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[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR RANDOM ACCESS BASED ON CALL PRIORITY IN A MOBILE COMMUNICATION SYSTEM

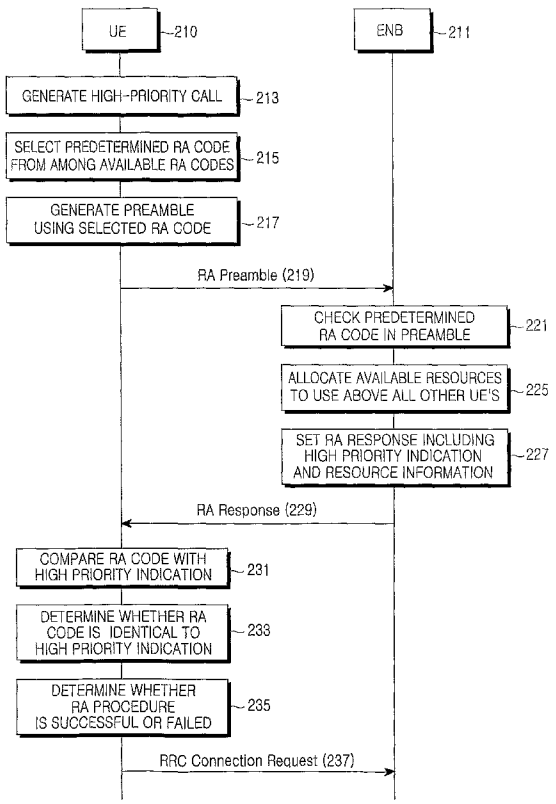

FIG.2

(57) Abstract: An apparatus and method for random access based on call priority in a mobile communication system are provided, in which upon generation of a high-priority call, an MS selects a predetermined RA code indicating generation of a high-priority call, generates a preamble using the selected RA code, and transmits the preamble to a BS.

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APPARATUS AND METHOD FOR RANDOM ACCESS BASED ON CALL PRIORITY IN A MOBILE COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a mobile communication system. More particularly, the present invention relates to an apparatus and method for establishing a call through random access between a Mobile Station (MS) and a Base Station (BS) in a mobile communication system.

2. Description of the Related Art

Today's mobile communication systems are evolving to high-speed, high-quality wireless data packet communication systems that additionally provide data service and multimedia service beyond the early-stage voice service. Universal Mobile Telecommunication System (UMTS), a 3rd Generation (3G) mobile communication system that operates in Wideband Code Division Multiple Access (WCDMA) based on European mobile communication systems, Global System for Mobile Communications (GSM) and General Packet Radio Services (GPRS), provides uniform services that enable mobile phone users or computer users to transmit packet-based text, digitized audio or video, and multimedia data at or above 2Mbps all around the world. The UMTS system adopts the access concept of packet switching using a packet protocol such as Internet Protocol (IP) and enables access to any end within a network all the time.

The 3rd Generation Partnership Project (3GPP) working on standardization of UMTS is discussing Long Term Evolution (LTE) as the future generation of UMTS. LTE is a technology for realizing packet communications at high rates around 100Mbps. For this purpose, many techniques have been discussed, including reduction of the number of nodes on a communication line by simplifying a network configuration and optimizing wireless protocols to radio channels.

A Radio Resource Control (RRC) state, which has been defined to distinguish User Equipment (UE) operation modes and communication states,

includes idle mode and connected mode. A UE in the idle mode or connected mode performs an Random Access (RA) procedure in order to acquire synchronization according to UpLink (UL) timing information received from an Enhanced Node B (ENB) of an Enhanced UMTS Terrestrial Radio Access Network (E-UTRAN), to perform power control setting for initial UL transmission, or to transmit an RRC message to the ENB.

FIG. 1 is a diagram illustrating a signal flow for an RA procedure in a 3GPP E-UTRAN system.

Referring to FIG. 1, a UE 110 starts the RA procedure for a new call connection in idle mode. The UE 110 selects one of available RA codes based on system information received from the ENB 111 in step 121 and transmits an RA Preamble based on the selected RA code to the ENB 111 in step 131. A channel for delivering the RA Preamble and a transmission time of the RA Preamble are indicated by the received system information.

The ENB 111 receives the RA Preamble, calculates a UL timing with the UE 110, and transmits an RA Response including timing synchronization information to the UE 110 so that the UE 110 can acquire UL timing synchronization in step 132. The RA Response includes code information that the ENB 111 has received in the RA Preamble and resource allocation information by which the UE 110 can perform scheduled transmission.

