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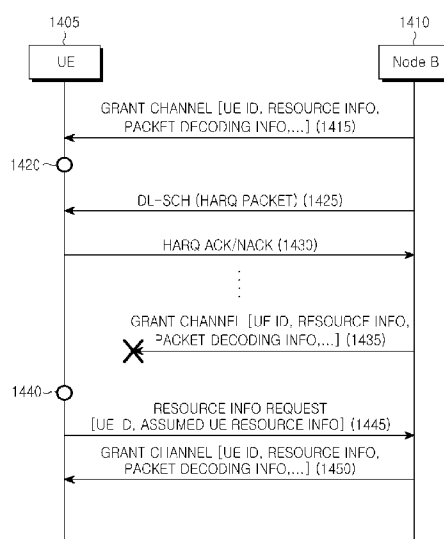
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(54) Title: METHOD AND APPARATUS FOR ALLOCATION OF TRANSMISSION RESOURCES IN A MOBILE COMMUNICATION SYSTEM



(57) Abstract: Disclosed is a method and an apparatus for reducing a signaling overhead of a Node B scheduling in a mobile communication system supporting the Node B scheduling, such as an LTE. The method includes: determining if first transmission resources indicated by a transmission resource allocation information known by an user equipment (UE) coincide with second transmission resources actually allocated by a network node; requesting the network node to transmit new transmission resource allocation information when the first transmission resources do not coincide with the second transmission resources; and receiving the new transmission resource allocation information indicating transmission resources allocated to the UE from the network node after the requesting.

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Description

METHOD AND APPARATUS FOR ALLOCATION OF TRANSMISSION RESOURCES IN A MOBILE COMMUNICATION SYSTEM

Technical Field

- [1] The present invention relates to a mobile communication system, and more particularly to a method and an apparatus for efficiently notifying a User Equipment (UE) of downlink and uplink transmission resources allocated by a Node B.

Background Art

- [2] A Universal Mobile Telecommunication Service (UMTS) system is a 3rd generation (3G) asynchronous mobile communication system that uses wideband Code Division Multiple Access (CDMA) and is based on Global System for Mobile Communications (GSM) and General Packet Radio Services (GPRS), which are European mobile communication systems.
- [3] In the third generation Partnership Project (3GPP), which is in charge of standardization of the UMTS, active discussion is being progressed about Long Term Evolution (LTE) of the UMTS system. The LTE is technology which is targeting commercialization thereof by the year 2010 and the realization of high speed packet-based communication at a speed of about 100 Mbps. To this end, being discussed are various schemes, which include a scheme of reducing the number of nodes located in communication paths by simplifying the structure of a network, and a scheme of approaching a wireless protocol to a wireless channel as much as possible. It is expected that the structure of the LTE will finally change to a 2 node structure or 3 node structure from the 4 node structure of the current UMTS system.
- [4] FIG. 1 illustrates an example of a structure of an evolved UMTS mobile communication system. As shown, the Evolved Radio Access Networks (E-RAN) 110 and 112 have a simplified 2 node structure, which includes Evolved Node Bs (ENBs) 120, 122, 124, 126, and 128 and Evolved Gateway GPRS Serving Nodes 130 and 132. A User Equipment (UE) 101 is connected to an Internet Protocol (IP) network 114 through the E-RANs 110 and 112.
- [5] The ENBs 120 to 128 correspond to legacy Node B of the UMTS system and are connected to the UE 101 through a wireless channel. Differently from the legacy Node B, the ENBs 120 to 128 perform more complex functions. In the LTE, all user traffic, including the real-time service, such as Voice over IP (VoIP), are provided through a shared channel. Therefore, the LTE requires an apparatus for collecting status information of UEs and performing scheduling by using the collected information. The

ENBs 120 to 128 take charge of the scheduling.

- [6] In order to implement a maximum transmission speed of 100 Mbps, the LTE may use Orthogonal Frequency Division Multiplexing (OFDM) in 20 MHz bandwidth as wireless connection technology. Further, the LTE may employ the Adaptive Modulation & Coding (AMC) scheme, which determines the modulation scheme and the channel coding rate in accordance with the channel state of the UE.
- [7] The LTE provides all traffic through a Shared Channel (SCH). The shared channel refers to a channel shared by multiple UEs, and transmission resources on a shared channel of each UE are dynamically allocated according to the channel state or the status report from a corresponding UE. The transmission/reception of data through a shared channel includes three steps of report, channel allocation, and data transmission through an allocated channel.
- [8] FIG. 2 illustrates an example of communication through a shared channel in a typical mobile communication system.
- [9] Referring to FIG. 2, in step 211, a UE 205 reports a Buffer Status Report (BSR) indicating the quantity of data to be transmitted by the UE 205 and a channel Quality Indicator (CQI) indicating a channel status to a Node B 210. The Node B 210 performs scheduling based on the channel status and the reported buffer status from multiple UEs and allocates transmission resources to the UEs. In step 212, the resources allocated to the UE 205 are notified to the UE 205 through a grant channel, which is a shared control channel. Which transmission resources have been allocated to the UE 205 is recorded in the message transmitted to the grant channel. Further, the message transmitted to the grant channel may include transmission resource allocation information of a plurality of UEs, as well as that of the UE 205.
- [10] In step 220, the UE 205 transmits packet type user data by using transmission resources on an Uplink Shared Channel (UL-SCH) indicated by transmission resource allocation information. At this time, before the transmission of the packet data, packet decoding control information in relation to the packet data is transmitted in step 215. The packet decoding control information includes the size of the packet data, information on a modulation scheme and a channel coding scheme, Hybrid Automatic Retransmission Request (HARQ) related information, etc. The HARQ information includes information necessary for execution of a HARQ process for the packet data between the UE 205 and the Node B 210. The HARQ process refers to a process of soft-combining previously-received data with retransmitted data without discarding the previously-received data, thereby improving the ratio of success in the reception.
- [11] Upon receiving the packet data, the Node B 210 decodes the packet data by referring to the packet decoding control information, and determines if the packet data has an error. Then, in step 225, the Node B 210 transmits an acknowledgement (ACK)

signal or a non-acknowledgement (NACK) signal to the UE 205 depending on if the packet data has an error. Based on the ACK or NACK signal, the UE 205 retransmits the packet data or transmits new packet data.

- [12] In the communication through the shared channel as described above, scheduling refers to dynamic allocation of transmission resources based on the buffer statuses of the channel statuses of UEs by a Node B. Therefore, the Node B notifies each UE of the resource allocation status through a grant channel. However, if the transmission resource allocation status is notified at each Transmission Time Interval (TTI), it may cause an excessive signaling overhead. Hereinafter, a conventional method of notifying transmission resource allocation at each TTI is described with reference to FIG. 3.
- [13] FIG. 3 illustrates an OFDM system, in which transmission resources of R1 305, R2 310, R3 315, R4 320, and R5 325 are available and five UEs named A, B, C, D, and E are performing communication. In the illustrated system, each of the transmission resources 305 to 325 may be frequency resources, a sub-carrier, or a group of sub-carriers. An actual LTE system may include a much larger number of available transmission resources than five available transmission resources. However, for convenience of description, only five transmission resources 305 to 325 are discussed herein.
- [14] At a certain transmission time point after the operation of the system, for example, in the n -th transmission time interval, R1 305 and R2 310 are allocated to the UE A, R3 315 and R4 320 are allocated to the UE B, R5 325 is allocated to the UE C, and transmission resource allocation information 330 indicating such resource allocation is broadcasted through a grant channel. In the $(n+1)$ -th transmission time interval, R1 305 is allocated to the UE A, R2 310, R3 315, and R4 320 are allocated to the UE B, R5 325 is allocated to the UE C, and transmission resource allocation information 335 indicating such resource allocation is broadcasted through a grant channel. In this way, a network broadcasts transmission resource allocation information 340, 345, 350, 355, 360, and 365 indicating transmission resource allocation of each transmission time interval to all UEs at each transmission time interval.
- [15] As noted from the example shown in FIG. 3, a case in which there is no change in transmission resources allocated to a specific UE may occur. That is, during five TTIs from the $(n+2)$ -th TTI to the $(n+6)$ -th TTI, the transmission resources of R2 310 and R3 315 have been continuously allocated to the UE B. However, transmission resource allocation information 340 to 360 indicating such resource allocation is repeatedly transmitted through the grant channel during the TTIs.
- [16] Therefore, the conventional method of always broadcasting the transmission resource allocation status without considering the transmission resource allocation status may increase the signaling overhead.

Disclosure of Invention

Technical Problem

- [17] Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior art, and the present invention provides a method and an apparatus for reducing a signaling overhead of a Node B scheduling in a mobile communication system supporting the Node B scheduling, such as an LTE.
- [18] Also, the present invention provides a method and an apparatus for efficiently notifying allocated transmission resources to a UE while reducing a signaling overhead of a Node B scheduling in a mobile communication system.

Technical Solution

- [19] In accordance with an aspect of the present invention, there is provided a method for allocating transmission resources in a mobile communication system, the method including the steps of: determining if first transmission resources indicated by a transmission resource allocation information known by an user equipment (UE) coincide with second transmission resources actually allocated by a network node; requesting the network node to transmit new transmission resource allocation information when the first transmission resources do not coincide with the second transmission resources; and receiving the new transmission resource allocation information indicating transmission resources allocated to the UE from the network node.
- [20] In accordance with another aspect of the present invention, there is provided an UE apparatus for allocating transmission resources in a mobile communication system, the UE apparatus including: a processor for determining if first transmission resources indicated by a transmission resource allocation information known by an user equipment (UE), coincide with second transmission resources actually allocated by a network node; a message generator for requesting the network node to transmit new transmission resource allocation information when the first transmission resources do not coincide with the second transmission resources; and a grant channel receiver for receiving the new transmission resource allocation information indicating transmission resources allocated to the UE from a network node after the requesting.
- [21] In accordance with another aspect of the present invention, there is provided a method for allocating transmission resources in a mobile communication system, the method including the steps of: receiving transmission resource allocation information indicating a change in transmission resources allocated to a UE from a network node; managing transmission resource information indicating the allocated transmission resources based on the transmission resource allocation information; determining packet decoding control information for the packet data, and calculating a Cyclic

Redundancy Check (CRC) code for the transmission resource information and the packet decoding control information; and transmitting the packet decoding control information and the CRC code to the network node.

- [22] In accordance with another aspect of the present invention, there is provided a method for allocating transmission resources in a mobile communication system, the method including the steps of: allocating transmission resources to a UE and managing transmission resource information indicating the allocated transmission resources; transmitting to the UE transmission resource allocation information indicating a change in the transmission resources allocated to the UE; receiving from the UE a Cyclic Redundancy Check (CRC) code and packet decoding control information for packet data to be received; calculating a CRC code for the packet decoding control information and the transmission resource information; comparing the calculated CRC code with the received CRC code, thereby determining if there is an error in the transmission resource information and the packet decoding control information; and re-transmitting the transmission resource allocation information to the UE when the CRC codes do not coincide.
- [23] In accordance with another aspect of the present invention, there is provided a method for allocating transmission resources in a mobile communication system, the method including the steps of: transmitting to a UE transmission resource allocation information indicating a change in transmission resources allocated to the UE; managing transmission resource information indicating the allocated transmission resources based on the transmission resource allocation information; determining packet decoding control information for packet data to be transmitted, and calculating a Cyclic Redundancy Check (CRC) code for the transmission resource information and the packet decoding control information; and transmitting the packet decoding control information and the CRC code to the UE.
- [24] In accordance with another aspect of the present invention, there is provided a method for allocating transmission resources in a mobile communication system, the method including the steps of: receiving transmission resource allocation information indicating a change in transmission resources allocated to a UE from a network node; managing transmission resource information indicating the allocated transmission resources based on the transmission resource allocation information; receiving from the network node a Cyclic Redundancy Check (CRC) code and packet decoding control information for packet data to be received; calculating a CRC code for the packet decoding control information and the transmission resource information; comparing the calculated CRC code with the received CRC code, thereby determining if there is an error in the transmission resource information and the packet decoding control information; and re-transmitting the transmission resource allocation in-

formation to the UE when the CRC codes do not coincide.

Advantageous Effects

[25] The present invention as described above have the following effects.

[26] In a packet communication between a Node B and a UE through a downlink or uplink shared channel according to the present invention, it is possible to detect discord between transmission resource information that the UE knows and transmission resource information allocated by the Node B, and make the two pieces of information coincide with each other, thereby reducing the signaling overhead for allocation of transmission resources and minimizing collision or waste of the transmission resources.

