



US009271263B2

(12) **United States Patent**  
**Lee et al.**

(10) **Patent No.:** **US 9,271,263 B2**  
(45) **Date of Patent:** **Feb. 23, 2016**

(54) **METHOD OF ERROR RECOVERY IN TRANSMITTING AND RECEIVING VOICE SERVICE IN PACKET BASED MOBILE COMMUNICATION SYSTEMS**

(76) Inventors: **Kyoung Seok Lee**, Daejeon (KR); **Jae Heung Kim**, Daejeon (KR); **Soo Jung Jung**, Daejeon (KR); **Jae Young Ahn**, Daejeon (KR)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 425 days.

(21) Appl. No.: **12/996,927**

(22) PCT Filed: **Jun. 17, 2009**

(86) PCT No.: **PCT/KR2009/003254**

§ 371 (c)(1),  
(2), (4) Date: **Dec. 8, 2010**

(87) PCT Pub. No.: **WO2009/154404**

PCT Pub. Date: **Dec. 23, 2009**

(65) **Prior Publication Data**

US 2011/0188461 A1 Aug. 4, 2011

(30) **Foreign Application Priority Data**

Jun. 20, 2008 (KR) ..... 10-2008-0058425  
Jun. 15, 2009 (KR) ..... 10-2009-0052760

(51) **Int. Cl.**  
**H04W 72/04** (2009.01)  
**H04W 72/12** (2009.01)

(52) **U.S. Cl.**  
CPC ..... **H04W 72/04** (2013.01); **H04W 72/0413** (2013.01); **H04W 72/1289** (2013.01)

(58) **Field of Classification Search**  
USPC ..... 370/328, 329-330, 335, 336, 337, 252; 455/450, 452.1, 452.2  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,031,688 B2 *	10/2011	Papasakellariou et al. ....	370/344
8,102,820 B2 *	1/2012	Kwon et al. ....	370/336
8,155,067 B2 *	4/2012	Wang et al. ....	370/329
2008/0192674 A1 *	8/2008	Wang et al. ....	370/315
2009/0010240 A1 *	1/2009	Papasakellariou ....	H04L 5/0007 370/344
2009/0168731 A1 *	7/2009	Zhang .....	H04L 1/1887 370/336
2009/0287976 A1 *	11/2009	Wang .....	H04L 1/1812 714/748
2009/0298524 A1 *	12/2009	Kuo .....	H04L 1/1874 455/509
2009/0307555 A1 *	12/2009	Cai .....	H04L 1/1887 714/748
2011/0124360 A1 *	5/2011	Sagfors .....	H04W 28/18 455/509
2011/0194502 A1 *	8/2011	Sung .....	H04L 12/66 370/329

FOREIGN PATENT DOCUMENTS

KR 10-2007-0103649 10/2007

OTHER PUBLICATIONS

Kalyanasundaram, Suresh et al., "Resource Allocation Scheme for 802.16," IEEE 802.16 Broadband Wireless Access Working Group, <http://ieee802.org/16>, 3 pages, (2007).

\* cited by examiner

*Primary Examiner* — Candal Elpenord

(57) **ABSTRACT**

Provided is a method of transmitting and receiving data using a persistent allocation scheme in order to effectively support a voice service between a base station and a mobile terminal in a packet based mobile communication system. When an error occurs in transmitting a control information that indicates whether to use a radio resource using the persistent allocation scheme, the base station may retransmit the control information and thereby maintain a communication quality.