If the code information included in the RA Response is identical to the RA code transmitted in the RA Preamble, the UE 110 transmits a scheduled transmission message according to the resource information included in the RA Response in step 141. The scheduled transmission message is a Layer 3 RRC message, for example. In step 142, the ENB 111 transmits an RRC message to the UE 110 to establish a signaling radio bearer for exchanging Layer 3 control messages with the UE 110. If a UE Identifier (ID) included in the RRC message does not identify the UE 110, the UE 110 re-starts the RA procedure.

As described above, since the 3GPP E-UTRAN uses only an RA code in the RA procedure, the ENB has no knowledge of information about the call

requested by the UE. As a result, when a preamble contention occurs among a plurality of UEs during RA, the setup of a call requiring fast call setup (e.g. an emergency call with a high priority level) is delayed.

SUMMARY OF THE INVENTION

An aspect of exemplary embodiments of the present invention is to address at least the problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of exemplary embodiments of the present invention is to provide an apparatus and method for reducing the connection delay of a high-priority call using preset bits of an RA Preamble in a mobile communication system.

Another aspect of exemplary embodiments of the present invention provides an RA method and apparatus for reducing RA contention among MSs and efficiently using resources by allocating available resources of a BS to a high-priority call above all in a mobile communication system.

In accordance with an aspect of exemplary embodiments of the present invention, there is provided a random access method of an MS in a mobile communication system, in which upon generation of a high-priority call, the MS selects a predetermined RA code indicating generation of a high-priority call, generates a preamble using the selected RA code, and transmits the preamble to a BS.

In accordance with another aspect of exemplary embodiments of the present invention, there is provided a random access method of a BS in a mobile communication system, in which the BS determines whether a preamble received from an MS includes a predetermined RA code, and allocates current available resources to the MS with priority over other MSs, if the preamble includes the predetermined RA code.

In accordance with a further aspect of exemplary embodiments of the present invention, there is provided a random access apparatus of an MS in a mobile communication system, in which a priority decider decides a priority level

of a call, upon generation of the call, an RA code generator generates a predetermined RA code indicating generation of a high-priority call, if the priority level of the call is high, a preamble generator generates a preamble using the generated RA code, and a transceiver transmits the preamble to a BS.

In accordance with still another aspect of exemplary embodiments of the present invention, there is provided a random access apparatus of a BS in a mobile communication system, in which a preamble receiver receives a preamble from an MS, a priority decider determines whether the preamble includes a predetermined RA code, and a resource manager allocates current available resources to the MS with priority over other MSs, if the preamble includes the predetermined RA code.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of certain exemplary embodiments of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 illustrates a conventional RA procedure;

FIG. 2 is a flowchart illustrating a call setup procedure based on an RA procedure according to an exemplary embodiment of the present invention;

FIGs. 3A and 3B are flowcharts illustrating an RA operation of a UE according to an exemplary embodiment of the present invention;

FIG. 4 is a flowchart illustrating an RA operation of an ENB according to an exemplary embodiment of the present invention;

FIG. 5 is a block diagram of a UE apparatus according to an exemplary embodiment of the present invention; and

FIG. 6 is a block diagram of an ENB apparatus according to an exemplary embodiment of the present invention.

Throughout the drawings, the same drawing reference numerals will be understood to refer to the same elements, features and structures.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

The matters defined in the description such as a detailed construction and elements are provided to assist in a comprehensive understanding of exemplary embodiments of the invention. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. Also, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

The principle of the present invention is that when a UE requests a high-priority call in a mobile communication system, it selects a predetermined RA code designated for requesting a high-priority call, generates a preamble using the selected RA codes, and transmits the preamble to an ENB, and the ENB allocates resources to the UE above all other UEs, determining that the UE has requested the high-priority call, if the preamble includes the predetermined RA code. While the predetermined RA code is a predetermined 6-bit sequence in the present invention, it is to be obviously understood that the number of bits of the sequence and its bit stream format may vary depending on a system.

The present invention will be described below in the context of a 3GPP LTE system based on UMTS. Yet, it is clear to those skilled in the art that the subject matter of the present invention, an RA procedure is applicable to other mobile communication systems having a similar technological background and channel configuration with slight modifications within the scope of the present invention.

FIG. 2 is a flowchart illustrating a call setup procedure based on an RA procedure according to an exemplary embodiment of the present invention.

Referring to FIG. 2, if a UE 210 generates a high-priority call upon user request in step 213, it selects a predetermined RA code from among available RA codes to perform the RA procedure in step 215. In step 217, the UE 210 configures an RA Preamble using the selected RA code in step 217. Although the RA Preamble is the RA code itself, it may further include other information in addition to the RA code depending on system setting. In step 219, the UE 210 transmits the RA Preamble to an ENB 211.

