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(71) Applicant *(for all designated States except US)*: **SAMSUNG ELECTRONICS CO., LTD.** [KR/KR]; 416, Maetan-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 442-742 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **KIM, Soeng-Hun** [KR/KR]; #321-1003, Cheongmyeongmaeul 3-danji, APT., Yeongtong-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-737 (KR). **VAN LIESHOUT, Gert Jan** [NL/GB]; Samsung Electronics Research Institute, Communication House South Street, Staines, Middlesex TW18 4QE (GB). **JEONG, Kyeong-In** [KR/KR]; #112-1302, Daewoo Purgio APT., Gisan-ri, Taean-eup, Hwaseong-si, Gyeonggi-do 445-972 (KR). **VAN DER VELDE, Himke** [NL/GB]; Samsung Electronics Research Institute, Communication House South Street, Staines, Middlesex TW18 4QE (GB).

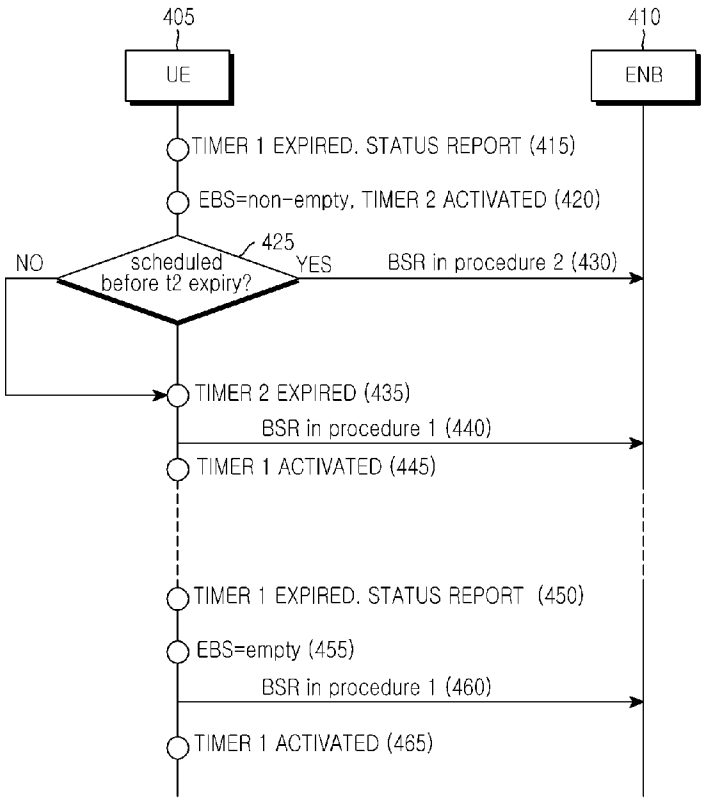
(74) Agent: **LEE, Keon-Joo**; Mihwa bldg.110-2, Myongryun-dong 4-ga, Chongro-gu, Seoul 110-524 (KR).

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(54) Title: METHOD AND APPARATUS FOR BUFFER STATUS REPORT IN MOBILE COMMUNICATION SYSTEM



(57) Abstract: Disclosed is a method and an apparatus for periodically reporting the buffer status in a mobile communication system. If there is a possibility that a transmission resource will be allocated to the UE, it stands by for a predetermined period of time until a transmission resource is allocated instead of directly transmitting a buffer status report so that, if possible, the buffer status report message is piggybacked onto uplink data and transmitted.

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Description

METHOD AND APPARATUS FOR BUFFER STATUS REPORT IN MOBILE COMMUNICATION SYSTEM

Technical Field

[1] The present invention relates to mobile communication systems, and more particularly to a method and an apparatus for periodically reporting the buffer status in a mobile communication system.