**8 Claims, 5 Drawing Sheets**

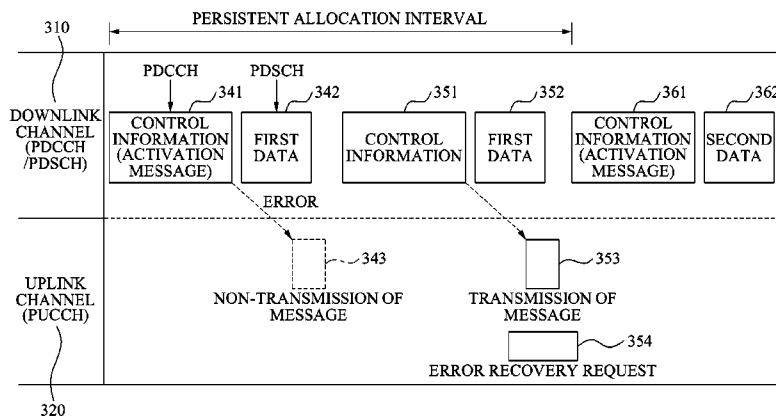


Fig. 1

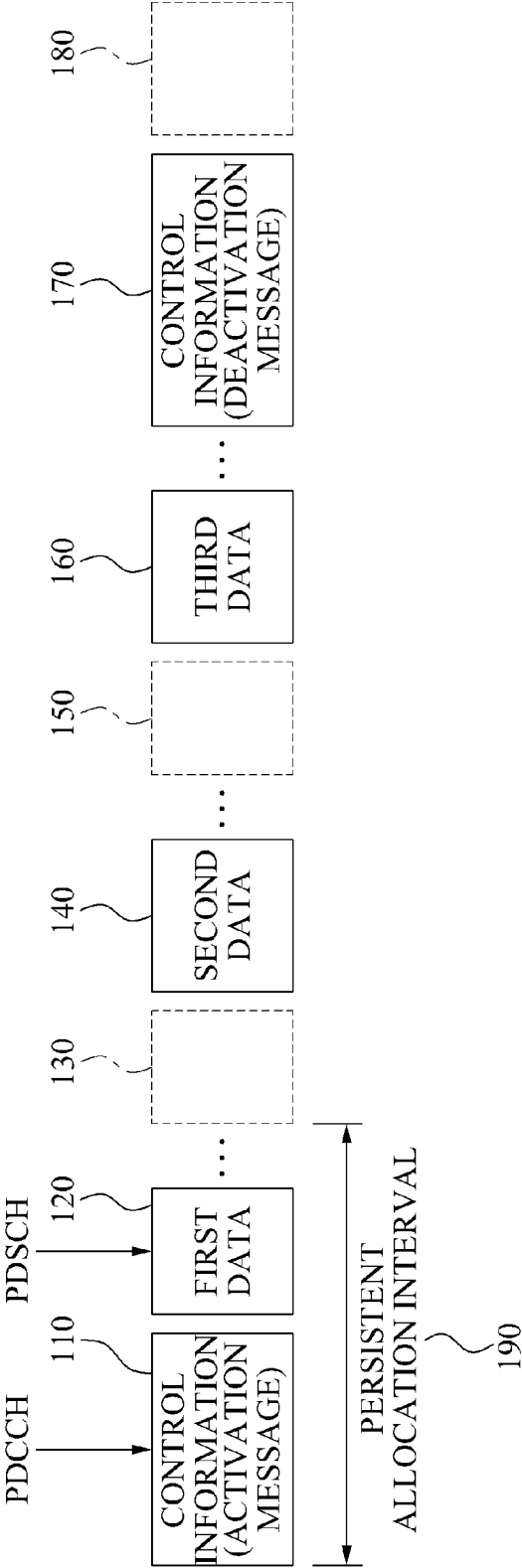