Upon receipt of the RA Preamble, the ENB 211 determines whether the RA Preamble includes the predetermined RA code in step 221. In the presence of the predetermined RA code, a Medium Access Control (MAC) scheduler of the ENB 211 checks available resources for RA reception and allocates the available resources to the UE 210, first of all in step 225. In step 227, the ENB 211 generates an RA Response including a high priority indication and resource information about the resources allocated to the UE 210 in step 229 and transmits the RA Response to the UE 210 in step 229. The high priority indication indicates that resources have been allocated to the UE 210 with priority. The high priority indication can be configured to be identical to the predetermined RA code received from the UE 210.

Upon receipt of the RA Response including the high priority indication and the resource information, the UE 210 compares the transmitted RA code with the high priority indication in step 231 and determines whether the RA code is identical to the high priority indication in step 233.

If the RA code is identical to the high priority indication in step 233, the UE 210 determines that the RA procedure is successful in step 235. If the RA code is different from the high priority indication in step 233, the UE 210 determines that the RA procedure is failed in step 235. Herein, the RA procedure is successful. Therefore, the UE 210 performs the call setup procedure by transmitting an RRC Connection Request message to the ENB 211 using the resource information included in the RA Response in step 237.

FIGs. 3A and 3B are flowcharts illustrating an RA operation of a UE according to an exemplary embodiment of the present invention.

Referring to FIG. 3A, upon generation of a high-priority call setup request as requested by a user in step 302, the UE determines to start an RA procedure with an ENB, for the call setup in step 304 and selects a predetermined RA code from among available RA codes to request the high-priority call in step 306. The UE generates an RA Preamble using the selected RA code in step 308 and transmits the RA preamble to the ENB in step 310.

Referring to FIG. 3B, upon receipt of an RA Response from the ENB in step 312, the UE compares the transmitted RA code with a high priority indication included in the RA Response in step 314. If the RA code is different from the high priority indication, the UE restarts the RA procedure, considering that the RA procedure has been failed in step 316. If the RA code is identical to the high priority indication, the UE transmits an RRC Connection Request message to the ENB using resource information (e.g. a UL grant) included in the RA Response, considering that the RA procedure is successful in step 322.

FIG. 4 is a flowchart illustrating an RA operation of an ENB according to an exemplary embodiment of the present invention.

Referring to FIG. 4, upon receipt of an RA Preamble from a UE in step 402, the ENB determines whether the RA Preamble includes a predetermined RA code in step 404. In the presence of the predetermined RA code, the ENB sets a high priority indication in step 406. The high priority indication can be set to be identical to the RA code. In step 408, the ENB allocates available resources to the UE, above all other UEs. The ENB transmits an RS Response including the high priority indication and resource information about the allocated resources to the UE in step 410.

On the other hand, in the absence of the predetermined RA code in the RA Preamble in step 404, the ENB allocates available resources to the UE like other UEs in a conventional manner, considering that the call requested by the UE is a typical call in step 410. Therefore, the ENB transmits a conventional RA Response to the UE in step 410.

FIG. 5 is a block diagram of a UE apparatus according to an exemplary embodiment of the present invention.

Referring to FIG. 5, a call initiator 513 initiates a call upon user request. A priority decider 514 determines the priority level of the call by analyzing the user request and transmits information about the decided priority level to an RA code generator 515. The RA code generator 515 generates a predetermined RA code among available RA codes, if the priority level information indicates a high

priority level. A preamble generator 516 generates an RA Preamble according to the RA code received from the RA code generator 515. A transceiver 517 transmits the RA Preamble received from the preamble generator 516 to an ENB.

Meanwhile, the transceiver 517 receives an RA Response from the ENB and provides it to the priority decider 514. The priority decider 514 compares a high priority indication included in the RA Response with the transmitted RA code and notifies a success/failure decider 519 of the comparison result. The success/failure decider 519 determines whether the RA procedure has been successful or failed according to the comparison result and notifies the transceiver 517 whether a UL signaling message is to be transmitted. The transceiver 517 transmits an RRC Connection Request message to the ENB under the control of the success/failure decider 519.

FIG. 6 is a block diagram of an ENB apparatus according to an exemplary embodiment of the present invention.

Referring to FIG. 6, a preamble receiver 611 receives an RA Preamble from a UE and provides the RA Preamble to a priority decider 613 and an RA code included in the RA Preamble to a response generator 619. The priority decider 613 determines whether the RA Preamble includes a predetermined RA code and notifies a resource manager 617 of the determination result. If the determination result indicates the presence of the predetermined RA code in the RA Preamble, the resource manager 617 allocates current available resources of the ENB to the UE and provides resource information indicating the allocated resources to the response generator 619. The response generator 619 generates an RA Preamble including the RA code received from the preamble receiver 611 and the resource information. A response transmitter 621 transmits the RA Response received from the response generator 619 to the UE.

As is apparent from the above description, the present invention advantageously reduces RA contention with other UEs that may occur during an RA procedure when a UE requests setup of a high-priority call and allocates available resources of an ENB to the high priority call of the UE above all other UEs. Therefore, the call can be established rapidly.

