30
RRC CONNECTION RELEASE PROCEDURE
START TIMER
UE ALLOWS IT'S CALL BE REDIRECTED
RRC CONNECTION REQUEST
(UE IDENTITY)
32
MATCH UE DENTITY
YES
RRC CONNECTION REJECT
(REDIRECTION INFO: GSM CELL OR UMTS CARRIER)
NOW UE WILL AUTOMATICALLY AS SPECIFIED IN STANDARD SPECIFICATION CAMP ON AND INITIATE THE CALL WITH THE GSM CELL OR UMTS CARRIER AS GIVEN IN REDIRECTION INFO

FIG. 3

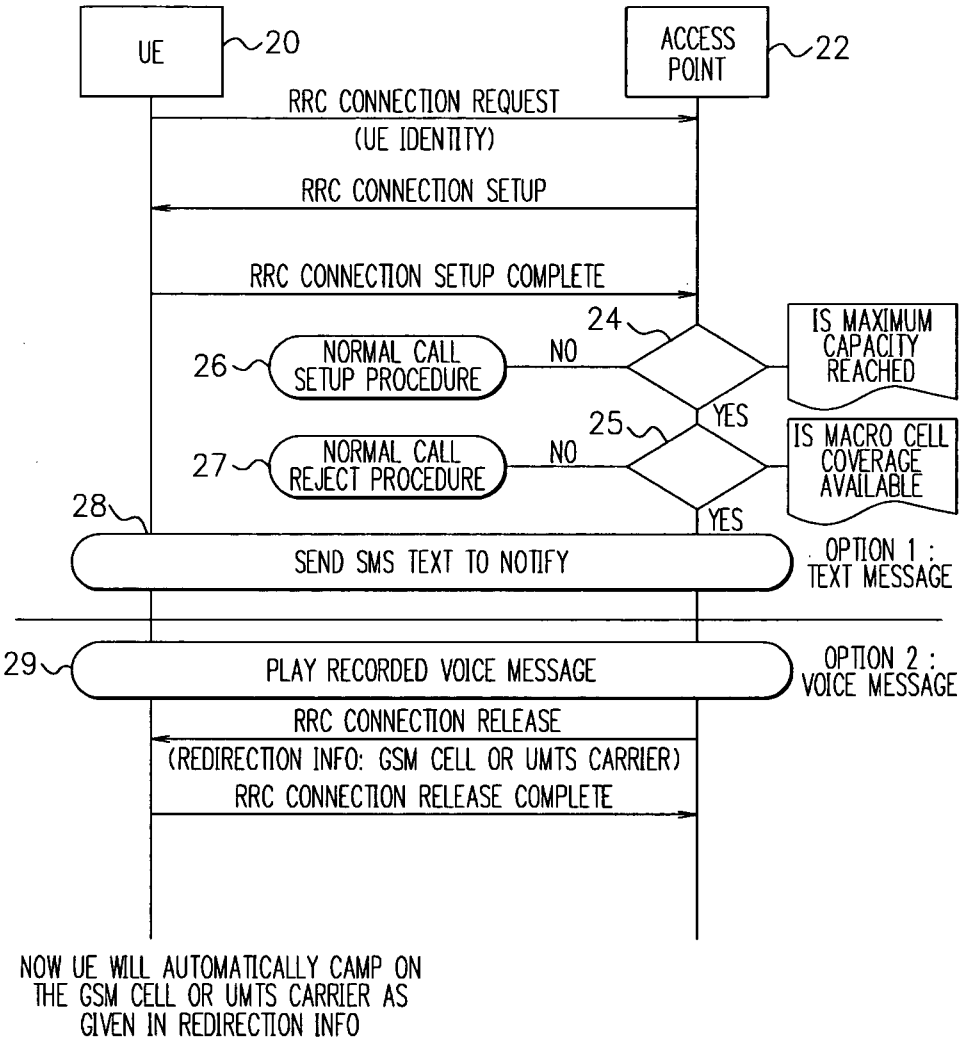
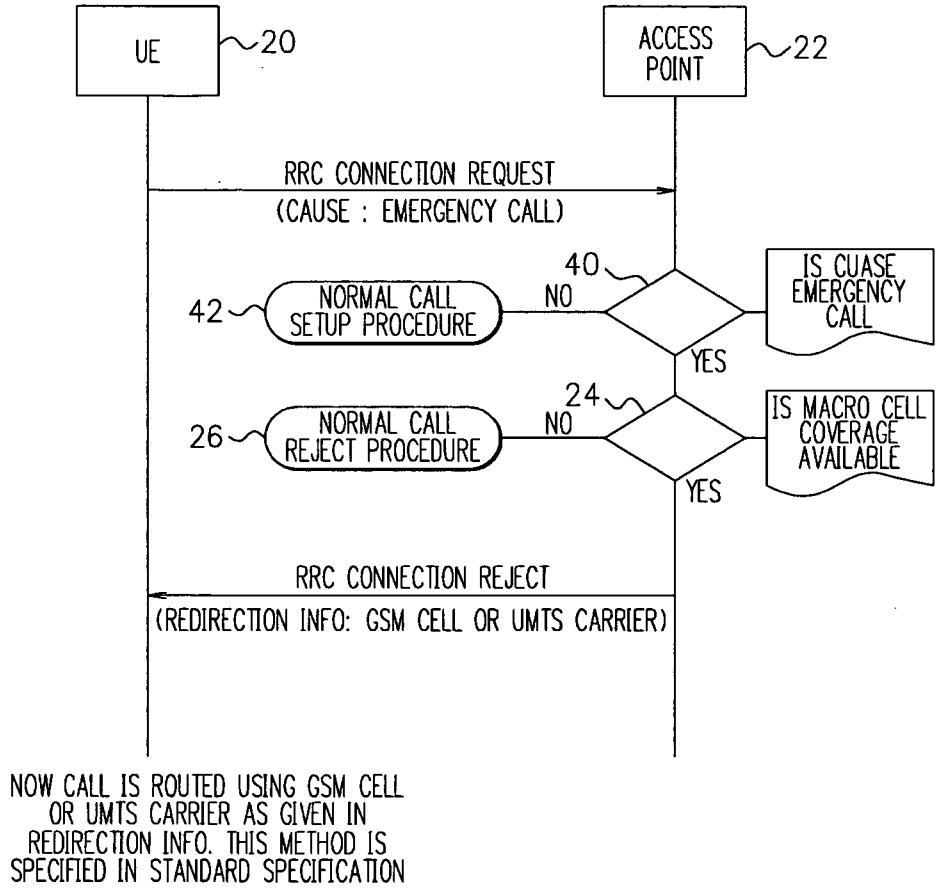