Fig. 2

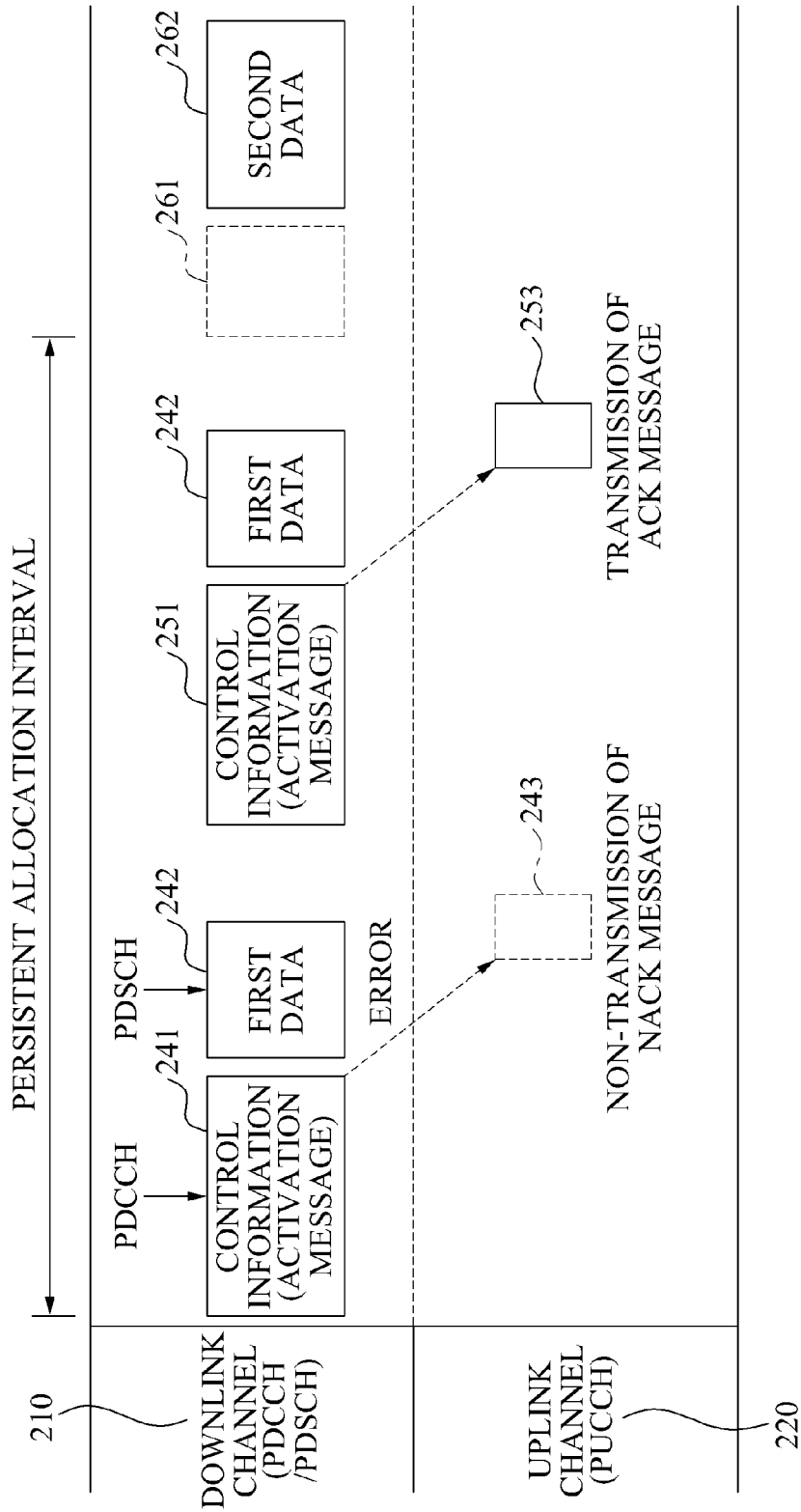


Fig. 3

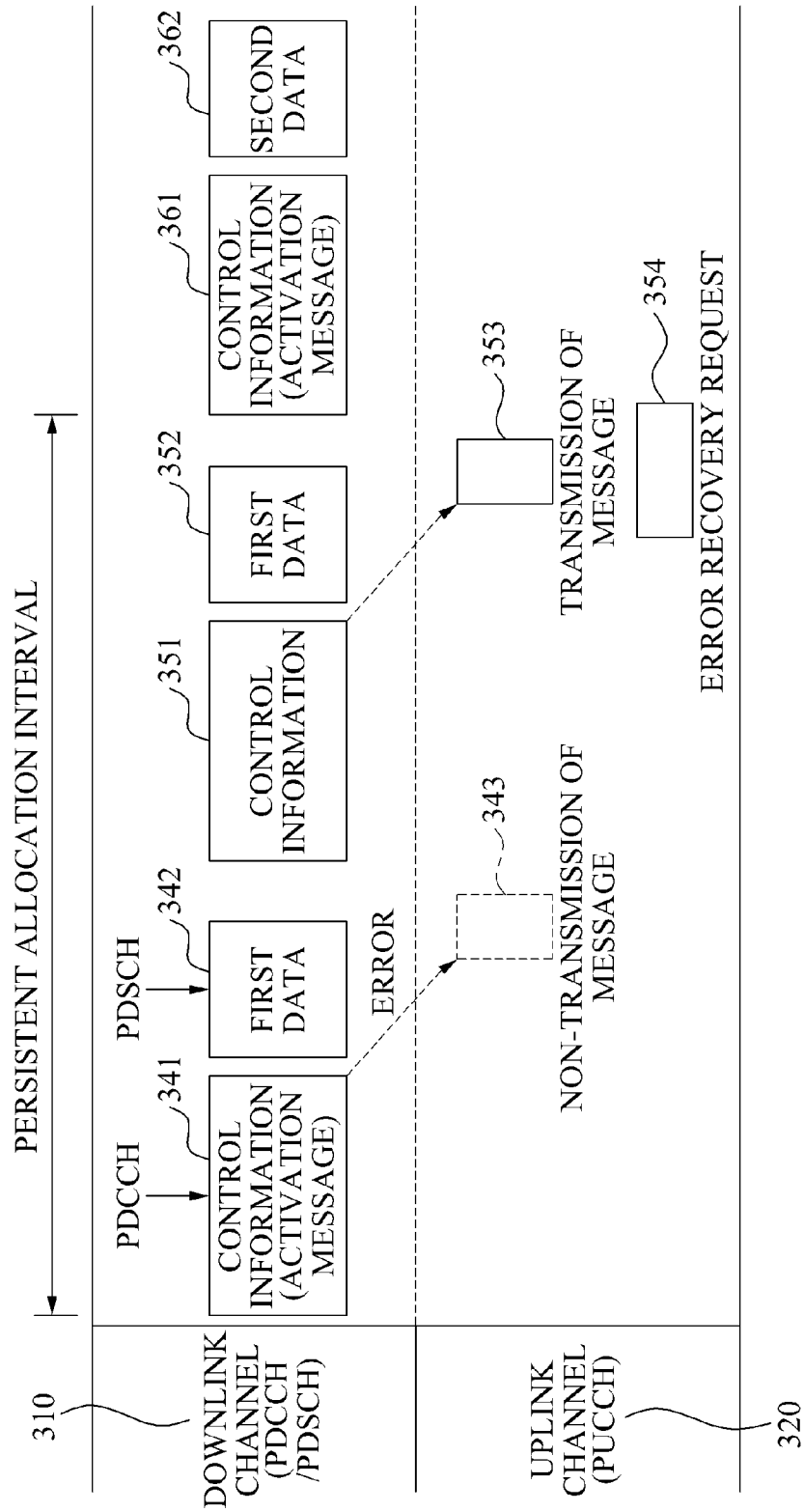


Fig. 4