While the invention has been shown and described with reference to certain exemplary embodiments of the present invention thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. A random access method of a Mobile Station (MS) in a mobile communication system, comprising:

selecting, upon generation of a high-priority call, a predetermined Random Access (RA) code indicating generation of a high-priority call; and

generating a preamble using the selected RA code and transmitting the preamble to a Base Station (BS).

2. The random access method of claim 1, further comprising:

receiving a response for the preamble from the BS; and

determining that a random access to the BS is successful, if the response includes the predetermined RA codes.

3. A random access method of a Base Station (BS) in a mobile communication system, comprising:

determining whether a preamble received from a Mobile Station (MS) includes a predetermined Random Access (RA) code; and

allocating current available resources to the MS with priority over other MSs, if the preamble includes the predetermined RA code.

4. The random access method of claim 3, wherein the allocation comprises:

setting a high priority indication to the predetermined RA code;

allocating the current available resources to the MS with priority over other MSs; and

generating a response including information about the high priority indication and information about the allocated resources and transmitting the response to the MS.

5. A random access apparatus of a Mobile Station (MS) in a mobile communication system, comprising:

a priority decider for, upon generation of a call, deciding a priority level of the call;

a Random Access (RA) code generator for generating a predetermined

RA code indicating generation of a high-priority call, if the priority level of the call is high;

a preamble generator for generating a preamble using the generated RA code; and

a transceiver for transmitting the preamble to a Base Station (BS).

6. The random access apparatus of claim 5, wherein the transceiver receives a response for the preamble from the BS, the priority decider determines whether the response includes the predetermined RA codes, further comprising a success/failure decider for determining that a random access to the BS is successful, if the response includes the predetermined RA codes.

7. A random access apparatus of a Base Station (BS) in a mobile communication system, comprising:

a preamble receiver for receiving a preamble from a Mobile Station (MS);

a priority decider for determining whether the preamble includes a predetermined Random Access (RA) code; and

a resource manager for allocating current available resources to the MS with priority over other MSs, if the preamble includes the predetermined RA code.

8. The random access apparatus of claim 7, further comprising a response generator for receiving an RA code included in the received preamble from the preamble receiver, receiving the information about the allocated resources from the resource manager, and generating a response including the RA code and the information about the allocated resources.

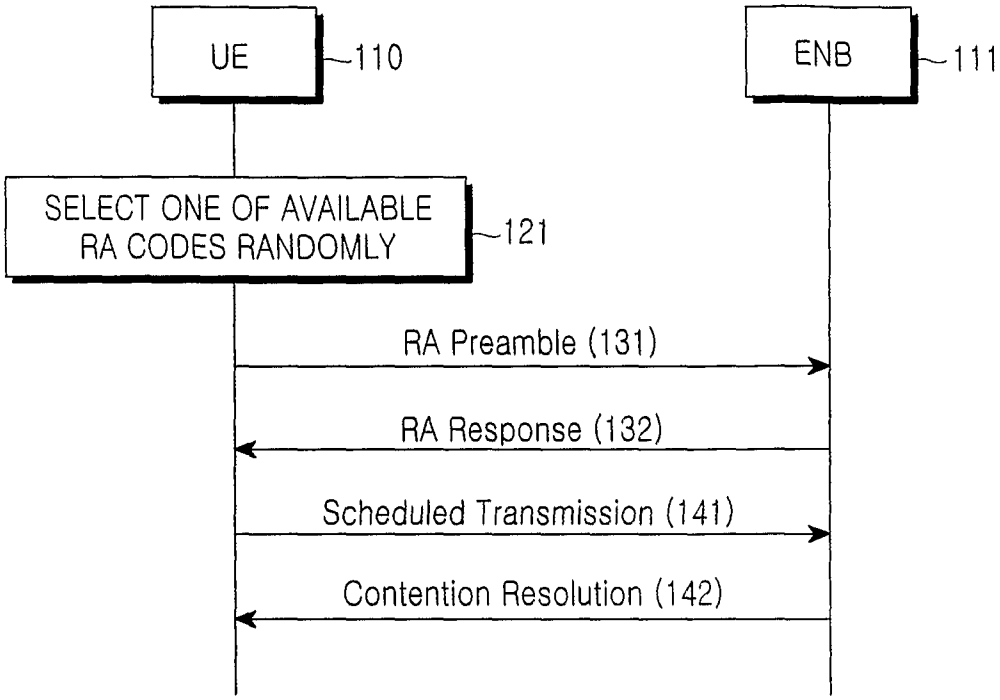
UE
110
ENB
111
SELECT ONE OF AVAILABLE RA CODES RANDOMLY
121
RA Preamble (131)
RA Response (132)
Scheduled Transmission (141)
Contention Resolution (142)