Brief Description of the Drawings

[27] The above and other aspects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

[28] FIG. 1 illustrates an example of a structure of an evolved UMTS mobile communication system;

[29] FIG. 2 illustrates an example of communication through a shared channel in a typical mobile communication system;

[30] FIG. 3 illustrates a conventional method of notifying transmission resource allocation at each TTI is described with reference to FIG. 3;

[31] FIG. 4 is a diagram for illustrating a process of notifying transmission resource allocation according to an exemplary embodiment of the present invention;

[32] FIG. 5 is a flow diagram illustrating an operation of a UE according to an exemplary embodiment of the present invention;

[33] FIG. 6 illustrates reception error that may occur in transmission resource allocation;

[34] FIG. 7 is a signaling flow diagram illustrating a process of overcoming a reception error in uplink transmission resource allocation according to an exemplary embodiment of the present invention, and illustrates CRC calculation according to an exemplary embodiment of the present invention;

[35] FIG. 8 is a flow diagram illustrating a process of notifying a Node B of a transmission resource status by a UE according to an exemplary embodiment of the present invention when the UE transmits packet decoding control information;

[36] FIG. 9 is a flow diagram illustrating an operation of a Node B for determining if there is an error in transmission resource allocation, based on packet decoding control information, according to an exemplary embodiment of the present invention;

[37] FIG. 10 is a signaling diagram illustrating a process for overcoming a reception error in downlink transmission resource allocation according to an exemplary

embodiment of the present invention;

[38] FIG. 11 is a flow diagram illustrating an operation of a UE for determining if there is an error in transmission resource allocation, based on the downlink packet decoding control information, according to an exemplary embodiment of the present invention;

[39] FIG. 12 is a block diagram illustrating a structure of a UE according to an exemplary embodiment of the present invention;

[40] FIG. 13 is a block diagram illustrating a structure of a network node, that is, a Node B according to an exemplary embodiment of the present invention;

[41] FIG. 14 is a signaling diagram illustrating a process of overcoming an error in allocation of semi-permanent transmission resources according to an exemplary embodiment of the present invention when the packet decoding control information is not transmitted; and

[42] FIG. 15 is a flow diagram illustrating a process for determining and overcoming an error in allocation of semi-permanent transmission resources by a UE according to an exemplary embodiment of the present invention.

Best Mode for Carrying Out the Invention

[43] Hereinafter, exemplary embodiments of the present invention will be described with reference to the accompanying drawings. In the following description, a detailed description of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention rather unclear. Further, various specific definitions found in the following description are provided only to help general understanding of the present invention, and it is apparent to those skilled in the art that the present invention can be implemented without such definitions.

[44] The main idea of the present invention described below is to broadcast transmission resource allocation information only when transmission resources allocated to a UE changes in a mobile communication system supporting a Node B scheduling, so that the UE can use the transmission resources until the allocation of the transmission resources is cancelled.

[45] In the following description, a 3GPP LTE system based on asynchronous UMTS is discussed in order to describe the present invention in detail. However, the allocation of transmission resources, the main idea of the present invention, can be applied to other types of mobile communication systems having similar technological background and similar channel types only with slight modification without departing from the scope of the present invention, which can be understood by one skilled in the art.

[46] A network node performing allocation of transmission resources in a mobile communication system, that is, a Node B in the case of a 3GTT LTE, broadcasts

transmission resource allocation information only when the transmission resources allocated to one UE changes. Once the Node B allocates transmission resources to a UE, the transmission resources are continuously allocated to the UE until the allocation of the transmission resources is cancelled.

[47] Usually, an evident signal is used in order to cancel allocation of transmission resources. However, according to an exemplary embodiment of the present invention, the transmission resources to be cancelled are allocated to another UE without evident signaling to the UE occupying the transmission resources, so that the UE occupying the transmission resources is implicatively notified that the allocation of the transmission resources to the UE has been cancelled. Therefore, the UE must continuously observe the grant channel, thereby continuously monitoring if the UE can go on using the transmission resources allocated to the UE itself. Because the present invention does not employ separate signaling in order to cancel allocation of transmission resources as described above, the present invention can reduce the overhead of the grant channel.

[48] According to exemplary embodiments of the present invention described below, a network node signals only the changing status of the transmission resource allocation through a grant channel, and the UE monitors the grant channel and manages its own transmission resource pool. The transmission resource pool of a UE refers to a set of transmission resources that can be transmitted at a current time point by the UE.

[49] FIG. 4 is a diagram for illustrating a process of notifying transmission resource allocation according to an exemplary embodiment of the present invention.

[50] Referring to FIG. 4, at a certain transmission time point after the operation of the system, for example, in the n -th transmission time interval, R1 405 and R2 410 are allocated to the UE A, R3 415 and R4 420 are allocated to the UE B, R5 425 is allocated to the UE C, and transmission resource allocation information 430 indicating such resource allocation is broadcasted through a grant channel. The transmission resource allocation status in the n -th transmission time interval is totally different from the transmission resource allocation status in the $(n-1)$ -th transmission time interval. Therefore, the transmission resource allocation information 430 in the n -th transmission time interval contains information about all allocated transmission resources.

[51] In the $(n+1)$ -th transmission time interval, R1 405 is allocated to the UE A, R2 410, R3 415, and R4 420 are allocated to the UE B, R5 425 is allocated to the UE C, and transmission resource allocation information 435 indicating such resource allocation is broadcasted through a grant channel. The $(n+1)$ -th transmission time interval is different from the previous transmission time interval in that the allocation of R2 410 to the UE A is cancelled and R2 is re-allocated to the UE B. Therefore, the

transmission resource allocation information 435 in the (n+1)-th transmission time interval contains only information about the changed resource allocation status of R2 410. Upon receiving the transmission resource allocation information 435 broadcasted in the (n+1)-th transmission time interval, the UE A recognizes that R2 410 has been re-allocated to the UE B, and uses only R1 405 for transmission of uplink packet data in the (n+1)-th transmission time interval.

[52] In the (n+2)-th transmission time interval, R1 405 is allocated to the UE A, R2 410 and R3 415 are allocated to the UE B, R5 425 is allocated to the UE C, and R4 420 is allocated to the UE D. That is, the allocation of R4 420 to the UE B is cancelled and R4 420 is re-allocated to the UE D. Therefore, the network node broadcasts transmission resource allocation information 440 containing only information about the changed resource allocation status of R4 420 through a grant channel.

[53] When there is no change in the resource allocation status as in the transmission time intervals as designated by reference numerals 450, 455, and 460, no transmission resource allocation information is transmitted through the grant channel.

[54] FIG. 5 is a flow diagram illustrating an operation of a UE according to an exemplary embodiment of the present invention.

[55] Referring to FIG. 5, in step 505, the transmission resource pool of the UE is initially empty. As used herein, the meaning of the word "initially" includes an instance when the UE is powered on, an instance when the UE moves to a new cell, etc. Then, in step 510, the UE monitors a grant channel of a cell (serving cell) to which the UE belongs, and checks if transmission resource allocation information signaled through the grant channel includes information of transmission resources allocated to the UE itself. At this time, the information about if the transmission resources have been allocated can be signaled in various ways. For example, when transmission resource allocation information signaled through the grant channel includes transmission resource information containing an identifier coinciding with the identifier of the UE, the UE determines that the transmission resource information containing the identifier is information about the transmission resources allocated to the UE.

[56] When there is transmission resource information containing a coinciding identifier, the UE proceeds to step 520, in which the UE adds transmission resources indicated by the transmission resource information into its own transmission resource pool. Then, the UE proceeds to step 525, in which the UE determines if the transmission resource pool includes transmission resources allocated to another UE by referring to the transmission resource allocation information signaled through the grant channel. In other words, the UE determines if there are any transmission resources in the transmission resource pool, which are indicated by the transmission resource allocation information to have been allocated to another UE.

- [57] If the transmission resource pool includes transmission resources allocated to another UE, the UE proceeds to step 530, in which the UE removes the transmission resources from the transmission resource pool, and then returns to step 510. If the transmission resource pool does not include transmission resources allocated to another, the UE directly returns to step 510.
- [58] By signaling the transmission resource allocation information only when there is any change in the transmission resource allocation status, it is possible to reduce the signaling overhead. However, in this case, a severe waste of transmission resources may occur if the UE fails to receive the transmission resource allocation information. Hereinafter, a reception error that may occur in transmission resource allocation is described with reference to FIG. 6.
- [59] Referring to FIG. 6, at a certain transmission time point after the operation of the system, for example, in the n -th transmission time interval, R1 605 and R2 610 are allocated to the UE A. R3 615 and R4 620 are allocated to the UE B, R5 625 is allocated to the UE C, and transmission resource allocation information 630 indicating such resource allocation is broadcasted through a grant channel. The transmission resource allocation status in the n -th transmission time interval is totally different from the transmission resource allocation status in the $(n-1)$ -th transmission time interval. Therefore, the transmission resource allocation information 630 in the n -th transmission time interval contains information about all allocated transmission resources.
- [60] In the $(n+1)$ -th transmission time interval, R1 605 is allocated to the UE A. R2 610, R3 615, and R4 620 are allocated to the UE B, R5 625 is allocated to the UE C, and transmission resource allocation information 635 indicating such resource allocation is broadcasted through a grant channel. The $(n+1)$ -th transmission time interval is different from the previous transmission time interval in that the allocation of R2 610 to the UE A is cancelled and R2 is re-allocated to the UE B. Therefore, the transmission resource allocation information 635 in the $(n+1)$ -th transmission time interval contains only information about the changed resource allocation status of R2 610. In this case, if the UE A has failed to receive the transmission resource allocation information 635, both the UE A and the UE B use R2 610 in the $(n+1)$ -th transmission time interval. Then, the data transmitted through R2 610 by the UE A and the UE B collide with each other, thereby remarkably lowering the possibility that both the UE A and the UE B can successfully transmit the data.
- [61] Further, when there is no change in the resource allocation status during the following transmission time intervals from the $(n+2)$ -th transmission time interval to the $(n+6)$ -th transmission time interval as shown in FIG. 6, corresponding transmission resource allocation information 640, 645, 650, 655, and 660 does not include the

resource allocation status of R1 610. As a result, all the resources (as hatched in FIG. 6) used by the UE A and the UE B are wasted during the multiple transmission time intervals. This is because it is necessary to successfully receive all data transmitted through multiple transmission resources in order to successfully receive all data transmitted by each UE. The waste of resources as described above is continued until R2 610 is reallocated to the UE A based on the transmission resource allocation information 665 in the (n+7)-th transmission time interval.

- [62] In order to solve this problem, the Node B must instantly recognize the error in the resource allocation status. To this end, an exemplary embodiment of the present invention employs transmission of error correction information containing the resource allocation status, especially, transmission of a Cyclic Redundancy Check (CRC) code containing the resource allocation status, which is added to packet decoding control information.
- [63] FIG. 7 is a signaling flow diagram illustrating a process of overcoming a reception error in uplink transmission resource allocation according to an exemplary embodiment of the present invention.
- [64] Referring to (a) of FIG. 7, in step 715, the Node B 710 notifies the UE 705 of allocated transmission resources by transmitting transmission resource allocation information indicating transmission resource allocation of the UE 705 and a grant channel message including an identifier (ID) of the UE 705 to the UE 705. The transmission resource allocation information, as described above with reference to FIG. 4, evidently or implicatively indicates the transmission resources allocated to the UE 705.
- [65] In step 720, the UE 705 updates its transmission resource pool by referring to the transmission resource allocation information according to the process as shown in FIG. 5, wherein transmission resources included in the transmission resource pool of the uplink shared channel (UL-SCH) are used for transmission of packet data in step 727. At this time, before the transmission of the packet data, packet decoding control information in relation to the packet data is transmitted in step 725. The packet decoding control information includes the size of the packet data, AMC information indicating the modulation scheme and channel coding scheme, HARQ related information indicating the number of retransmission, etc.
- [66] In order to overcome the transmission error, a CRC code is added to the packet decoding control information. The CRC code is calculated in consideration of not only the packet decoding control information, but also transmission resource information that the UE knows. That is, as shown in (b) of FIG. 7, the CRC code 750 is calculated in relation to the CRC range 755 including the transmission resource information 740 indicating a current transmission resource status of the UE, and the actually

transmission part 760 includes the packet decoding control information 745 and the CRC code 750.

[67] The transmission resource information 740 of the UE refers to the transmission resource pool of the UE, which has been reconstructed into a bit type a CRC operation of which is possible. In order to allocate transmission resources to the UE, the Node B identifies each transmission resource item by a logical identifier. For example, R1 605 shown in FIG. 6 is allocated a logical identifier of "0", and R2 610 is allocated a logical identifier of "1". Therefore, the transmission resource pool of the UE can be expressed by a set of logical identifiers of the transmission resources allocated to the UE, and the transmission resource information 740 of the UE includes sequentially arranged logical identifiers of the transmission resources included in the transmission resource pool and is used for performing the CRC operation on the packet decoding control information.

[68] For example, Table 1 below shows logical identifiers provided to transmission resources in a system.