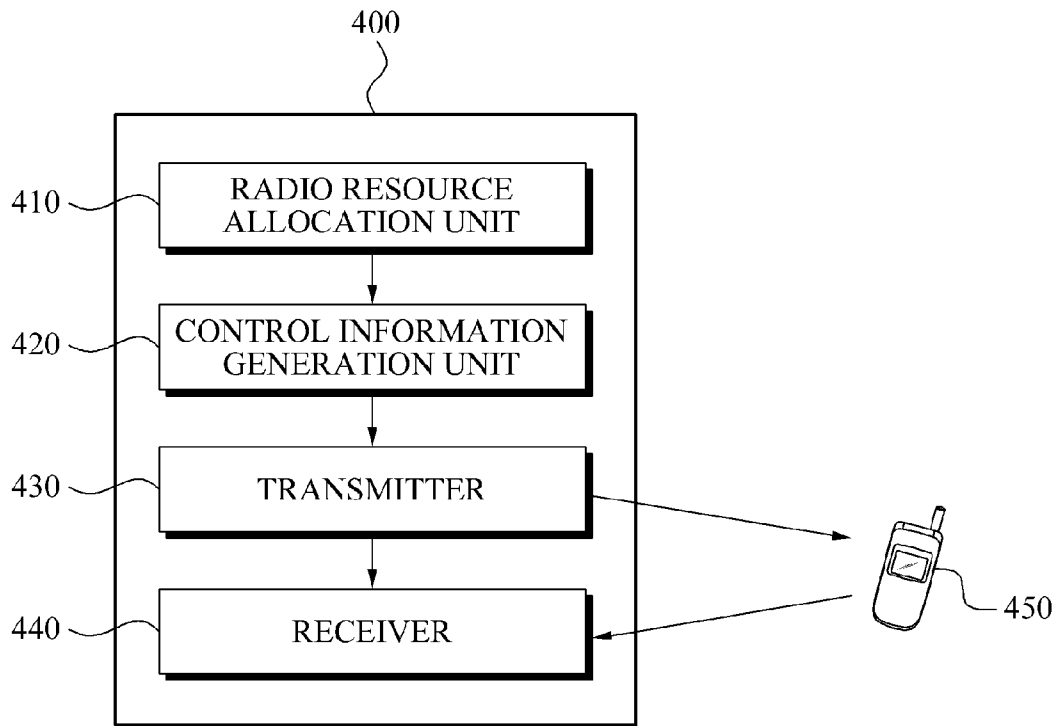


Fig. 5

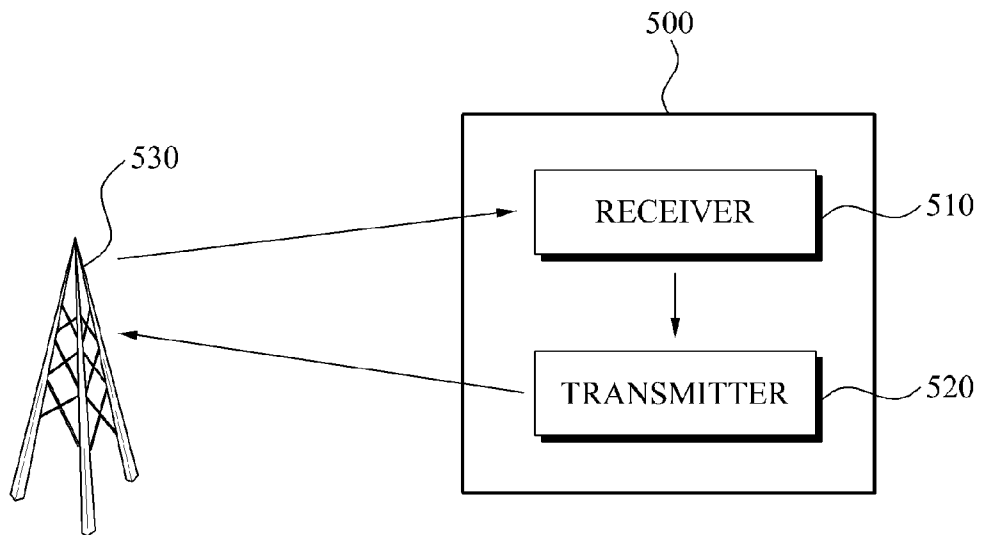
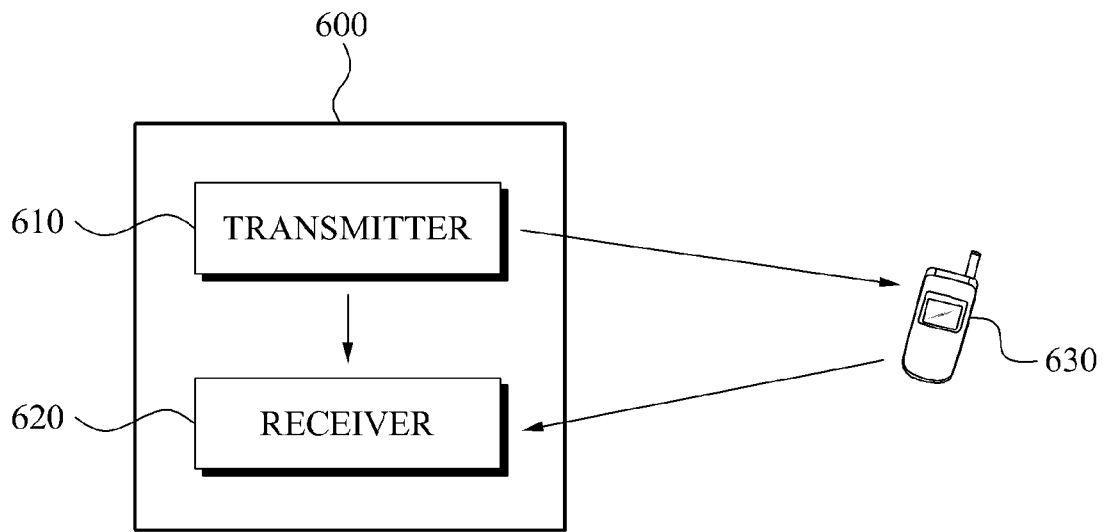