FIG.1

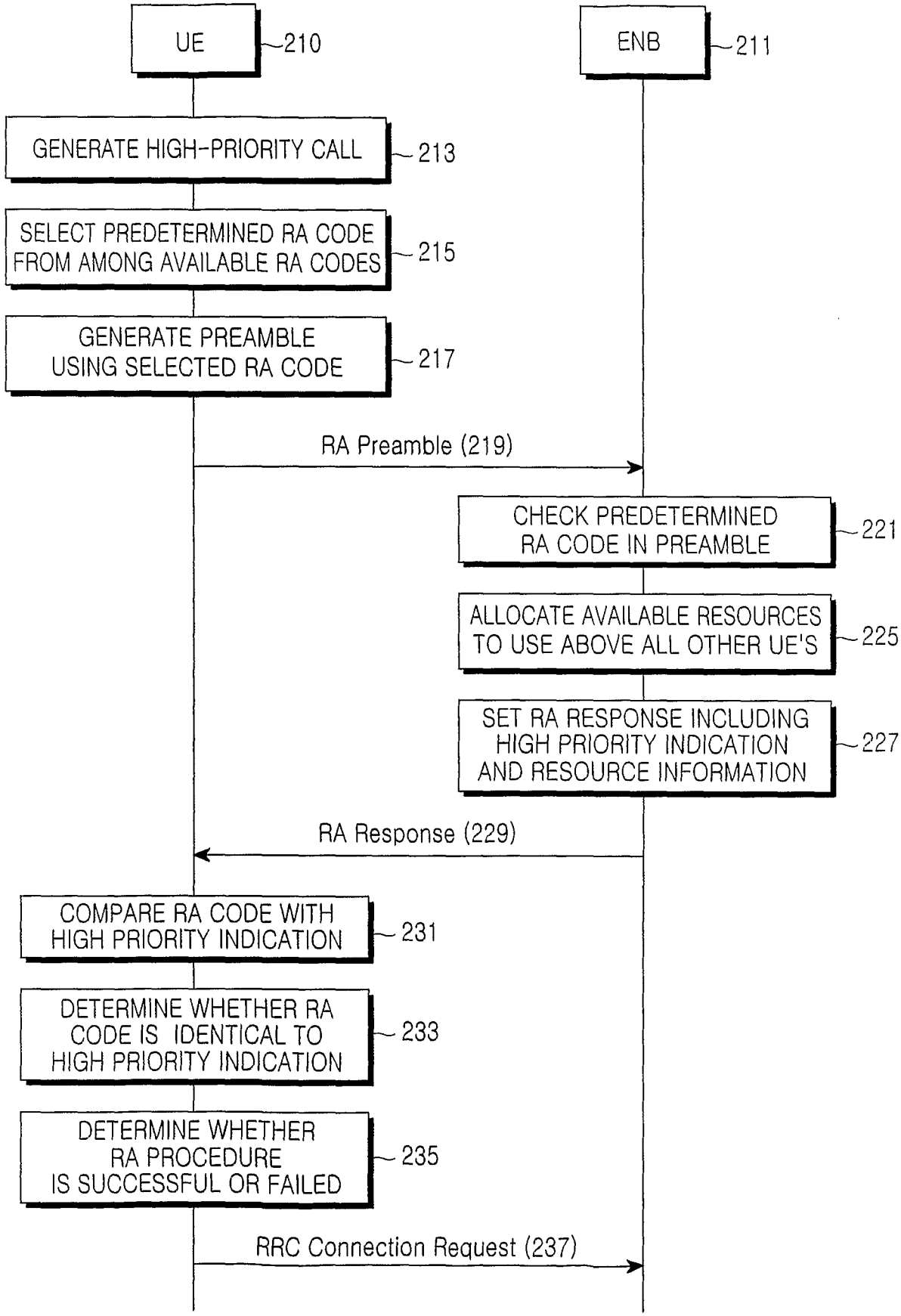
UE
210
ENB
211
GENERATE HIGH-PRIORITY CALL
213
SELECT PREDETERMINED RA CODE FROM AMONG AVAILABLE RA CODES
215
GENERATE PREAMBLE USING SELECTED RA CODE
217
RA Preamble (219)
CHECK PREDETERMINED RA CODE IN PREAMBLE
221
ALLOCATE AVAILABLE RESOURCES TO USE ABOVE ALL OTHER UE'S
225
SET RA RESPONSE INCLUDING HIGH PRIORITY INDICATION AND RESOURCE INFORMATION
227
RA Response (229)
COMPARE RA CODE WITH HIGH PRIORITY INDICATION
231
DETERMINE WHETHER RA CODE IS IDENTICAL TO HIGH PRIORITY INDICATION
233
DETERMINE WHETHER RA PROCEDURE IS SUCCESSFUL OR FAILED
235
RRC Connection Request (237)

