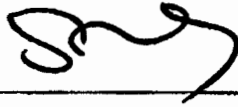


CERTIFICATE OF VERIFICATION

I, Sung Mi JEON of 7th Floor, Hyundai Building, 175-9, Jamsil-dong, Songpa-ku, Seoul, 138-861, Republic of Korea state that the attached documents are a true and complete translation to the best of my knowledge of the Korean-English language and that the writings contained in the following pages are correct English translations of the Provisional U.S. Patent Application No. 61/018,492

Dated this 13th day of March, 2009

Signature of translator: _____



Sung Mi JEON

SPECIFICATION

1. Title of the Invention

METHOD FOR TRANSMITTING AND RECEIVING RANDOM ACCESS

RESPONSE

2. Detailed Description of the Invention

1) Object of the Invention

The present invention is to solve a problem that a specific user equipment erroneously receives a random access response of another user equipment.

2) Description of Prior Art

(1) Configuration of Prior Art

In [1], a random access channel may have a period from 1 ms to 20 ms as shown in the following table.

Table 5.7.1-2: Random access preamble timing for preamble format 0-3.

PRACH configuration	System frame number	Subframe number
0	Even	1
1	Even	4
2	Even	7
3	Any	1
4	Any	4
5	Any	7
6	Any	1, 6
7	Any	2, 7
8	Any	3, 8
9	Any	1, 4, 7
10	Any	2, 5, 8
11	Any	3, 6, 9
12	Any	0, 2, 4, 6, 8
13	Any	1, 3, 5, 7, 9
14	Any	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
15	Even	9

[1] 3GPP TS 36.211 v. 8.1.0, "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation", 2007-12-20.

(2) Description of the Operation of the Apparatus of the
Prior Art

(3) Problems of Prior Art

Each user equipment may attempt to access the system with a randomly selected sequence or opportunity in each RACH slot. A base station detects the RACH sequence (opportunity) and then transmits a response thereof. Each user equipment receives the RACH response from the base station, considers a response including the sequence transmitted by itself as its response, and performs a timing advance operation. At this time, if an accurate time interval for allowing each user equipment to wait for the response is not present, each user equipment may erroneously receive a response of another user equipment as its response. This state is shown in FIG. 1. This state may appear in every RACH period, but, for convenience, it is assumed that this state appears in an RACH state having a preamble format of 0 and a period of 1 ms.

In FIG. 1, a first user equipment attempts access with a randomly selected sequence 1 in an uplink (UL) subframe 0. In an uplink subframe 1, a second user equipment attempts access with a randomly selected sequence 1 (S120). It is assumed that both the sequences of the two user equipments are detected by a base station. The base station transmits responses to the detected sequences. At this time, the two

user equipments which attempt access wait for their respective responses. When the response of the sequence 1 is reached in an uplink subframe 7, both the UE1 and UE2 may erroneously receive the response as their respective responses to the sequences, with which the user equipments attempt access. Accordingly, since the two user equipments perform time synchronization by the response received in the uplink subframe 7, one user equipment performs erroneous time synchronization. In addition, since data or a control signal is transmitted again in uplink using the same resource indicated by the response, a problem that the two user equipments use the same resource occurs.

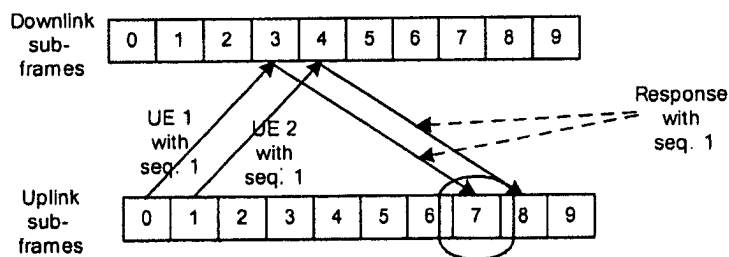


FIG. 1: Example of RACH response

In addition, unlike the above example, if a resource available in a time domain in which the base station transmits the response is not present, a problem that the response cannot be transmitted on time occurs. In this case, the response of the RACH slot corresponding thereto is not transmitted or is delayed. At this time, there is a need for a method of distinguishing between a delayed response and a

response which is transmitted on time or between delayed responses.

In addition, if responses of several RACH slots are collected and are simultaneously transmitted, there is a need for a method of distinguishing between RACH slots.

There is a need for a method for solving such problems.

3) Description of the Invention

(1) Configuration of the Invention

In the following description, the RACH configuration having the period of 1 ms will be described. However, the present invention is not limited to such an RACH period. In addition, since the effect of the present invention is further increased when the period is short, the present invention may be used only in a specific RACH configuration having a short period. In addition, although the 3GPP LTE system is used for convenience of description, the present invention is not limited to this. For example, the present invention is applicable to a ranging channel of the IEEE 802.16. In other words, an RACH response of the LTE described in the present invention may be analyzed as a ranging response of the 802.16.