Fig. 6



1

# METHOD OF ERROR RECOVERY IN TRANSMITTING AND RECEIVING VOICE SERVICE IN PACKET BASED MOBILE COMMUNICATION SYSTEMS

## RELATED APPLICATIONS

This application is a 35 U.S.C. §371 national stage filing of PCT Application No. PCT/KR2009/003254 filed on Jun. 17, 2009, which claims priority to, and the benefit of, Korean Patent Application No. 10-2008-0058425 filed on Jun. 20, 2008 and Korean Patent Application No. 10-2009-0052760 filed on Jun. 15, 2009. The contents of the aforementioned applications are hereby incorporated by reference.

## TECHNICAL FIELD

The present invention relates to a method of transmitting and receiving data in a packet based mobile communication system, and more particularly, to a method of re-covering from a reception error of a control message, which occurs when transmitting and receiving data using a persistent allocation scheme, in order to effectively support a voice service between a base station and a mobile terminal in a next generation packet mobile communication system, which is under discussion for a standardization.

## BACKGROUND ART

3<sup>rd</sup> Generation Partnership Project (3GPP), one of a number of mobile communication standardization organizations, is engaging in a Long Term Evolution (LTE) standardization process and an advanced LTE standardization process in order to develop a packet based mobile communication system standardization. A mobile communication system generally includes a base station constituting a cell, and a mobile terminal used by a user. A plurality of mobile terminals may transmit and receive packet data to and from the base station via a radio channel.

## DISCLOSURE OF INVENTION

### Technical Problem

An aspect of the present invention provides a method of effectively controlling an activation and a deactivation of a persistent allocation scheme when transmitting and receiving packet data using the persistent allocation scheme, and a method of transmitting and receiving a control message for an error recovery.

### Technical Solution

According to an aspect of the present invention, there is provided a base station including: a radio resource allocation unit to allocate a radio resource to a terminal; a control information generation unit to generate control information based on the allocated radio resource; a transmitter to transmit the control information to the terminal; and a receiver to receive an acknowledgement (ACK) message with respect to the control information.

According to another aspect of the present invention, there is provided a terminal including: a receiver to receive, from a base station, control information associated with data; and a transmitter to transmit, to the base station, an ACK message with respect to the control information. The receiver may receive the data based on the control information.

2

According to still another aspect of the present invention, there is provided a base station including: a transmitter to transmit, to a terminal, control information associated with first data, and to transmit the first data to the terminal using the control information; and a receiver to receive an ACK message with respect to the control information. When the ACK message with respect to the control information is not received, the transmitter may retransmit the control information.

## Advantageous Effects

According to embodiments of the present invention, when an error occurs wherein the error is an activation message not received by a terminal transmitted from a base station in a persistent allocation scheme, it is possible to quickly recover from the error.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a diagram illustrating an example of recovering from a transmission error according to an embodiment of the present invention;

FIG. 2 is a diagram illustrating an operation of a base station recovering from a transmission error according to an embodiment of the present invention;

FIG. 3 is a diagram illustrating an operation of a terminal recovering from a transmission error according to an embodiment of the present invention;

FIG. 4 is a block diagram illustrating a structure of a base station according to an embodiment of the present invention;

FIG. 5 is a block diagram illustrating a structure of a terminal according to an embodiment of the present invention; and

FIG. 6 is a block diagram illustrating a structure of a base station according to another embodiment of the present invention.

## MODE FOR THE INVENTION

Reference will now be made in detail to exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. Exemplary embodiments are described below to explain the present invention by referring to the figures.

FIG. 1 is a diagram illustrating an example of recovering from a transmission error according to an embodiment of the present invention. Although FIG. 1 shows an embodiment where a base station transmits downlink data to a terminal, the present invention may be applicable to an embodiment where the terminal transmits uplink data to the base station.