[69] Table 1

Transmission resources	Logical identifiers
R1	0000
R2	0001
R3	0010
R4	0011
...	...

[70] If the resources allocated to the UE are R1 and R2, the transmission resource information of the UE is "0000 0001", and the bit stream is included in the CRC range.

[71] Referring again to (a) of FIG. 7, in step 730, the Node B 710 determines if there is an error in the packet decoding control information and the transmission resource information by using the packet decoding control information received from the UE 705, the CRC code, and the already-known transmission resource information of the UE 705. If the UE 705 has failed to normally receive the transmission resource allocation information of step 715, the transmission resource information of the UE 705 is different from the transmission resource information of the Node B 710, and the Node B 710 will fail in the CRC checking. Based on the result of the CRC checking, the Node B 710 determines if the transmission resource information of the UE 705 is different from the transmission resource information of the Node B 710. When they are different from each other, the Node B 710 retransmits the transmission resource allocation information in step 735. At this time, the Node B 710 inserts a most-

recently-transmitted transmission resource allocation status into the transmission resource allocation information.

[72] FIG. 8 is a flow diagram illustrating a process of notifying a transmission resource status to a Node B by a UE according to an exemplary embodiment of the present invention when the UE transmits packet decoding control information. The UE may perform the process of FIG. 8 whenever or less frequently than whenever the UE transmits packet data and packet decoding control information.

[73] Referring to FIG. 8, the UE determines packet decoding control information in relation to packet data to be transmitted (step 805), and then determines a CRC range for a CRC operation (step 810). As described above, the CRC range includes the transmission resource information and bit streams of the packet decoding control information, which are sequentially arranged. The transmission resource information of the UE includes sequentially arranged logical identifiers of transmission resources allocated to the UE. The UE calculates the CRC code by performing a CRC operation for the CRC range in step 815, attaches the calculated CRC code behind the packet decoding control information in step 820, and transmits the packet decoding control information and the CRC code in step 825.

[74] FIG. 9 is a flow diagram illustrating an operation of a Node B for determining if there is an error in transmission resource allocation based on packet decoding control information, according to an exemplary embodiment of the present invention.

[75] Referring to FIG. 9, the Node B receives packet decoding control information including the CRC code from the UE in step 905, and determines a CRC range for a CRC operation in step 910. The CRC range includes the transmission resource information and bit streams of the packet decoding control information, which are sequentially arranged. The Node B calculates the CRC by performing the CRC operation on the packet decoding control information and the transmission resource information of the UE in step 915, and determines if the CRC checking is successful or not by comparing the received CRC code with the CRC code calculated through the CRC operation in step 920. When the CRC codes are identical and the CRC checking successful, which implies that the transmission resource information of the UE is the same as that of the Node B, the Node B proceeds to step 930, in which the Node B determines that it is unnecessary to retransmit previous transmission resource allocation information, and receives and decodes packet data based on the packet decoding control information. At this time, the transmission resource allocation information is transmitted in the same way as shown in FIG. 4.

[76] In contrast, as a result of the determination in step 920, when the received CRC code is different from the calculated CRC code, the Node B determines that the transmission resource information of the UE is different from that of the Node B, and

proceeds to step 925, in which the Node B retransmits the transmission resource allocation information. The transmission resource allocation information retransmitted in step 925 is transmission resource allocation information that has been most recently transmitted. Thereafter, in step 927, the Node B processes the packet data according to the HARQ operation. Specifically, the Node B transmits a NACK signal indicating failure in the decoding of the packet data to the UE, stores the received packet data in a buffer, and waits for retransmission of the packet data. This is because, from the failure in the CRC checking, it is determined that the packet decoding control information is improper for the decoding.

[77] The embodiment described above corresponds to a discussion for a solution in order to overcome the problem due to discord in uplink transmission resource allocation. However, it is also possible to calculate a CRC code for the decoding control information and downlink transmission resource information of a UE, attach the CRC code behind the packet decoding control information, and transmit them through a downlink. Hereinafter, a process for overcoming a reception error in downlink transmission resource allocation according to an exemplary embodiment of the present invention is described with reference to FIG. 10.

[78] Referring to FIG. 10, in step 1015, the Node B 1010 allocates downlink transmission resources to the UE 1005 by referring to the channel state and the buffer state report from the UE 1005, and transmits transmission resource allocation information indicating the allocated transmission resources to the UE 1005 through a grant channel. In step 1020, the UE 1005 updates its transmission resource pool with the allocated transmission resources. The allocated transmission resources are used for transmission of downlink packet data to the UE by the Node B. At this time, the Node B determines packet decoding control information for the packet data, and calculates a CRC code for the packet decoding control information and known downlink transmission resource information for the UE 1005. Then, before the transmission of the packet data in step 1027, the Node B 1010 transmits the packet decoding control information including the CRC code to the UE 1005 in step 1025. At this time, the CRC code may be either simply attached to or masked on the packet decoding control information.

[79] After receiving the packet decoding control information including the CRC code, the UE 1005 calculates a CRC code for the packet decoding control information and transmission resource information recorded in the downlink transmission resource pool of the UE, and compares the calculated CRC code with the received CRC code. If the UE 1005 has failed to normally receive the transmission resource allocation information, the transmission resource information of the UE 1005 is different from the transmission resource information of the Node B 1010, and the two CRC codes do not

coincide. Upon recognizing through the CRC checking that the transmission resource information of the UE 1005 is different from the transmission resource information of the Node B 1010, the UE 1005 makes a request for retransmission of the transmission resource allocation information to the Node B 1010 in step 1035. At this time, a message of making a request for retransmission of the transmission resource allocation information may be transmitted either by using non-orthogonal transmission resources allocated to the UE or through a random access channel, and includes an identifier of the UE 1005 and transmission resource information that the UE 1005 currently knows.

[80] Upon receiving the retransmission request message, the Node B 1010 retransmits most recently transmitted transmission resource allocation information in step 1040, so that the UE 1005 can update the downlink transmission resource pool with the transmission resource information.

[81] The operation of generating and transmitting the packet decoding control information by the Node B is the same as the operation of generating and transmitting the uplink packet decoding control information by the UE as shown in FIG. 8, so detailed description thereof is omitted here.

[82] FIG. 11 is a flow diagram illustrating an operation of a UE for determining if there is an error in transmission resource allocation, based on the downlink packet decoding control information, according to an exemplary embodiment of the present invention.

[83] Referring to FIG. 11, the Node B receives packet decoding control information including the CRC code from the UE in step 1105, and determines a CRC range for a CRC operation in step 1110. The CRC range includes the downlink transmission resource information and bit streams of the packet decoding control information, which are sequentially arranged. The UE performs the CRC operation on the packet decoding control information and the current downlink transmission resource information of the UE in step 1115, and determines if the CRC checking is successful or not by comparing the received CRC code with the calculated CRC code in step 1120. When the CRC checking is successful, which implies that the transmission resource information of the UE is the same as that of the Node B, the UE proceeds to step 1130, in which the UE decodes packet data based on the packet decoding control information.

[84] In contrast, as a result of the determination in step 1120, when the received CRC code is different from the calculated CRC code, which implies that the transmission resource information of the UE is different from that of the Node B, the UE proceeds to step 1125 in which the UE retransmits a message of requesting retransmission of the transmission resource allocation information. The message of requesting retransmission of the transmission resource allocation information may include an identifier of the UE and the downlink transmission resource information of the UE.

Thereafter, in step 1127, the UE transmits a NACK signal indicating failure in the decoding of the packet data to the Node B, stores the received packet data in a buffer, and waits for retransmission of the packet data.

[85] FIG. 12 is a block diagram illustrating a structure of a UE according to an exemplary embodiment of the present invention. As illustrated, the UE includes a multiplexer/demultiplexer 1205, a HARQ processor 1215, a grant channel receiver 1220, a resource pool manager 1225, a control information processor 1230, a CRC calculator 1235, a message generator 1240, and a transceiver unit 1245.

[86] Referring to FIG. 12, the grant channel receiver 1220 receives a grant channel message from a network node, and determines if there are any transmission resources newly allocated to the UE or allocation of which to the UE is cancelled. The transmission resources, which are newly allocated to the UE or allocation of which to the UE is cancelled, are reported to the resource pool manager 1225. The resource pool manager 1225 receives a report about change in the transmission resources from the grant channel receiver 1220, and manages downlink and uplink transmission resource pools. The resource pool manager 1225 commands the transceiver unit 1245 to use uplink transmission resources indicated by the uplink transmission resource pool when the uplink transmission resource pool is not empty, and commands the transceiver unit 1245 to use downlink transmission resources indicated by the downlink transmission resource pool when the downlink transmission resource pool is not empty.

[87] First, management of the uplink transmission resources is described hereinafter.

[88] When uplink packet data are transmitted, the multiplexer/demultiplexer 1205 constructs uplink packet data by multiplexing data from upper layer entities. The HARQ processor 1215 transfers the uplink packet data to the transceiver unit 1245 after performing a predetermined HARQ process on the uplink packet data. The transceiver unit 1245 transmits the uplink packet data to a network node. The uplink packet data are transmitted by using the uplink transmission resources indicated by the uplink transmission resource pool managed by the resource pool manager 1225. The resource pool manager 1225 provides the uplink transmission resource information indicated by the uplink transmission resource pool to the CRC calculator 1235 so that the uplink transmission resource information can be used for transmission of the uplink packet decoding control information.

[89] The control information processor 1230 determines the packet decoding control information in relation to the uplink packet data, and provides the determined packet decoding control information to the CRC calculator 1235 and 1250. The CRC calculator 1235 calculates a CRC code for the uplink decoding control information provided by the control information processor 1230 and the uplink transmission resource information provided by the resource pool manager 1225, and the calculated

CRC code is attached to the packet decoding control information by 1250 and is then transmitted to a network node by the transceiver unit 1245.

[90] Next, management of the downlink transmission resources is described hereinafter.

[91] When the transceiver unit 1245 has received a CRC code and downlink packet decoding control information in relation to downlink packet data from the Node B, the transceiver unit 1245 provides the CRC code and the downlink packet decoding control information to the CRC calculator 1235 and the control information processor 1230. The resource pool manager 1225 provides downlink transmission resource information indicated by the downlink transmission resource to the CRC calculator 1235, so that the downlink transmission resource information can be used in checking the downlink packet decoding control information.

[92] The CRC calculator 1235 calculates a CRC code for the downlink packet decoding control information provided by the transceiver unit 1245 and the downlink transmission resource information provided by the resource pool manager 1225, and compares the CRC code received together with the downlink packet decoding control information with the calculated CRC code, thereby determining if there is an error in the downlink transmission resource information and the downlink packet decoding control information. When the CRC codes are different, the CRC calculator 1235 reports "Failure" as a result of the CRC checking to the control information processor 1230.

[93] The control information processor 1230 receives a report about the result of the CRC checking from the CRC calculator 1235. When the result of the CRC checking is "Success", the control information processor 1230 provides the downlink packet decoding control information to the transceiver unit 1245, the HARQ processor 1215, and the multiplexer/demultiplexer 1205, so that the downlink packet decoding control information can be used for reception and decoding of the downlink packet data. The transceiver unit 1245 receives the downlink packet data by using the downlink transmission resources indicated by the downlink transmission resource pool managed by the resource pool manager 1225.

[94] When the result of the CRC checking is "Failure", the control information processor 1230 reports it to the message generator 1240. Then, the message generator 1240 generates a message for requesting retransmission of the downlink transmission resources, and transmits the generated message to a network node through the transceiver unit 1245. The message for requesting retransmission of the downlink transmission resources includes an identifier of a UE and downlink transmission resource information of the UE. The received downlink packet data are stored in a HARQ buffer (not shown) within the HARQ processor 1215 without being decoded, and the HARQ processor 1215 transmits a NACK signal to the Node B in order to

make a request for retransmission of the downlink packet data.

[95] FIG. 13 is a block diagram illustrating a structure of a network node, that is, a Node B according to an exemplary embodiment of the present invention. As illustrated, the Node B includes a multiplexer/demultiplexer 1305, an HARQ processor 1315, a grant channel transmitter 1320, a scheduler 1325, a control information processor 1330, a CRC calculator 1335, a message receiver 1340, and a transceiver unit 1345.

[96] Referring to FIG. 13, the scheduler 1325 allocates downlink transmission resources and uplink transmission resources to each UE by referring to the channel status and buffer status report from UEs connected to the Node B for downlink or uplink packet communication, and notifies the allocated transmission resources to the grant channel transmitter 1320. The grant channel transmitter 1320 checks if there are any transmission resources newly allocated to the UE or allocation of which to the UE is cancelled. When there are transmission resources which are newly allocated to the UE or allocation of which to the UE is cancelled, the grant channel transmitter 1320 loads transmission resource allocation information indicating the allocated transmission resources on a grant channel message and then broadcasts the grant channel message to the UEs through the transceiver unit 1345. Further, when the message receiver 1340 has received the message of requesting retransmission of the transmission resource allocation information through the transceiver unit 1345, the grant channel transmitter 1320 broadcasts again the most recently transmitted downlink transmission resource allocation information through the transceiver unit 1345 and a grant channel to the UEs.