UE
20
ACCESS POINT
22
RRC CONNECTION REQUEST
(UE IDENTITY)
RRC CONNECTION SETUP
RRC CONNECTION SETUP COMPLETE
24
IS MAXIMUM CAPACITY REACHED
26
NORMAL CALL SETUP PROCEDURE
NO
YES
25
IS MACRO CELL COVERAGE AVAILABLE
27
NORMAL CALL REJECT PROCEDURE
NO
YES
28
SEND SMS TEXT TO NOTIFY
OPTION 1 : TEXT MESSAGE
29
PLAY RECORDED VOICE MESSAGE
OPTION 2 : VOICE MESSAGE
RRC CONNECTION RELEASE
(REDIRECTION INFO: GSM CELL OR UMTS CARRIER)
RRC CONNECTION RELEASE COMPLETE
NOW UE WILL AUTOMATICALLY CAMP ON THE GSM CELL OR UMTS CARRIER AS GIVEN IN REDIRECTION INFO

FIG. 4


UE
20
ACCESS POINT
22
RRC CONNECTION REQUEST
(CAUSE : EMERGENCY CALL)
40
IS CUASE EMERGENCY CALL
NO
42
NORMAL CALL SETUP PROCEDURE
YES
24
IS MACRO CELL COVERAGE AVAILABLE
NO
26
NORMAL CALL REJECT PROCEDURE
YES
RRC CONNECTION REJECT
(REDIRECTION INFO: GSM CELL OR UMTS CARRIER)
NOW CALL IS ROUTED USING GSM CELL OR UMTS CARRIER AS GIVEN IN REDIRECTION INFO. THIS METHOD IS SPECIFIED IN STANDARD SPECIFICATION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/060237

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. H04Q7/38(2006.01)i, H04Q7/20(2006.01)i

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)

Int.Cl. H04Q7/00-H04Q7/38, H04B7/24-H04B7/26

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2008
Registered utility model specifications of Japan 1996-2008
Published registered utility model applications of Japan 1994-2008

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005-223447 A (Sony Ericsson mobile communications inc.) 2005.08.18, Fig.11, [0053],[0054] (family:none)	1,7,13,14
A		2-6,8-12

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* 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 another 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 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	Date of mailing of the international search report
01.08.2008	19.08.2008

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Akitoshi Mochizuki 5J 4101 Telephone No. +81-3-3581-1101 Ext. 3534

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/060237

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☑ Claims Nos.: 15,16
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 15 and 16 quote accompanying drawings, so claims 15 and 16 are unclear.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.