Generally, an amount of the downlink data may be too great to be transmitted from the base station to the terminal at once. Therefore, the base station may divide the downlink data into a plurality of data blocks, and sequentially transmit the divided data blocks to the terminal. Hereinafter, the divided data blocks are referred to as first data, second data, and the like, respectively.

Referring to FIG. 1, the base station may transmit first data **120** to the terminal. The base station may transmit control information **110** associated with the first data **120** prior to transmitting the first data **120**. According to an embodiment of the present invention, the control information **110** may include information associated with a radio resource used to transmit the first data **120**. The terminal may receive information associated with the radio resource, and receive the first

data **120** by referring to the received information associated with the radio resource. For example, the terminal may be aware of information associated with a time domain or a frequency domain where the first data **120** is transmitted, by referring to information associated with the radio resource. The terminal may receive the first data **120** in the time domain or the frequency domain where the first data **120** is transmitted.

The control information **110** may include modulation and coding scheme information associated with the first data **120** or error control scheme information associated with the first data **120**. The terminal may receive the modulation and coding scheme information or the error control scheme information, and receive the first data **120** using the modulation and coding scheme information or the error control scheme information.

When the present invention is applied to a 3<sup>rd</sup> Generation Partnership Project (3GPP) Long Term Evolution (LTE) system, control information may be transmitted using a Physical Downlink Control Channel (PDCCH). Also, first data or second data may be transmitted using a Physical Downlink Shared Channel (PDSCH).

Referring again to FIG. 1, the base station may transmit data every persistent allocation interval **190**. After transmitting the first data **120**, the base station may transmit second data **140** to the terminal. When control information **130** associated with the second data **140** is different from the control information **110** associated with the first data **120**, the base station may transmit the control information **130** associated with the second data **140** to the terminal.

The terminal may receive information associated with a radio resource to transmit the second data **140**, and modulation and coding scheme information or error control scheme information associated with the second data **140**, which are included in the control information **130**. The terminal may receive the second data **140** using the control information **130**.

A case where the control information **110** associated with the first data **120** is different from the control information **130** associated with the second data **140** is referred to as a variable allocation scheme. The variable allocation scheme may need to transmit control information with respect to every piece of data.

In the case of a service with a low data transmission rate such as a voice service, when control information is additionally transmitted with respect to every piece of data, it may be ineffective. The base station may apply the same modulation and coding scheme or the same error control scheme to every piece of data. In this case, the control information **110** associated with the first data **120** may be the same as the control information **130** associated with the second data **140**. Accordingly, only when initially transmitting data, the base station may transmit the control information **110**. After transmitting the control information **110**, the base station may not transmit additional control information. Since a transmission of control information decreases, a radio resource utilization efficiency may be enhanced, which is referred to as a persistent allocation scheme or a semi-persistent scheduling scheme.

In the case of the persistent allocation scheme, an activation message included in the control information **110** may be transmitted prior to data transmission. The activation message indicates a start of use of the radio resource. Also, a deactivation message included in control information **170** may be transmitted after the data transmission. The deactivation message indicates a suspension of use of the radio resource.

Since a status of a radio channel formed between the base station and the terminal may be unstable, the terminal may not receive control information. When the terminal does not receive the control information, the terminal may not receive first data and second data.

Referring to FIG. 1, in the variable allocation scheme, the control information **110**, **130**, and **150** may be transmitted with respect to the first data **120**, the second data **140**, and third data **160**, respectively. Therefore, when the terminal does not receive the control information **110** associated with the first data **120**, the terminal may abandon receiving of the first data **120**. When the terminal receives the control information **130** associated with the second data **140**, the terminal may receive the second data **140** using the control information **130**.

In the persistent allocation scheme, the control information **110** and **130** may be transmitted at particular points in time. When the terminal does not receive the control information **110** and **130**, the terminal may not receive the first data **120** and the second data **140**.

According to an embodiment of the present invention, when a terminal receives a control information, the terminal may transmit, to a base station, an acknowledgement (ACK) message with respect to the control information. When the base station receives, from the terminal, the ACK message with respect to the control information, it may be known that the base station successfully receives the control information.

Conversely, when the base station does not receive the ACK message with respect to the control information, whether the terminal successfully receives the control information may be uncertain. In preparation for a case where the terminal does not receive the control information, the base station may retransmit the control information to the terminal.

FIG. 2 is a diagram illustrating an operation of a base station recovering from a transmission error according to an embodiment of the present invention. The base station may transmit first data **242** and **252**, second data **262**, and control information **241**, **251**, and **261** using a downlink channel **210**.

The control information **241** may include an activation message with respect to a radio resource. The terminal may receive the first data **242** using the radio resource. The transmission error may be defined as the control information **241** or the first data **242** transmitted from the base station is not received by the terminal.

When the transmission error occurs, the terminal may not recognize that the radio resource is activated. Also, since the terminal may be unaware of that the control information **241** or the first data **242** is transmitted, the terminal may not transmit a NACK message **243**.

When the base station does not receive an ACK message from the terminal, the base station may retransmit the first data **252**. Also, the base station may retransmit the control information **251** associated with the first data **252**. The retransmitted control information **251** may include an activation message with respect to the radio resource, and modulation and coding scheme information or error control scheme information associated with the first data **252**.