[97] Meanwhile, the scheduler 1325 manages downlink transmission resource information and uplink transmission resource information, which indicate downlink transmission resources and uplink transmission resources allocated to each UE, respectively, and commands the transceiver unit 1245 to use the downlink transmission resources and the uplink transmission resources indicated by the downlink transmission resource information and the uplink transmission resource information.

[98] First, management of the downlink transmission resources is described hereinafter.

[99] In order to transmit downlink packet data for a specific UE, the multiplexer/demultiplexer 1305 constructs downlink packet data by multiplexing data from upper layer entities. The HARQ processor 1315 transfers the downlink packet data to the transceiver unit 1345 after performing a predetermined HARQ process on the downlink packet data. The transceiver unit 1345 transmits the downlink packet data to the UE. The downlink packet data are transmitted by using downlink transmission resources allocated to the UE by the scheduler 1325. The scheduler 1325 provides downlink transmission resource information to the CRC calculator 1335 so that the downlink transmission resource information can be used for transmission of the

downlink packet decoding control information.

- [100] The control information processor 1330 determines the packet decoding control information in relation to the downlink packet data, and provides the determined packet decoding control information to the CRC calculator 1335 and 1350k. The CRC calculator 1335 calculates a CRC code for the downlink decoding control information provided by the control information processor 1330 and the downlink transmission resource information provided by the scheduler 1325, and the calculated CRC code is attached to the packet decoding control information by 1350k and is then transmitted to the UE by the transceiver unit 1345.
- [101] Next, management of the uplink transmission resources is described hereinafter.
- [102] When the transceiver unit 1345 has received a CRC code and uplink packet decoding control information in relation to uplink packet data from the UE, the transceiver unit 1345 provides the CRC code and the uplink packet decoding control information to the CRC calculator 1335 and the control information processor 1330. The scheduler 1325 provides uplink transmission resource information indicating the uplink transmission resources allocated to the UE to the CRC calculator 1335, so that the uplink transmission resource information can be used in checking the uplink packet decoding control information.
- [103] The CRC calculator 1335 calculates a CRC code for the uplink packet decoding control information provided by the transceiver unit 1345 and the uplink transmission resource information provided by the scheduler 1325, and compares the CRC code received together with the uplink packet decoding control information with the calculated CRC code, thereby determining if there is an error in the uplink transmission resource information and the uplink packet decoding control information. When the CRC codes are different, the CRC calculator 1335 reports "Failure" as a result of the CRC checking to the control information processor 1330.
- [104] The control information processor 1330 receives a report about the result of the CRC checking from the CRC calculator 1335. When the result of the CRC checking is "Success", the control information processor 1330 provides the uplink packet decoding control information to the transceiver unit 1345, the HARQ processor 1315, and the multiplexer/demultiplexer 1305, so that the uplink packet decoding control information can be used for reception and decoding of the uplink packet data. The transceiver unit 1345 receives the uplink packet data by using the uplink transmission resources allocated by the scheduler 1325.
- [105] When the result of the CRC checking is "Failure", the control information processor 1330 reports it to the grant channel transmitter 1320. Then, the grant channel transmitter 1320 broadcasts again the most recently transmitted downlink transmission resource allocation information through the transceiver unit 1345 and a grant channel

to the UEs. The uplink packet data received in relation to the uplink packet decoding control information are stored in an HARQ buffer within the HARQ processor 1315 without being decoded, and the HARQ processor 1315 transmits a NACK signal to the Node B in order to make a request for retransmission of the uplink packet data.

- [106] Meanwhile, the UE may transmit packet data through allocated transmission resources without transmitting the packet decoding control information. In this case, the UE overcomes an error in the allocation of transmission resources by determining by another means if the allocated transmission resources coincide with transmission resources actually allocated by the Node B, that is, by determining if the allocated transmission resources are exact. In the embodiment as described below, the number of times of transmission failure of the packet received through the allocated transmission resources is used in order to determine if the allocated transmission resources are exact. However, it is of course possible to determine by another means if the allocated transmission resources are exact.
- [107] An LTE system includes either transmission resources which are maintained allocated before the allocation is canceled once they are allocated, or transmission resources which are available only at the time point of the allocation. As used herein, the former transmission resources, which are maintained allocated before the allocation is canceled once they are allocated, is referred to as "semi-permanent transmission resources".
- [108] If a UE, having been allocated downlink semi-permanent transmission resources, misses transmission resource allocation information for allocating new downlink semi-permanent transmission resources, consecutive HARQ failure occurs because the UE performs the HARQ operation for a signal received through the semi-permanent transmission resources that are not available any longer. Therefore, if a UE allocated semi-permanent transmission resources has experienced consecutive HARQ failure, it is possible to doubt if the downlink semi-permanent transmission resources are erroneous. In this case, the UE can request the Node B to retransmit transmission resource allocation information indicating the semi-permanent transmission resources, thereby minimizing the problems caused by missing of the transmission resource allocation information.
- [109] FIG. 14 is a signaling diagram illustrating a process of overcoming an error in allocation of semi-permanent transmission resources according to an exemplary embodiment of the present invention when the packet decoding control information is not transmitted.
- [110] Referring to FIG. 14, in step 1415, the Node B 1410 allocates semi-permanent transmission resources (hereinafter, referred to "as first semi-permanent transmission resources") for downlink to the UE 1405 by referring to the channel state and the

buffer state report from the UE 1405, and transmits transmission resource allocation information indicating the first semi-permanent transmission resources to the UE 1405 through a grant channel. In step 1420, the UE 1405 updates its transmission resource pool with the first semi-permanent transmission resources. The first semi-permanent transmission resources are used for transmission of downlink packet data to the UE by the Node B. At this time, packet decoding control information of the packet data to be transmitted through the first semi-permanent transmission resources may be transmitted together in step 1415. Thereafter, the packet decoding control information is not separately transmitted any more.

[111] Then, the UE 1405 receives HARQ packets through a downlink shared channel (DL-SCH) by using the first semi-permanent transmission resources in step 1425, and performs a predetermined HARQ operation for the HARQ packets and transmits an ACK/NACK signal to the Node B 1410 in step 1430. As long as the first semi-permanent transmission resources are not canceled or revised, the HARQ operation for the HARQ packets received through the first semi-permanent transmission resources are continuously performed.

[112] When the Node B 1410 has determined to cancel or revise the first semi-permanent transmission resources allocated to the UE 1405, the Node B transmits transmission resource allocation information indicating new semi-permanent transmission resources (hereinafter, referred to as "second semi-permanent transmission resources") through a grant channel in step 1435. At this time, if the transmission resource allocation information is not transferred to the UE 1405 due to some reasons, the UE 1405 will continuously perform the HARQ operation for the packets received through the first semi-permanent transmission resources, and will thus experience consecutive HARQ failure. The HARQ failure refers to failure in reception of an HARQ packet due to reception of a new (next) HARQ packet through the HARQ processor before reception of a current HARQ packet is successfully completed. In other words, when decoding of the HARQ packet fails until the number of times by which the HARQ packet has been transmitted reaches a predetermined maximum number of times, it can be said that HARQ failure has occurred. There is a high probability that the packet received through the second semi-permanent transmission resources may use packet decoding control information 1435 different from the packet decoding control information 1415 recognized by the UE 1405. Therefore, the UE 1405, having missed the transmission resource allocation information of step 1435, will continuously fail to receive the HARQ packet.

[113] If the UE 1405 continuously fails to receive N number of HARQ packets in step 1440, the UE determines that the first semi-permanent transmission resources recognized by the UE are wrong and requests the Node B 1410 to retransmit

transmission resource allocation information in step 1445. At this time, the message for requesting retransmission of the transmission resource allocation information may be transmitted by using, for example, non-orthogonal transmission resources allocated to the UE 1405, or through a random access channel, and the request message includes an identifier of the UE 1405 and transmission resource information indicating the first semi-permanent transmission resources that the UE 1405 currently knows.

[114] When the Node B has received a retransmission request message, the Node B 1410 retransmits transmission resource allocation information indicating the transmission resources currently allocated to the UE 1405, that is, the second semi-permanent transmission resources.

[115] FIG. 15 is a flow diagram illustrating a process for determining and overcoming an error in allocation of semi-permanent transmission resources by a UE according to an exemplary embodiment of the present invention.

[116] Referring to FIG. 15, first, semi-permanent transmission resources are allocated to the UE in step 1505. In step 1510, the UE receives a HARQ packet transmitted through the semi-permanent transmission resources and performs a predetermined HARQ operation on the packet. In other words, the UE decodes the received HARQ packet and performs a CRC operation based on the packet decoding control information recognized in advance by the UE in response to the semi-permanent transmission resources. As a result of the CRC calculation, when the HARQ packet has an error, the UE stores the HARQ packet in a HARQ processor and transmits a HARQ NACK to the Node B. As a result of the CRC calculation, when the HARQ packet has no error, the UE transfers the HARQ packet to a higher layer and transmits a HARQ ACK to the Node B.

[117] While the UE performs the HARQ operation for the HARQ packets received through the semi-permanent transmission resources, the UE monitors in step 1520 if HARQ failure consecutively occurs N number of times. The number N may be either fixedly determined or signaled to the UE during a call setup process. When the UE has not experienced consecutive N number of times of HARQ failure, the UE returns to step 1510, in which the UE receives again an HARQ packet transmitted through the semi-permanent transmission resources. In contrast, when the HARQ failure has consecutively occurred N number of times, the UE proceeds to step 1525, in which the UE stops the reception of the HARQ packet through the semi-permanent transmission resources and requests the Node B to retransmit the transmission resource allocation information. Then, in step 1530, the UE monitors the grant channel until the transmission resource allocation information is transmitted. When the transmission resource allocation information is received through the grant channel, the UE returns to step 1505 and receives HARQ packets by using the packet decoding control in-

formation recognized in advance by the UE through new semi-permanent transmission resources indicated by the transmission resource allocation information.

[118] The UE according to the embodiment described with reference to FIGs. 14 and 15 has nearly the same structure as that shown in FIG. 13, except for the HARQ processor 1215. The HARQ processor 1215 of FIG. 12 counts the number of times of HARQ failure, and reports HARQ failure to the message generator 1240 when the result of the counting concludes failure in reception of consecutive N number of HARQ packets, so that the message generator 1240 transmits a message of requesting retransmission of transmission resource allocation information through the transceiver unit 1245 to a network node, that is, a Node B.

[119] While the invention has been shown and described with reference to certain exemplary embodiments 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 invention as defined by the appended claims.

Claims

- [1] A method for allocating transmission resources in a mobile communication system, the method comprising the steps of:
- (1) determining if first transmission resources indicated by a transmission resource allocation information known by an user equipment (UE), coincide with second transmission resources actually allocated by a network node;
 - (2) requesting the network node to transmit new transmission resource allocation information when the first transmission resources do not coincide with the second transmission resources; and
 - (3) receiving the new transmission resource allocation information indicating transmission resources allocated to the UE from the network node after the requesting.
- [2] The method as claimed in claim 1, wherein step (1) comprises the steps of: receiving packets through the first transmission resources; monitoring reception of the packets in order to determine if reception failure of the packets through the first transmission resources consecutively occurs a pre-determined number of times; and when reception failure of the packets through the first transmission resources has consecutively occurred the predetermined number of times, judging that the first transmission resources do not coincide with the second transmission resources.
- [3] The method as claimed in claim 1, wherein the transmission resource allocation information comprises at least one logical identifier of transmission resources allocated to at least one UE and an identification of the at least one UE, allocation of transmission resources to which has been changed.
- [4] The method as claimed in claim 3, wherein the transmission resource allocation information further comprises packet decoding control information about packets received through transmission resources indicated by the transmission resource allocation information.
- [5] An user equipment (UE) apparatus for allocating transmission resources in a mobile communication system, the UE apparatus comprising:
- a processor for determining if first transmission resources indicated by a transmission resource allocation information known by an user equipment (UE), coincide with second transmission resources actually allocated by a network node;
 - a message generator for requesting the network node to transmit new transmission resource allocation information when the first transmission resources do not coincide with the second transmission resources; and

a grant channel receiver for receiving the new transmission resource allocation information indicating transmission resources allocated to the UE from a network node after the requesting.