Method 1: Response location based on a predetermined timing period (no overhead case)

A method for allowing each user equipment to previously know when its response is transmitted after each user equipment attempts access based on a predetermined timing period may be used. For example, the predetermined timing period may be determined in association with HARQ timing. A method for, at each user equipment, estimating a response location based on HARQ timing at a time location of the RACH slot transmitted by itself and receiving only a downlink signal in a specific time location section is possible. For example, as shown in FIG. 2, if it is assumed that the number of HARQ processes is 8. A time consumed for, at the user equipment, processing a signal transmitted from a base station in downlink and transmitting the signal in uplink again, and, at the base station, processing the signal transmitted by the user equipment is 8 ms. In other words, about a half of the number of HARQ processes is consumed for receiving a response to a transmitted signal, excluding the processing time of the received signal.

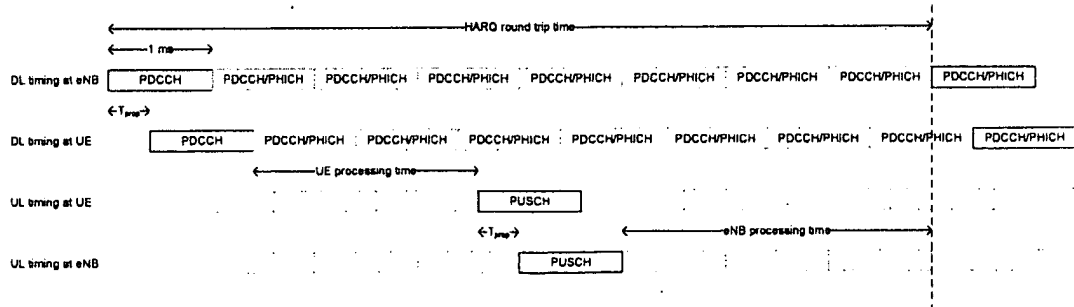


FIG. 1: Example of HARQ processing

The user equipment which attempts access may wait for the response within a time period corresponding to about a half of the number of HARQ processes. Alternatively, a method of applying an offset in consideration of a difference between a data processing time and a random access processing time may be used. For example, a method of receiving a downlink signal by the user equipment at a location offset from a time determined by the number of HARQ processes by one subframe is possible. This offset may be represented by adding or subtracting of a predetermined number and may be represented by a multiple of the number of HARQ processes.

If the RACH having a length of 2 ms or 3 ms is transmitted in the above method, a method of estimating a time for always waiting for a response from a time location for a start time location of an RACH slot is possible. Alternatively, a method of estimating a time for always waiting for a response from a time location for an end time location of an RACH slot is possible.

It is possible to prevent each user equipment from erroneously receiving a response for another user equipment as its response using a predetermined response reception time location.

Method 2: Method for including transmitted or received time location information in RACH response

The problems can be solved by a method of including time location information in an RACH response while enduring signaling overhead.

For example, when an RACH response is transmitted in downlink in FIG. 2, a UL subframe number can be transmitted together.

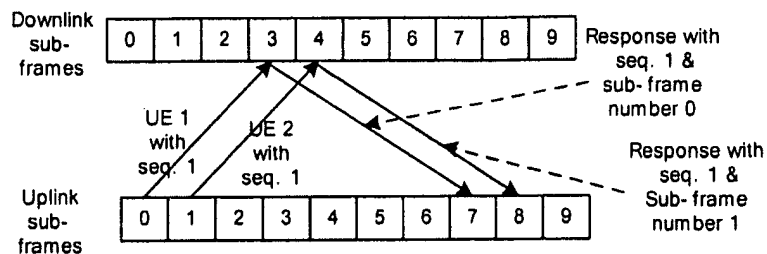


FIG. 2: Example of response including time information

A base station can know a UL subframe number of a received signal in consideration of a size which can be supportably by a cell. Accordingly, the base station transmits the subframe number in a state of being included in the response in addition to the detected sequence information, and each user equipment uses only the response, in which the sequence transmitted by itself is matched with the subframe information, as its information.

FIG. 3 shows an example of the case where a period is 2 ms. In this case, the subframe number may be informed together. Alternatively, in order to reduce the number of signaling bits, a method of renumbering only subframes, in which actual RACH slots are present, instead of the subframe number and transmitting the renumbered subframes is also

possible. In the example of FIG. 3, information about a second subframe may be represented by 1.