When the terminal receives the retransmitted control information **251** and transmits an ACK message **253** to the base station using an uplink channel **220**, the base station may no longer transmit additional control information. The base station may transmit the second data **262** to the terminal but may not transmit control information **261** associated with the second data **262**. The terminal may receive the second data **262** using the control information **251** with respect to the second data **262**.

When the terminal does not receive, from the base station, a deactivation message with respect to a radio resource, the

5

base station may retransmit the deactivation message to the terminal, which is similar to an embodiment of checking on ACK message and retransmitting an activation message with respect to the radio resource.

FIG. 3 is a diagram illustrating an operation of a terminal recovering from a transmission error according to an embodiment of the present invention. A base station may transmit first data 342 and 352, and second data 362 using a downlink channel 310. Also, the base station may transmit control information 341, 351, and 361 using the downlink channel 310.

Here, it is assumed that the base station transmits the control information 341 associated with the first data 342 but a transmission error occurs.

When the transmission error occurs, the terminal may not receive an ACK message and may not transmit a NACK message 343. When the base station does not receive the ACK message from the terminal, the base station may retransmit the first data 352. The retransmitted control information 351 may include modulation and coding scheme information or error control scheme information associated with the first data 352.

The terminal may receive the first data 352 using the retransmitted control information 351. An activation message with respect to a radio resource may not be received yet at the terminal. The terminal may retransmit an error recovery request 354 using an uplink channel 320.

The base station may retransmit an activation message 361, in response to the error recovery request 354.

When the terminal does not receive, from the base station, a deactivation message with respect to a radio message, the base station may retransmit the deactivation message to the terminal, which is similar to an embodiment of retransmitting an activation message with respect to the radio resource.

FIG. 4 is a block diagram illustrating a structure of a base station 400 according to an embodiment of the present invention. The base station 400 may include a radio resource allocation unit 410, a control information generation unit 420, a transmitter 430, and a receiver 440.

The radio resource allocation unit 410 may allocate a radio resource to a terminal 450.

The control information generation unit 420 may generate control information by referring to the allocated radio resource. The control information may include information associated with the radio resource.

The transmitter 430 may transmit the control information to the terminal 450. According to an embodiment of the present invention, the transmitter 430 may transmit first data to the terminal 450 using the radio resource. The terminal 450 may receive information associated with the radio resource, included in the control information, and receive the first data using information associated with the radio resource.

According to an embodiment of the present invention, control information may include an activation message or a deactivation message with respect to a radio resource. The activation message with respect to the radio resource indicates that a previously unused radio resource is allocated to a particular terminal and is used to transmit first data. The deactivation message with respect to the radio resource indicates that a radio resource used to transmit the first data is released. In a 3GPP LTE system, the activation message and the deactivation message may be indicated as a field of a PDCCH, for example, one bit, or may be indicated as a terminal identifier for a voice service, for example, a semi-persistent scheduling C-RNTI, and the like.

Accordingly, the terminal 450 may receive the activation message with respect to the radio resource, and transmit the

6

first data using the radio resource associated with the activation message. The terminal 450 may receive the deactivation message with respect to the radio resource and may suspend a transmission of the first data using the radio resource.

When the terminal 450 does not receive the activation message with respect to the radio resource, the terminal 450 may not receive the first data. Also, when the terminal 450 does not receive the deactivation message with respect to the radio resource, the radio resource may not be retrieved. Accordingly, the base station 400 may need to verify whether the terminal 450 receives the activation message or the deactivation message with respect to the radio resource. The terminal 450 may receive the control information, and may transmit, to the base station 400, an ACK message with respect to the received control information.

The receiver 440 may receive the ACK message with respect to the control information. When the receiver 440 does not receive the ACK message with respect to the control information, the base station 400 may not verify whether the terminal 450 does not receive the control information. In this case, the transmitter 430 may retransmit the control information to the terminal 450.

When the present invention is applied to the 3GPP LTE system, the ACK message may be transmitted using a Physical Uplink Control Channel (PUCCH). A content of the ACK message may include a Hybrid ARQ Positive Acknowledgement (HARQ ACK). A content of a NACK message may include a HARQ NACK.

According to an embodiment of the present invention, the control information may include modulation and coding scheme information associated with the first data or error control scheme information associated with the first data.

The transmitter 430 may transmit, to the terminal 450, the modulation and coding scheme information or the error control scheme information associated with the first terminal. The terminal 450 may receive the first data based on the modulation and coding scheme information or the error control scheme information.

According to an embodiment of the present invention, the transmitter 430 may transmit, to the terminal 450, second data using modulation and coding scheme information associated with the first data or error control scheme information associated with the first data. Specifically, control information transmitted from the transmitter 430 may be applicable to a plurality of data as well as particular data.

Also, the transmitter 430 may transmit the first data or the second data using the radio resource associated with the activation message.

FIG. 5 is a block diagram illustrating a structure of a terminal 500 according to an embodiment of the present invention. The terminal 500 may include a receiver 510 and a transmitter 520.