- [6] The UE apparatus as claimed in claim 5, wherein the processor receives packets through the first transmission resources and judges that the first transmission resources do not coincide with the second transmission resources when reception failure of the packets through the first transmission resources has consecutively occurred a predetermined number of times.
- [7] The UE apparatus as claimed in claim 5, wherein the transmission resource allocation information comprises at least one logical identifier of transmission resources allocated to at least one UE and an identification of the at least one UE, allocation of transmission resources to which has been changed.
- [8] The UE apparatus as claimed in claim 7, wherein the transmission resource allocation information further comprises packet decoding control information about packets received through transmission resources indicated by the transmission resource allocation information.
- [9] A method for allocating transmission resources in a mobile communication system, the method comprising the steps of:
 - (1) receiving transmission resource allocation information indicating a change in transmission resources allocated to a user equipment (UE) from a network node;
 - (2) managing transmission resource information indicating the allocated transmission resources based on the transmission resource allocation information;
 - (3) determining packet decoding control information for the packet data and calculating a Cyclic Redundancy Check (CRC) code for the transmission resource information and the packet decoding control information; and
 - (4) transmitting the packet decoding control information and the CRC code to the network node.
- [10] The method as claimed in claim 9, wherein the transmission resource allocation information comprises at least one logical identifier of transmission resources allocated to at least one UE and an identification of the at least one UE, allocation of transmission resources to which has been changed.
- [11] The method as claimed in claim 9, wherein step (2) comprises the steps of:
 - determining if the transmission resource allocation information includes transmission resources corresponding to an identifier of the UE;
 - adding an identifier of transmission resources corresponding to the identifier of the UE of the transmission resource allocation information to the transmission resource information, when the transmission resource allocation information

includes transmission resources corresponding to the identifier of the UE;
determining if any item of transmission resources used by the UE is allocated to another UE based on the transmission resource allocation information; and
removing an identifier of the item of transmission resources allocated to another UE from the transmission resource information, when an item of transmission resources in the transmission resource information has been allocated to another UE based on the transmission resource allocation information.

- [12] A method for allocating transmission resources in a mobile communication system, the method comprising the steps of:
- (1) allocating transmission resources to an user equipment (UE) and managing transmission resource information indicating the allocated transmission resources;
 - (2) transmitting to the UE transmission resource allocation information indicating a change in the transmission resources allocated to the UE;
 - (3) receiving from the UE a Cyclic Redundancy Check (CRC) code and packet decoding control information for packet data to be received;
 - (4) calculating a CRC code for the packet decoding control information and the transmission resource information;
 - (5) comparing the calculated CRC code with the received CRC code, thereby determining if there is an error in the transmission resource information and the packet decoding control information; and
 - (6) re-transmitting the transmission resource allocation information to the UE when the CRC codes do not coincide.
- [13] The method as claimed in claim 12, wherein the transmission resource allocation information comprises at least one logical identifier of transmission resources allocated to at least one UE and an identification of the at least one UE, allocation of transmission resources to which has been changed.
- [14] The method as claimed in claim 12, wherein step (2) comprises the steps of:
determining if there is any change in the transmission resources allocated to the UE; and
when there is no change in the transmission resources allocated to the UE, inserting the identifier of the transmission resources allocated to the UE and the identifier of the UE in the transmission resource allocation information, and then transmitting the transmission resource allocation information.
- [15] A method for allocating transmission resources in a mobile communication system, the method comprising the steps of:
- (1) transmitting to an user equipment (UE) transmission resource allocation information indicating a change in transmission resources allocated to the UE;

- (2) managing transmission resource information indicating the allocated transmission resources based on the transmission resource allocation information;
- (3) determining packet decoding control information for packet data to be transmitted, and calculating a Cyclic Redundancy Check (CRC) code for the transmission resource information and the packet decoding control information; and
- (4) transmitting the packet decoding control information and the CRC code to the UE.

[16] The method as claimed in claim 15, wherein the transmission resource allocation information comprises at least one logical identifier of transmission resources allocated to at least one UE and an identification of the at least one UE, allocation of transmission resources to which has been changed.

[17] The method as claimed in claim 15, wherein step (1) comprises the steps of: determining if there is any change in the transmission resources allocated to the UE; and
when there is no change in the transmission resources allocated to the UE, inserting the identifier of the transmission resources allocated to the UE and the identifier of the UE in the transmission resource allocation information and then transmitting the transmission resource allocation information.

[18] A method for allocating transmission resources in a mobile communication system, the method comprising the steps of:

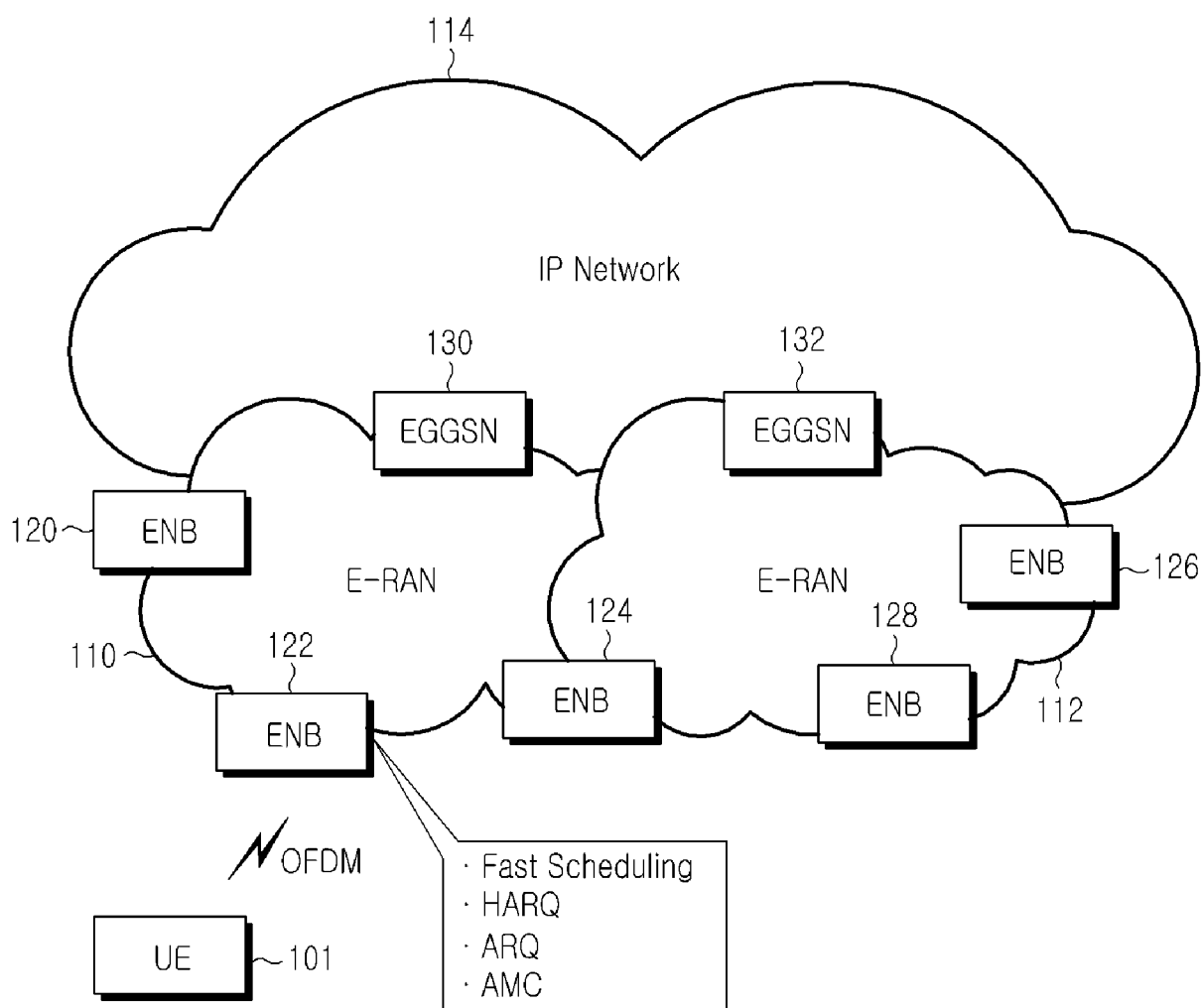
- (1) receiving transmission resource allocation information indicating a change in transmission resources allocated to an user equipment (UE) from a network node;
- (2) managing transmission resource information indicating the allocated transmission resources based on the transmission resource allocation information;
- (3) receiving from the network node a Cyclic Redundancy Check (CRC) code and packet decoding control information for packet data to be received;
- (4) calculating a CRC code for the packet decoding control information and the transmission resource information;
- (5) comparing the calculated CRC code with the received CRC code, thereby determining if there is an error in the transmission resource information and the packet decoding control information; and
- (6) re-transmitting the transmission resource allocation information to the UE when the CRC codes do not coincide.

[19] The method as claimed in claim 18, wherein the transmission resource allocation

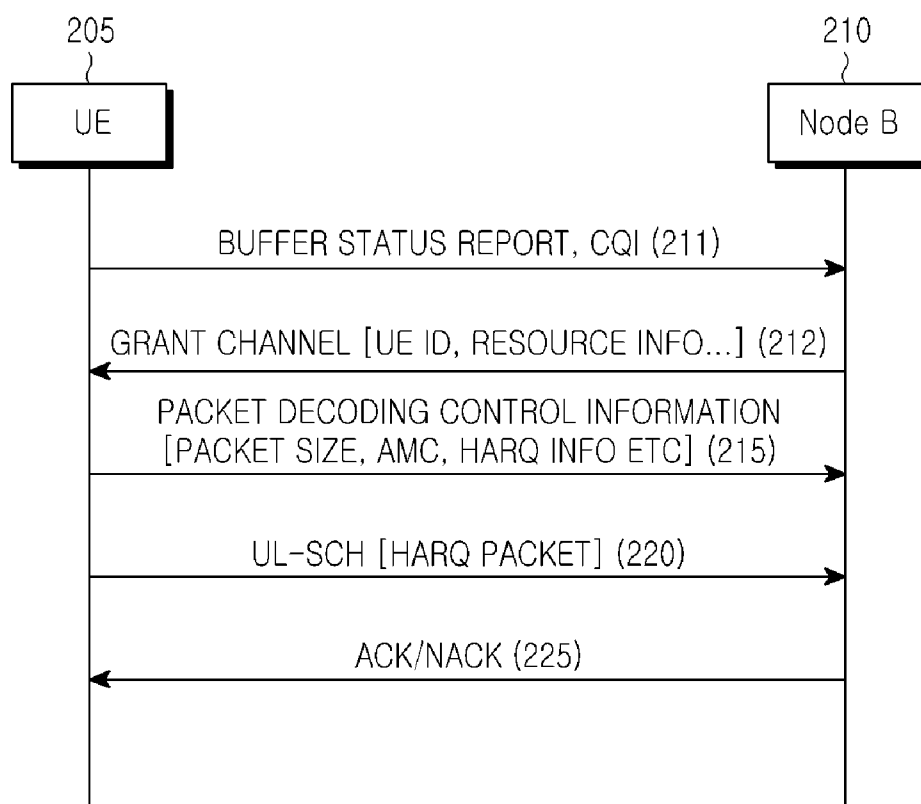
information comprises at least one logical identifier of transmission resources allocated to at least one UE and an identification of the at least one UE, allocation of transmission resources to which has been changed.

- [20] The method as claimed in claim 18, wherein step (2) comprises the steps of: determining if the transmission resource allocation information includes transmission resources corresponding to an identifier of the UE; adding an identifier of transmission resources corresponding to the identifier of the UE of the transmission resource allocation information to the transmission resource information when the transmission resource allocation information includes transmission resources corresponding to the identifier of the UE; determining if any item of transmission resources used by the UE is allocated to another UE based on the transmission resource allocation information; and when an item of transmission resources used by the UE has been allocated to another UE based on the transmission resource allocation information, removing an identifier of the item of transmission resources allocated to another UE from the transmission resource information.