FIG.2

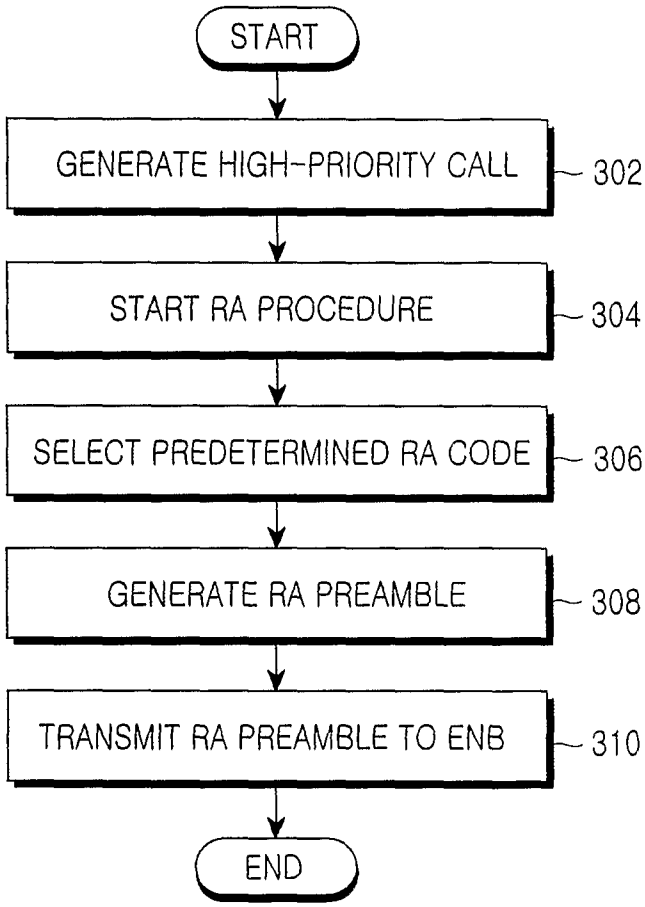
START
GENERATE HIGH-PRIORITY CALL
302
START RA PROCEDURE
304
SELECT PREDETERMINED RA CODE
306
GENERATE RA PREAMBLE
308
TRANSMIT RA PREAMBLE TO ENB
310
END

FIG.3A

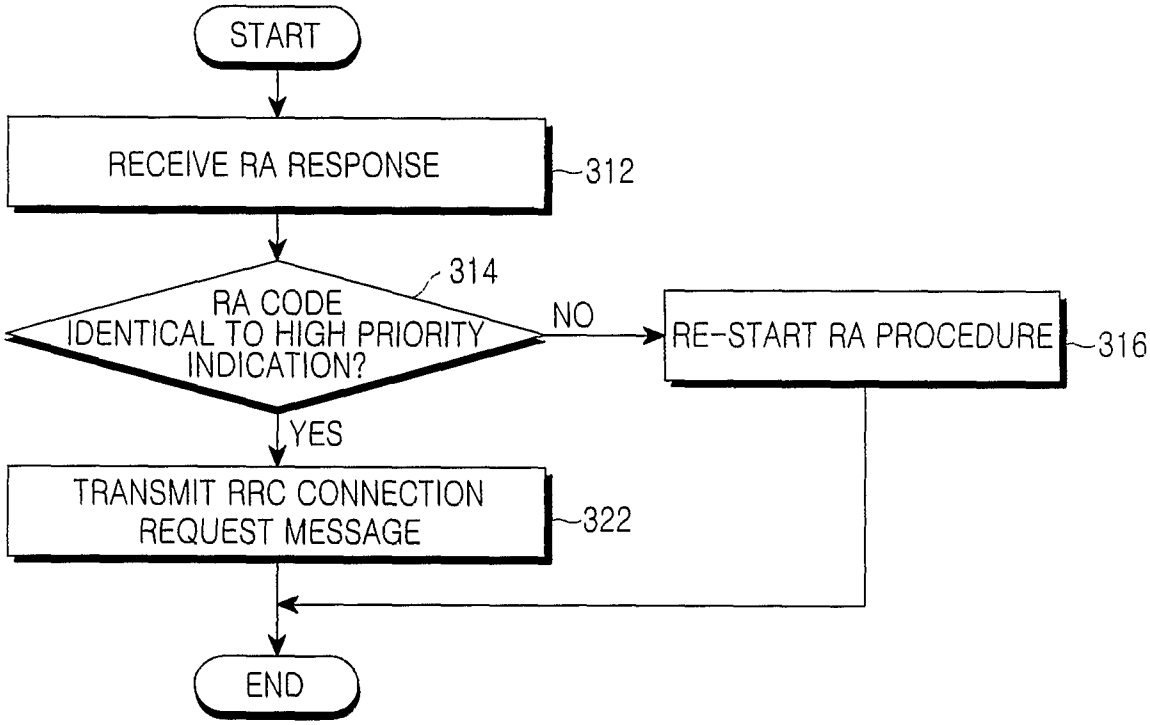
START
RECEIVE RA RESPONSE
312
314
RA CODE IDENTICAL TO HIGH PRIORITY INDICATION?
NO
RE-START RA PROCEDURE
316
YES
TRANSMIT RRC CONNECTION REQUEST MESSAGE
322
END