The receiver 510 may receive, from a base station 530, control information associated with data.

When the receiver 510 successfully receives the control information, the transmitter 520 may transmit, to the base station 530, an ACK message with respect to the control information. According to an embodiment of the present invention, the control information may include information regarding a radio resource associated with first data. The receiver 510 may receive the first data by referring to information associated with the radio resource.

According to an embodiment of the present invention, the control information may include modulation and coding scheme information associated with the first data or error control scheme information associated with the first data.

According to an embodiment of the present invention, the control information may include an activation message or a deactivation message with respect to the radio resource. The activation message with respect to the radio resource indicates that a previously unused radio resource is allocated to a particular terminal and is used to transmit the first data. The deactivation message with respect to the radio resource indicates that the radio resource used to transmit the first data is released. The receiver 510 may receive the first data using the activated radio resource.

FIG. 6 is a block diagram illustrating a structure of a base station 600 according to another embodiment of the present invention. The terminal 600 may include a transmitter 610 and a receiver 620.

The transmitter 610 may transmit, to a terminal 630, control information associated with first data. According to an embodiment of the present invention, the control information may include information associated with a radio resource that is allocated for the first data. Specifically, the control information may include information associated with a time domain or a frequency domain where the first data is transmitted.

According to an embodiment of the present invention, the control information may include an activation message with respect to the radio resource. The activation message with respect to the radio resource indicates that a previously unused radio resource is allocated to a particular terminal and is used to transmit the first data. The terminal 630 may receive the activation message and receive the first data using the activated radio resource.

Also, the deactivation message with respect to the radio resource indicates that the radio resource used to transmit the first data is released. The terminal 630 may receive the deactivation message and suspend the data transmission using the radio resource.

The control information may include at least one of modulation and coding scheme information associated with the first data and error control scheme information associated with the first data. The terminal 630 may receive the first data using the modulation and coding scheme information or the error control scheme information.

The control information is required for the terminal 630 to receive the first data. Accordingly, the base station 600 may verify whether the terminal 630 receives the control information. According to an embodiment of the present invention, when the terminal 630 receives the control information, the terminal 630 may transmit, to the base station 600, an ACK message with respect to the control information. The receiver 620 may receive the ACK message with respect to the control information.

When the receiver 620 does not receive the ACK message with respect to the control information, it is uncertain whether the terminal 630 receives the control information. Accordingly, the transmitter 610 may retransmit the control information to the terminal 630.

According to an embodiment of the present invention, the control information may be applicable to second data as well as the first data. In this case, the transmitter 610 may also transmit the second data using the control information.

Although a few exemplary embodiments of the present invention have been shown and described, the present invention is not limited to the described exemplary embodiments. Instead, it would be appreciated by those skilled in the art that changes may be made to these exemplary embodiments with-

out departing from the principles and spirit of the invention, the scope of which is defined by the claims and their equivalents.

The invention claimed is:

1. A method of transmitting data in a base station, the method comprising:

transmitting a first part of the data and an activation message indicating a start of a persistent scheduling transmission in a same persistent allocation interval, the activation message transmitted through a Physical Downlink Control Channel (PDCCH);

receiving an acknowledgement message for the activation message from a terminal;

transmitting a second part of the data according to the persistent scheduling transmission;

transmitting a deactivation message indicating an end of the persistent scheduling transmission; and

receiving an acknowledgement message for the deactivation message from the terminal, wherein the activation message is retransmitted to the terminal if a negative acknowledgement message for the activation message is received or a positive acknowledgement message for the activation message is not received from the terminal.

2. The method of claim 1, wherein the PDCCH including the activation message is perceived by the terminal through Semi-Persistent Scheduling Cell-Radio Network Temporary Identifier (SPS C-RNTI).

3. The method of claim 1, wherein the first part of the data and the second part of the data are transmitted through Physical Downlink Shared Channel (PDSCH).

4. The method of claim 1, wherein the deactivation message is transmitted through Physical Downlink Control Channel (PDCCH) and the acknowledgement message for the deactivation message is received through Physical Uplink Control Channel (PUCCH).

5. A method of receiving data in a terminal, the method comprising:

receiving a first part of the data and an activation message indicating a start of a persistent scheduling transmission in a same persistent allocation interval, the activation message received through a Physical Downlink Control Channel (PDCCH);

transmitting an acknowledgement message for the activation message to a base station;

receiving a second part of the data according to the persistent scheduling transmission;

receiving a deactivation message indicating an end of the persistent scheduling transmission, the deactivation message received through the PDCCH; and

transmitting an acknowledgement message for the deactivation message to the base station.

6. The method of claim 5, wherein the terminal perceives the PDCCH including the activation message or the deactivation message using Semi-Persistent Scheduling Cell-Radio Network Temporary Identifier (SPS C-RNTI).

7. The method of claim 5, wherein the terminal transmits positive acknowledgement message for the activation message successfully received through PDCCH.

8. The method of claim 5, wherein the terminal transmits negative acknowledgement message for the deactivation message included in PDCCH if the terminal fails to decode the PDCCH.