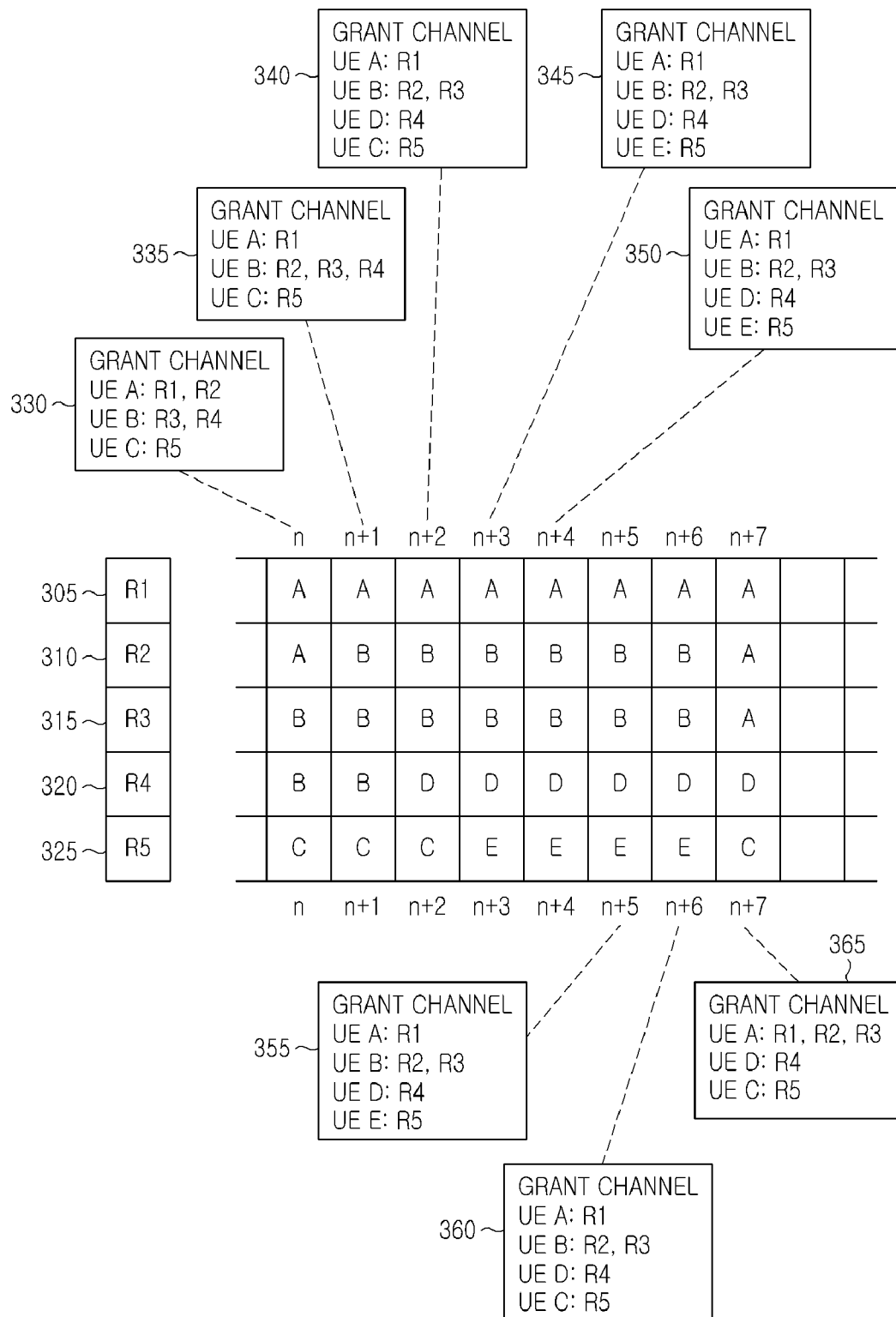
[Fig. 1]



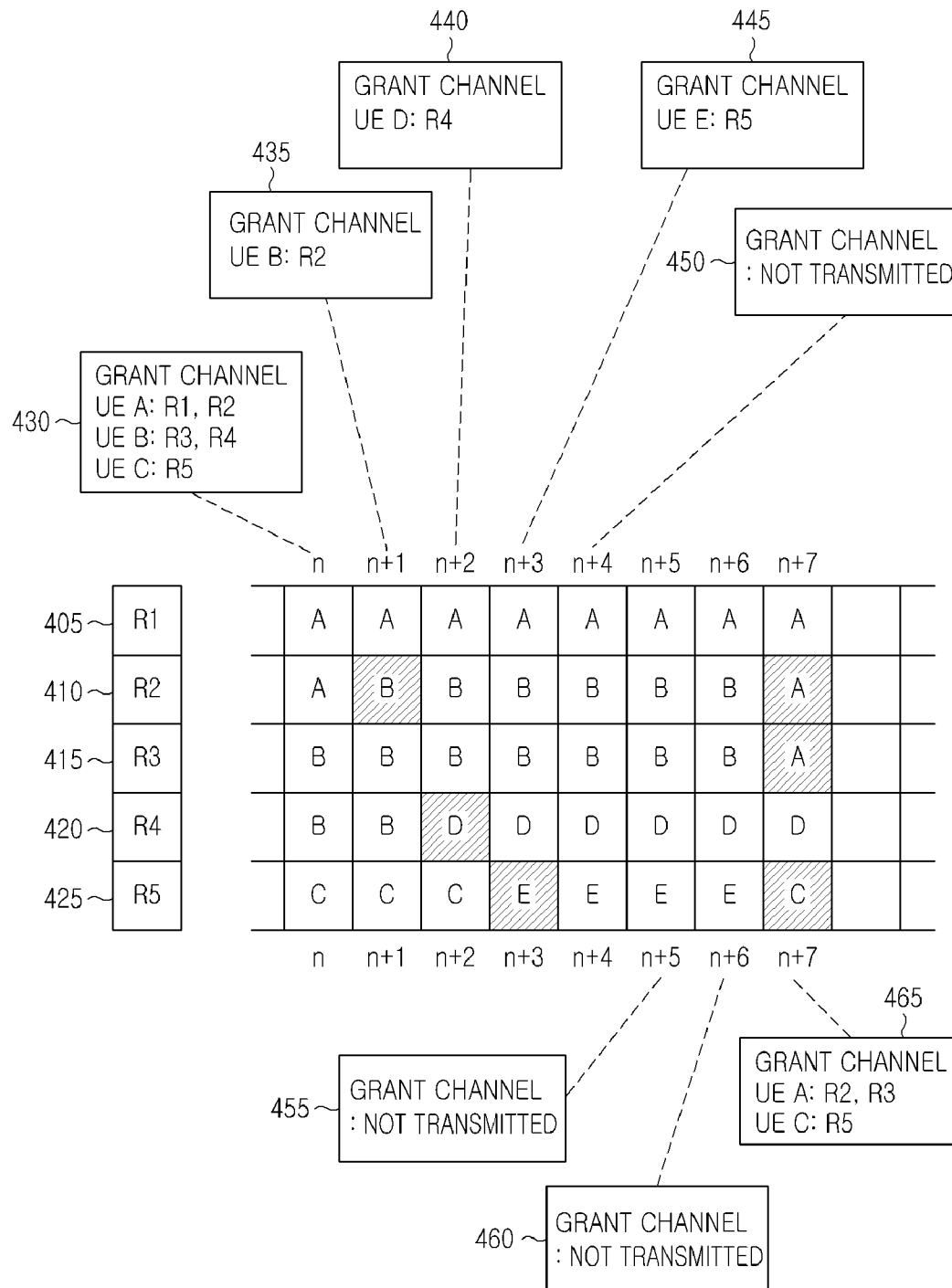
[Fig. 2]



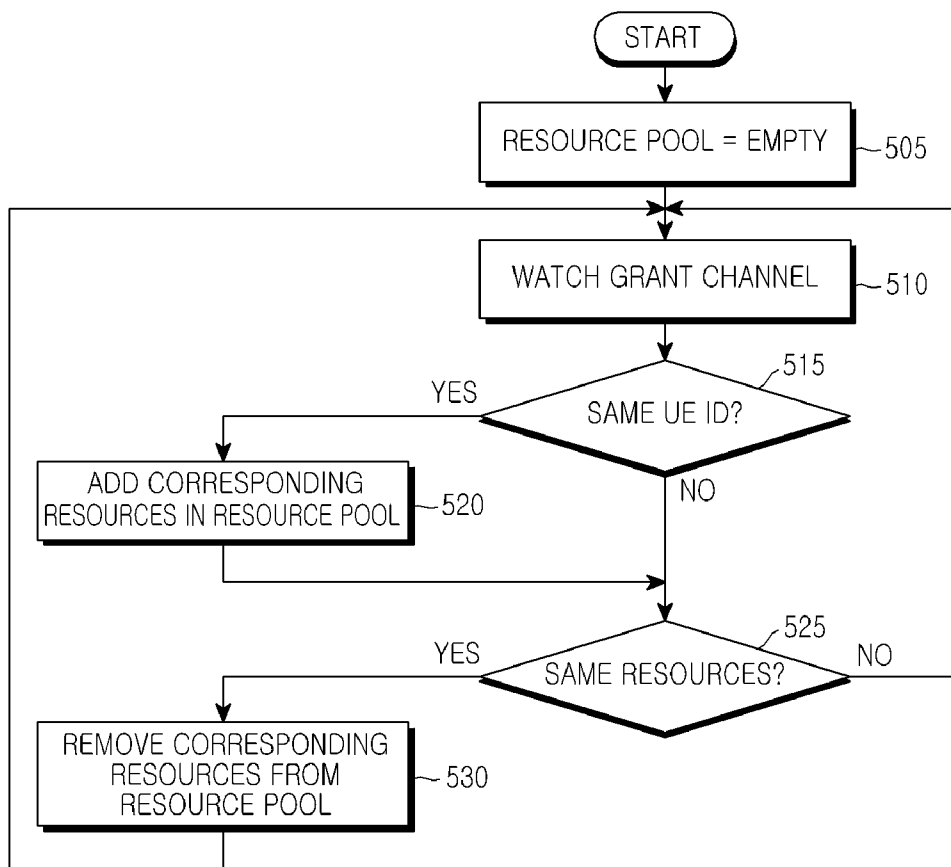
[Fig. 3]



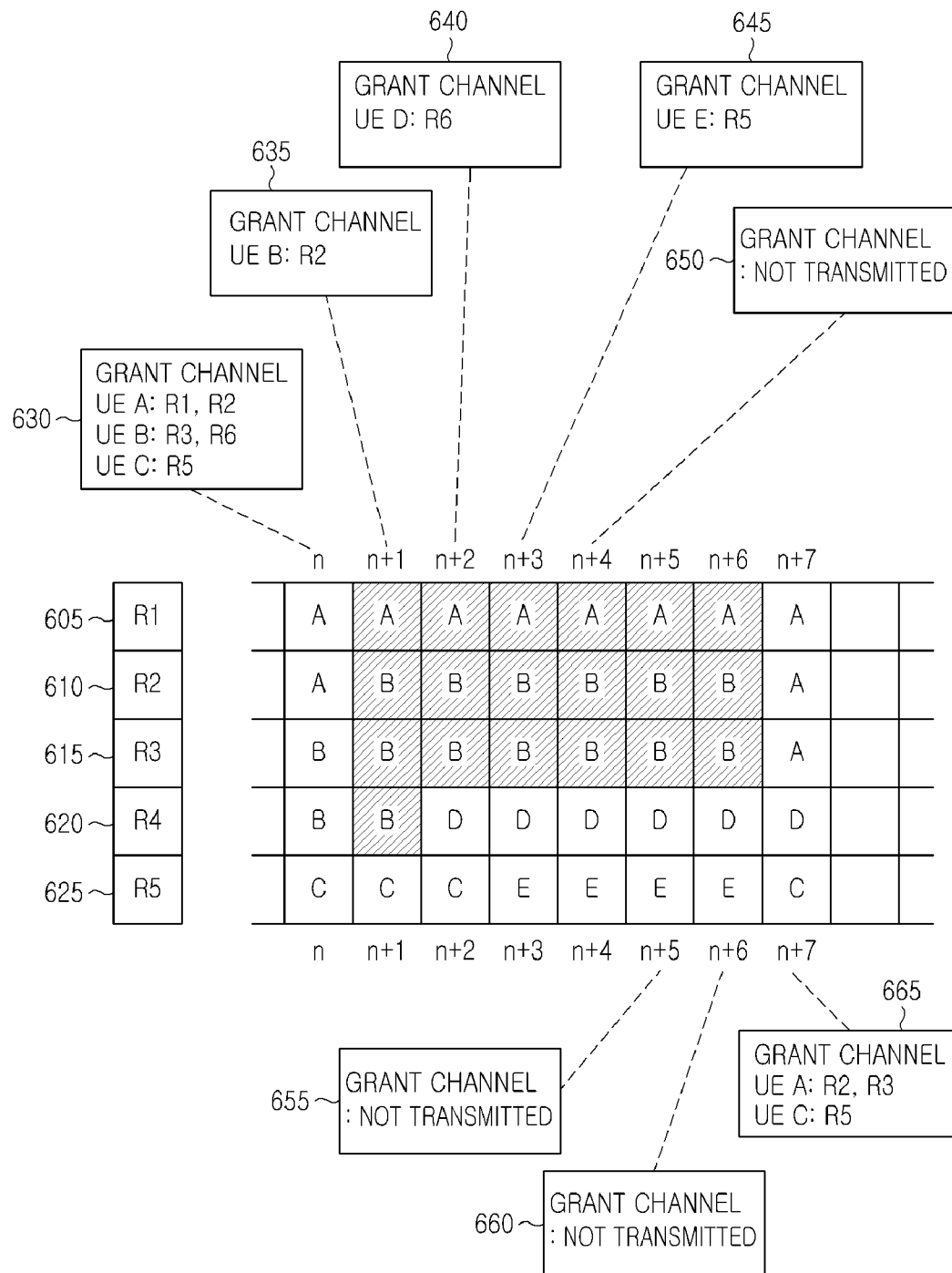
[Fig. 4]