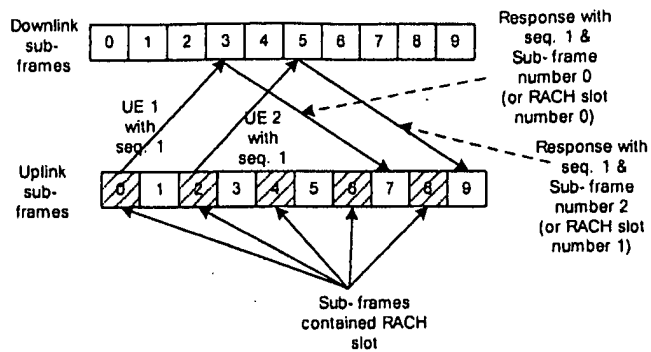


FIG. 3: Example of the response including time information in the case where a period is 2 ms.

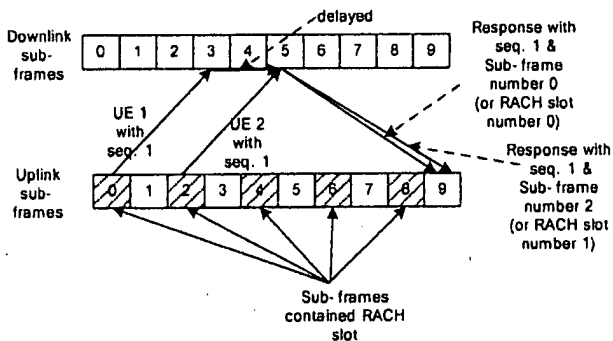


FIG. 4: Example of the delayed response in the case where a period is 2 ms.

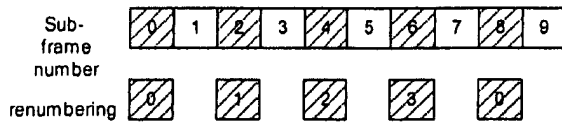
In FIG. 4, the case where the RACH response of a 0th UL subframe is delayed will be described. When an RACH is received in a downlink subframe 3, the base station may not have a resource which will be transmitted in downlink. This may occur in various cases. For example, if a resource is used for a dedicated multicast broadcast single frequency network (MBSFN), a unicast downlink resource cannot be allocated. In contrast, although a resource is not used for a special purpose, all resources may be used for other

control signals and data signals at a specific time. In this case, the transmission of the response may be delayed. In addition, several responses may be simultaneously transmitted by one resource. Accordingly, time information is preferably included in the RACH response.

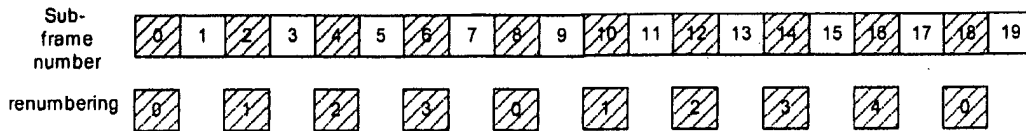
Although, in the above method, the subframe number or the renumbered subframe number is used as the time information included in the RACH response, another method is possible. For example, an actual reception time location may be previously set, and an offset according to at how far from that time location an actual response is transmitted may be included and transmitted. If such an offset is used, it is possible to reduce the number of signaling bits.

In the above method, as the subframe number or the renumbered subframe number which is used as the time information included in the RACH response, a method of transmitting information in a period shorter than 10 ms or a method of transmitting information using grouping is possible. For example, in the case of 4-bit signaling, the subframe number may be reduced by a modular operation in four units and may be transmitted. In addition, the renumbered subframe number may be transmitted by the modular operation in four units. Such an example is shown in FIG. 5. Here, the hatched subframes indicate subframes each including the RACH

slot. The subframes each including the RACH slot are renumbered and are rearranged by the modular-4 operation.



(a) Example of 10 ms



(b) Example of 20 ms

FIG. 5: Renumbering & grouping (or modular operation)

In the above method, if the RACH having a length of 2 ms or 3 ms is transmitted, the time location for the start time location of the RACH slot may be always included in the response and may be informed. Alternatively, the time location for the end time location of the RACH slot may be always included in the response and may be informed.

By including the transmission or reception time location in the response message, it is possible to prevent each user equipment from erroneously receiving the response of another user equipment as its response.

Although, in all the examples, the number up to 10 which is a half of one radio frame of the frame structure type 1 is considered as the subframe number, the present invention is not limited to such a unit. As described above, the unit of 10 ms may be used and the number up to 20 may be used as the

length of one radio frame as the maximum value of the subframe number.

Even when only the subframes including the RACH slot are renumbered and used, any unit such as 10 ms, 20 ms or 40 ms may be used as the unit.