FIG.3B

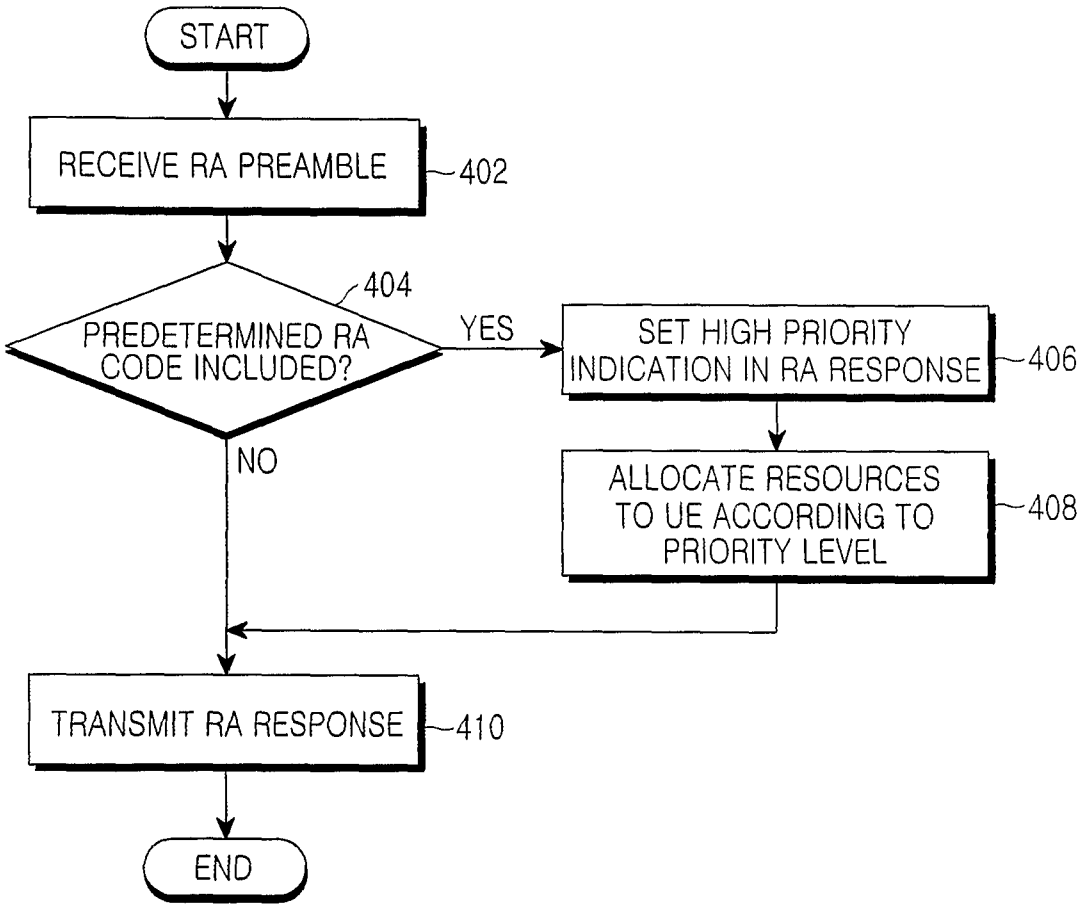
START
RECEIVE RA PREAMBLE
402
404
PREDETERMINED RA CODE INCLUDED?
YES
SET HIGH PRIORITY INDICATION IN RA RESPONSE
406
NO
ALLOCATE RESOURCES TO UE ACCORDING TO PRIORITY LEVEL
408
TRANSMIT RA RESPONSE
410
END