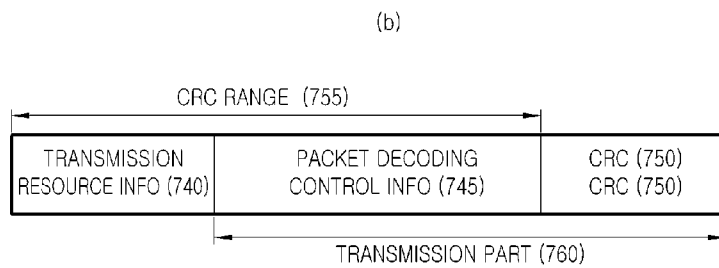
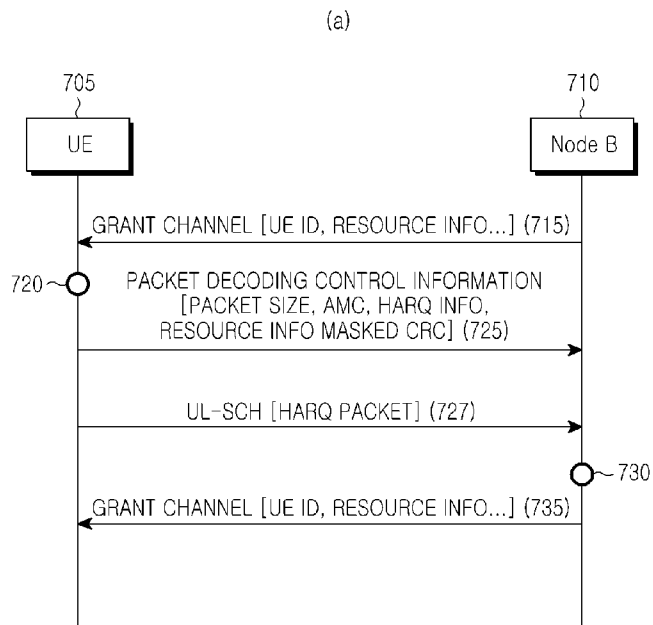
[Fig. 5]



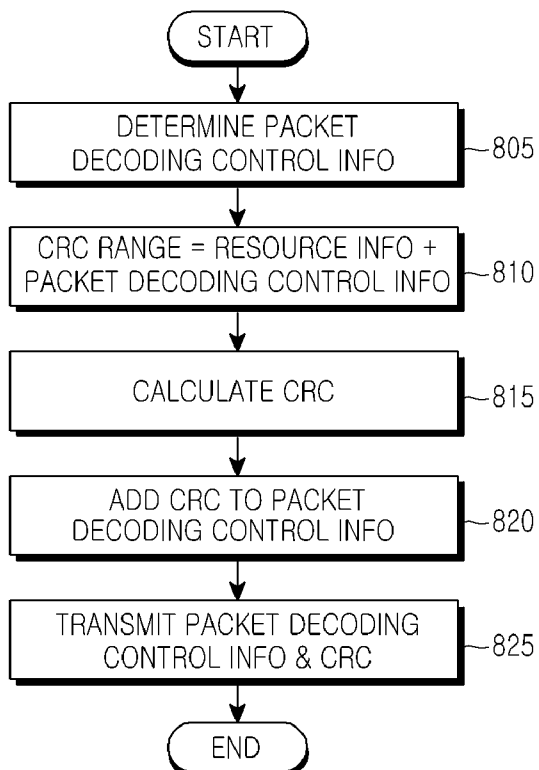
[Fig. 6]



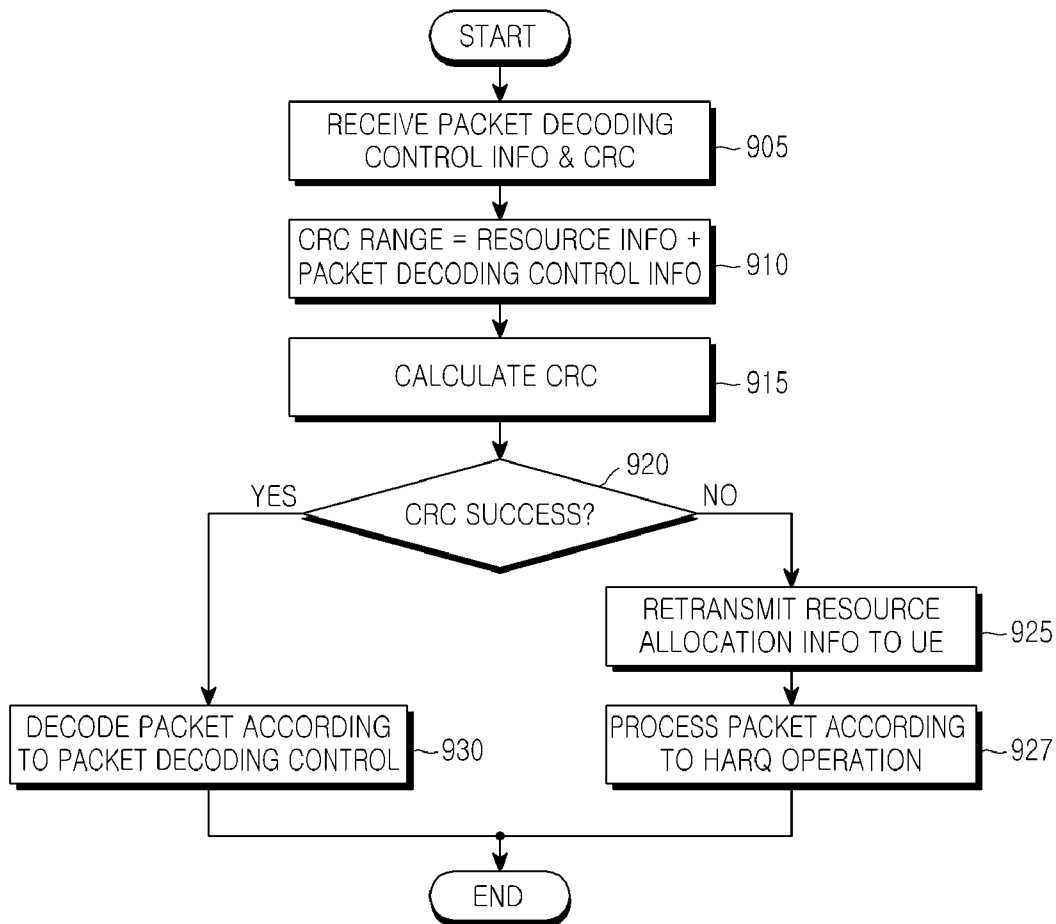
[Fig. 7]



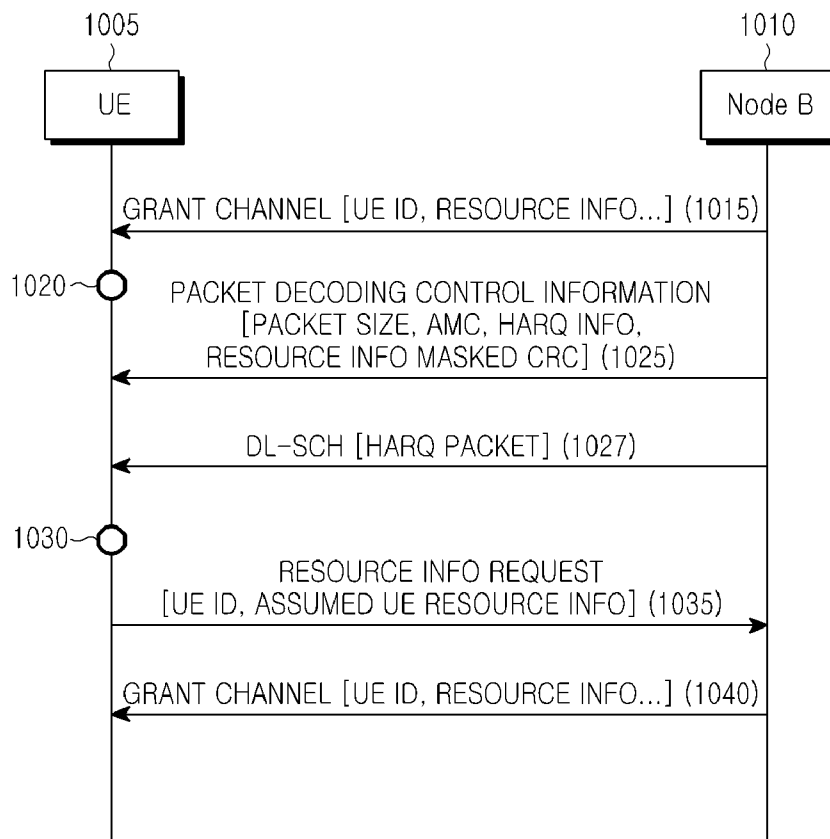
[Fig. 8]



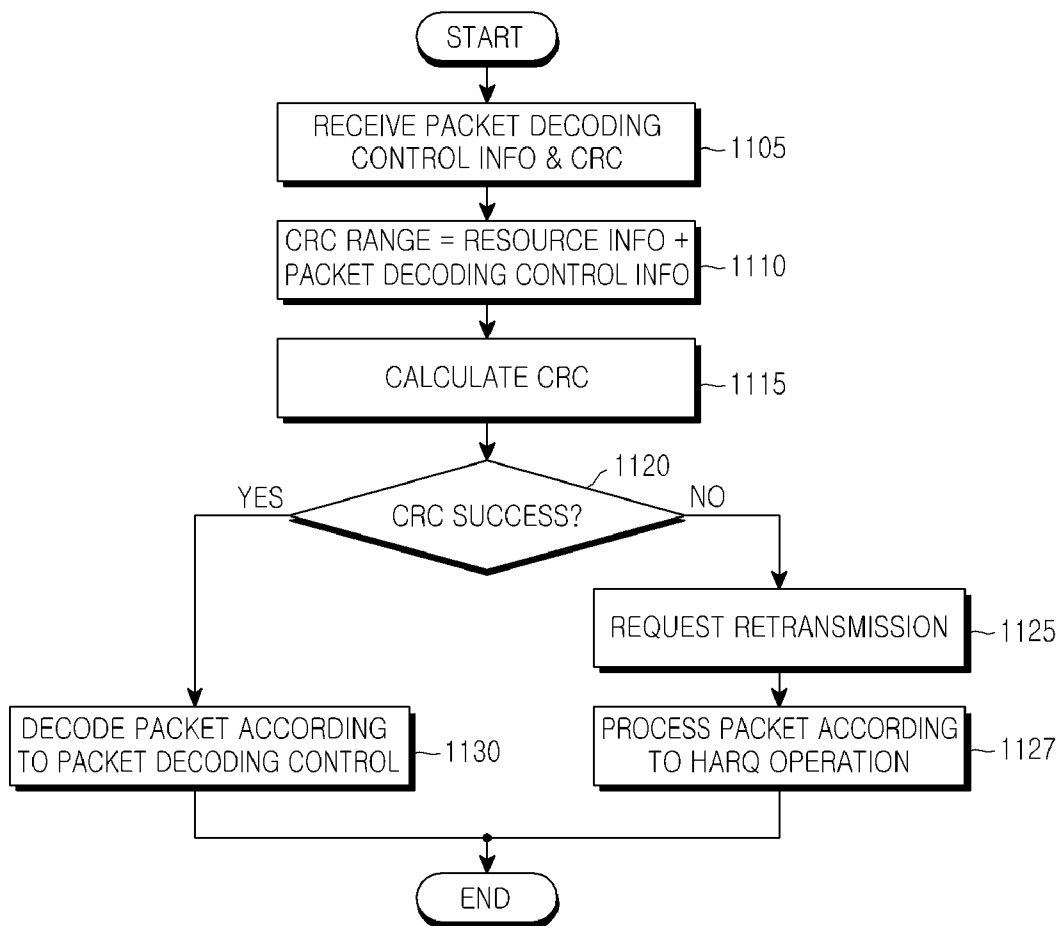
[Fig. 9]



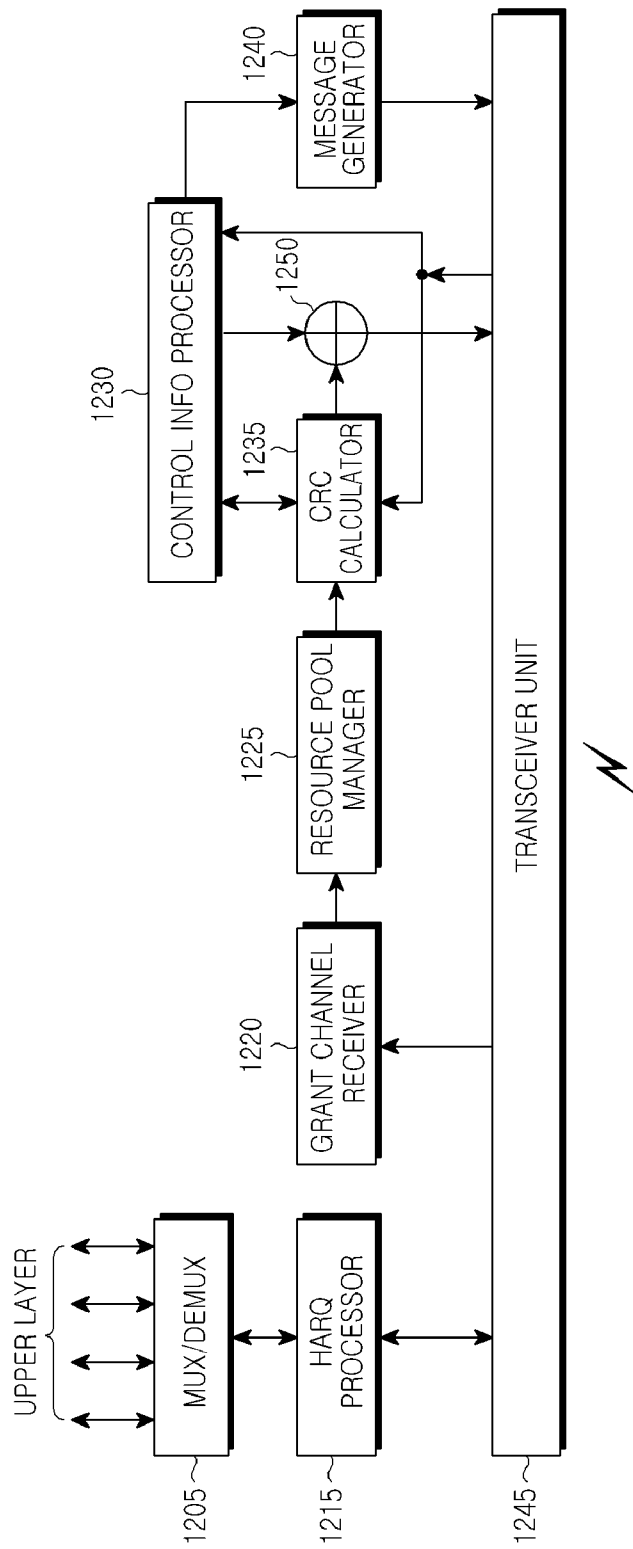
[Fig. 10]

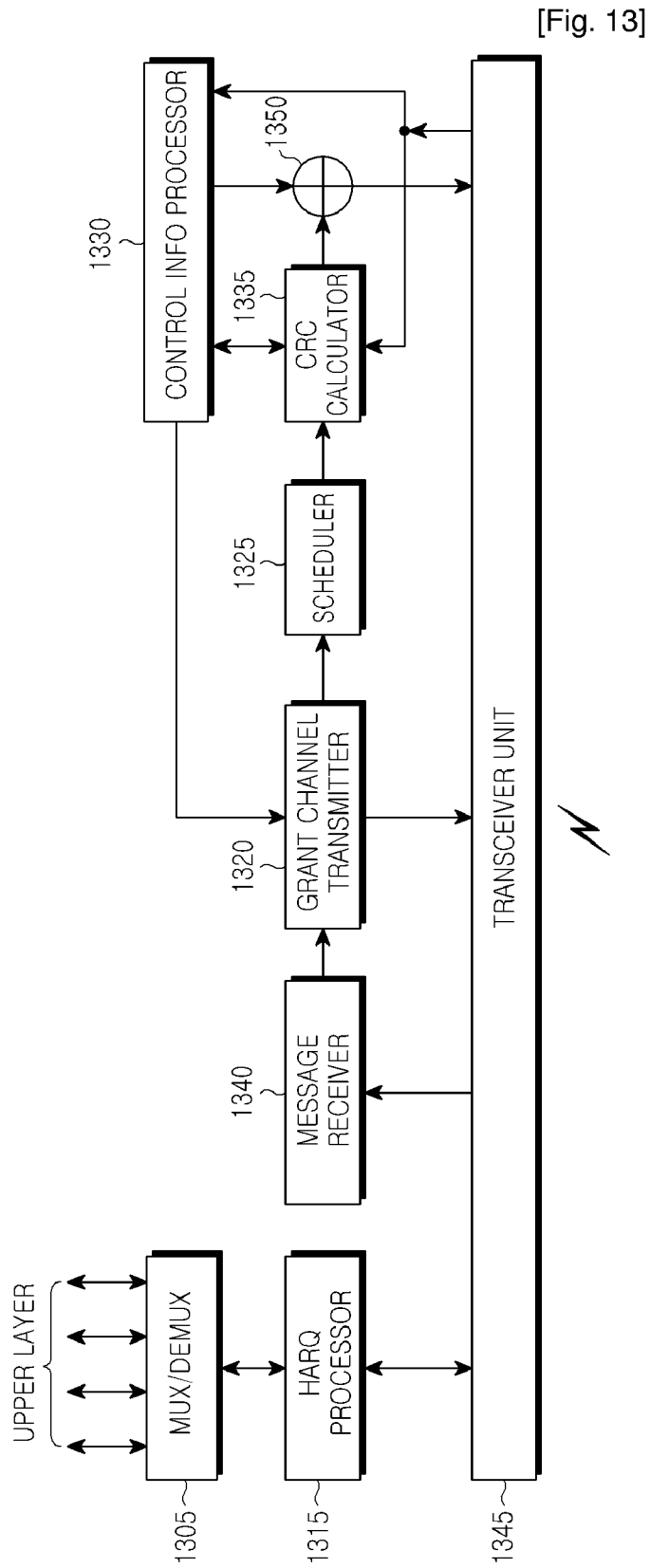


[Fig. 11]

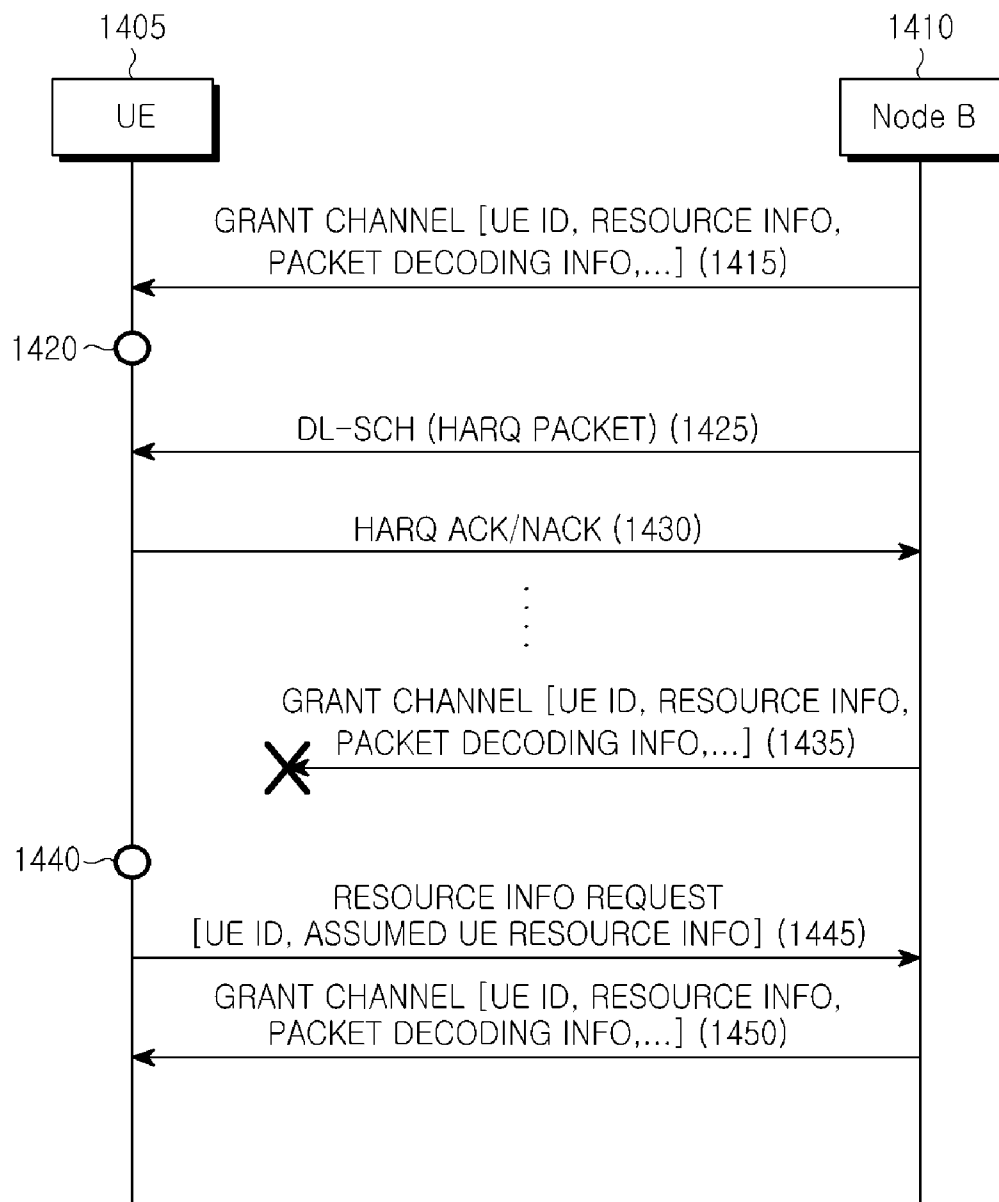


[Fig. 12]

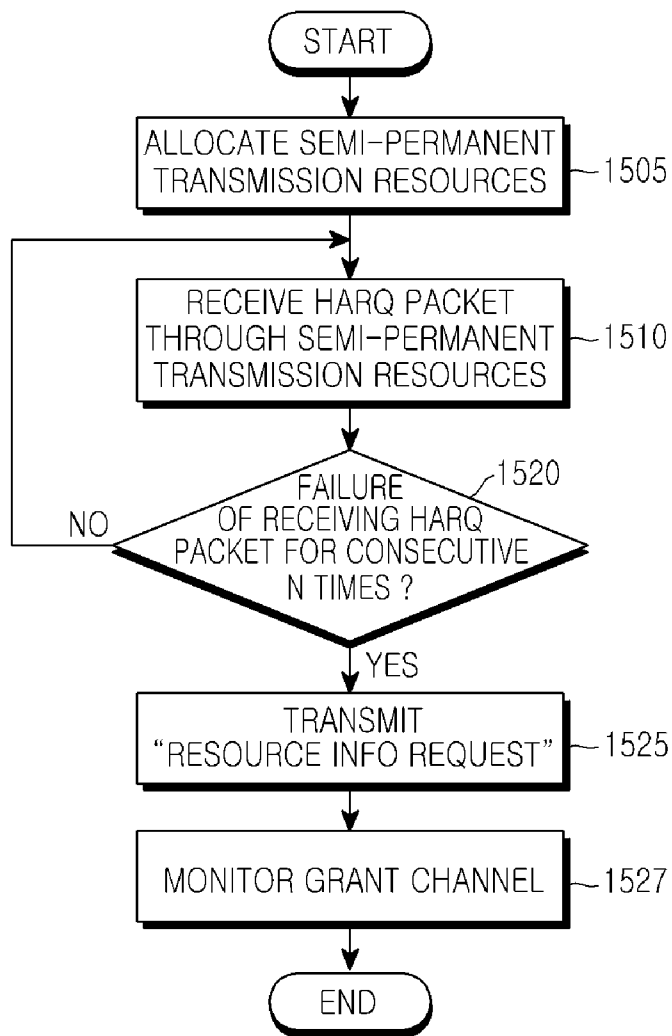




[Fig. 14]



[Fig. 15]



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)

IPC8 H04B, H04Q 7, H04J 11, H04L 12

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-UMTS (LTE), Node B, scheduling, transmission, resource, allocation, grant 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.
A	US2004-190485 A1 (KHAN) 30 September 2004 * abstract, paragraph [0053], figure 10 *	1-20
A	US2004-160936 A1 (LIU et al.) 19 August 2004 * abstract, paragraphs [0018]-[0020], figure 1 *	1-20
A	US2005-30953 A1 (VASUDEVAN et al.) 10 February 2005 * abstract, paragraphs [0033]-[0035], figure 2 *	1-20
A	US2002-90004 A1 (RINCHIUSO) 11 July 2002 * abstract, paragraphs [0030]-[0042], figures 3A-3B *	1-20



Further documents are listed in the continuation of Box C.



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"&" document member of the same patent family

Date of the actual completion of the international search

25 JUNE 2007 (25.06.2007)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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