FIG.4

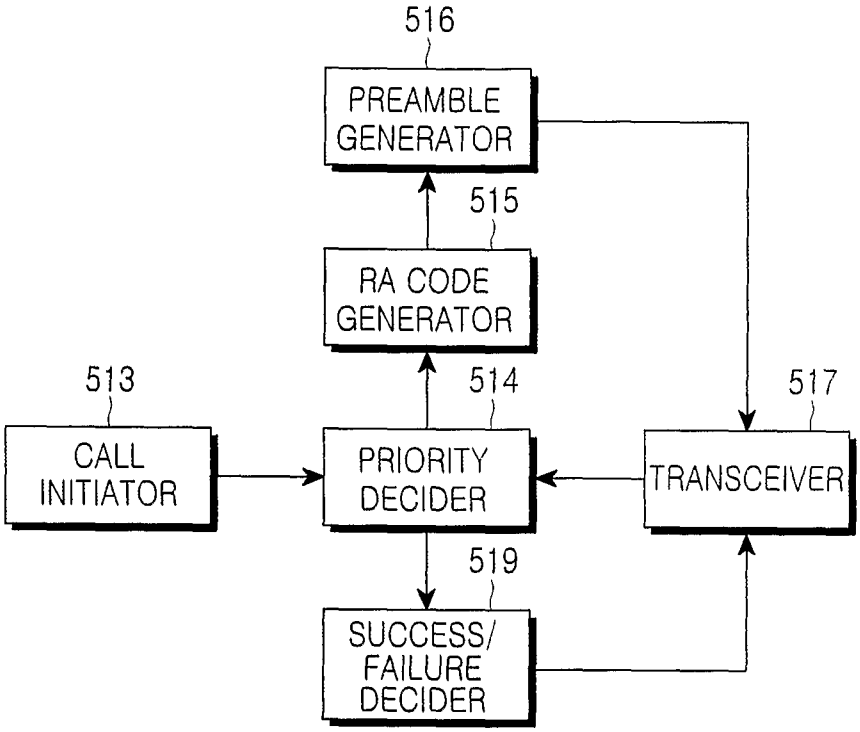
516
PREAMBLE GENERATOR
515
RA CODE GENERATOR
513
514
517
CALL INITIATOR
PRIORITY DECIDER
TRANSCEIVER
519
SUCCESS/ FAILURE DECIDER

FIG.5

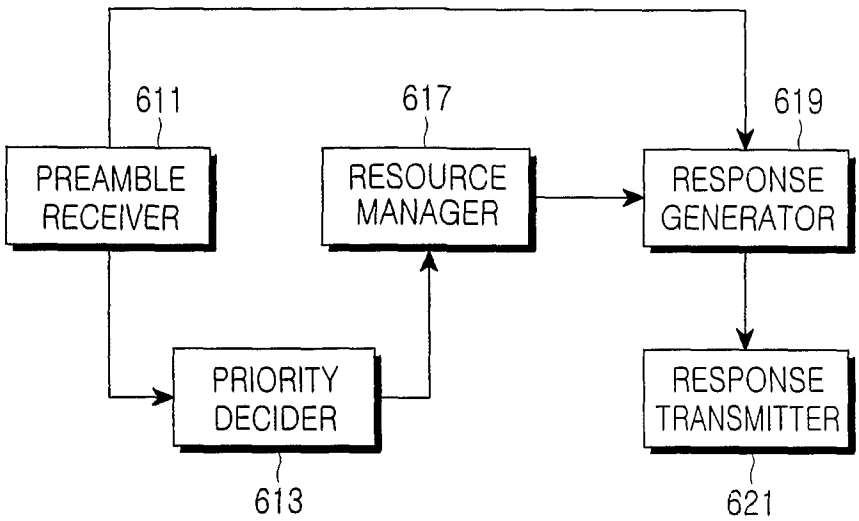
611
617
619
PREAMBLE RECEIVER
RESOURCE MANAGER
RESPONSE GENERATOR
PRIORITY DECIDER
RESPONSE TRANSMITTER
613
621

FIG.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/007090

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/26(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)
IPC H04B, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KOREAN UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975
JAPANESE 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)
eKIPASS, DELPHION, ESPACENET & Keywords : E-UTRAN, random access, code, preamble, call, priority and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US2007-230600 A1 (BERTRAND et al.) 4 October 2007 * abstract, paragraphs [0074]-[0079], figure 12, claim 28 *	1-8
A	US2007-165567 A1 (TAN et al.) 19 July 2007 * abstract *	1-8
A	JICHAO LIU et al.; 'Preamble Design Based on Complete Complementary Sets for Random Access in MIMO-OFDM Systems'; Wireless Communications and Networking Conference, 2007.WCNC 2007. IEEE; 11-15 March 2007; pp. 858 - 862	1-8
A	POPOVIC, B.M. et al.; 'Random Access Preambles for Evolved UTRA Cellular System'; Spread Spectrum Techniques and Applications, 2006 IEEE Ninth International Symposium on; 28-31 August 2006; pp. 488 - 492	1-8

☐ 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 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
23 MARCH 2009 (23.03.2009)	**23 MARCH 2009 (23.03.2009)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
KIM, Sang Woo
Telephone No. 82-42-481-8324

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/007090

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007-0230600 A1	04.10.2007	NONE	
US 2007-165567 A1	19.07.2007	NONE	