Background Art

[2] As generally known in the art, the LTE (Long Term Evolution), which is the evolved mobile communication system of the third-generation mobile communication system of UMTS (Universal Mobile Telecommunication Service), provides a high-speed packet service based on the OFDM. In the case of a mobile communication system in which the Node B dynamically allocates a transmission resource, such as LTE or EUDCH (Enhanced Uplink Dedicate Channel), the UE must report the buffer status to the Node B prior to transmitting data through the uplink. Schemes for reporting the buffer status include an event-triggered scheme in which a buffer status report message is transmitted if a specific condition is satisfied, and a periodic scheme in which a buffer status report message is transmitted at a predetermined cycle.

[3] In the case of the EUDCH, both the event-triggered scheme and the periodic scheme have been adopted. Both schemes are also expected to be employed by the LTE.

[4] FIG. 1 shows an exemplary scheme for periodically reporting the buffer status according to the prior art.

[5] When such a periodic scheme is employed, the UE activates a timer after completing the transmission of a buffer status report message. If the timer expires, the UE transmits a new buffer status report message.

[6] Referring to FIG. 1, if no transmission resource has been allocated to the UE 105 when the timer has expired (115), the UE 105 transmits a signal for a scheduling request, for example, to the Node B 110 (120), which then is allocated a transmission resource for the buffer status report (125). The UE 105 then transmits a buffer status report message based on the allocated transmission resource (130).

[7] On the other hand, if the UE 105 has a transmission resource allocated thereto when the timer has expired (135), the UE 105 piggybacks the buffer status report message onto the uplink data by using the allocated transmission resource, and transmits it.

Disclosure of Invention

Technical Problem

[8] In other words, if the UE is to transmit a buffer status report message with no

transmission resource allocated thereto, the UE must transmit a separate uplink signal to the Node B (120), and receive a downlink transmission resource allocation signal from the Node B (125). If a transmission resource has been allocated (135), the UE can directly piggyback and transmit an uplink signal, which includes a buffer status report message, without exchanging a separate control messagefor transmitting the buffer status report message (140). As such, the buffer status report message is preferably transmitted after a transmission resource has been allocated.

Technical Solution

[9] Accordingly, the present invention has been made to solve the above-mentionedproblems occurring in the prior art, and it is an aspect of the present invention to provide a method and an apparatus for periodically reporting the buffer status by a UE in such a manner that the buffer status report is conducted according to whether or not a transmission resource can be allocated.

[10] In order to accomplish this aspect of the present invention, there is provided a method for reporting a buffer status to a Node B by a user equipment in a mobile communication system, the method includingthe steps of checking if there is data to be transmitted to the Node B when a buffer status report event occurs; and transmitting the data together with the buffer status report by using a resource allocated first after the buffer status report event has occurred when there is data to be transmitted to the Node B.

[11] In accordance with another aspect of the present invention, there is provided a user equipment apparatus for reporting a buffer status to a Node B in a mobile communication system, the apparatusincluding a transmission buffer for storing data to be transmitted to an anchor layer; a buffer status report controller for generating a buffer status report message regarding data stored in the transmission buffer when a buffer status report event occurs; a transmission resource allocation request unit for requesting the Node B to allocate a resource; a transceiver for multiplexing data transferred from the transmission buffer and the buffer status report controller, transmitting the data to the Node B, and transmitting a resource allocation request to the Node B at a request of the transmission resource allocation request unit; and a transmission controller for receiving a control channel via the transceiver, checking if a resource has been allocated by the Node B, and transmitting a check result to the buffer status report controller, wherein the buffer status report controller is adapted to generate the buffer status report message after receiving a first report on resource allocation from the transmission controller after the buffer status report event has occurred when there is data to be transmitted to the transmission buffer, and the transceiver is adapted to transmit the data together with the buffer status report

message by using the resource.

Advantageous Effects

[12] The merits and effects of exemplary embodiments will be described as follows.

[13] According to the present invention, the UE periodically reports the buffer status to the Node B in the following manner: if there is a possibilitythat the Node B will allocate a transmission resource to the UE in the near future, the UE stands by for a predetermined period of time and, if a transmission resource is allocated, transmits a buffer status report message. If there is no possibility that the Node B will allocate a transmission resource to the UE, the UE transmits a buffer status report message as soon as a buffer status report is triggered. Therefore, even if the time to transmit a buffer status report message arrives while no transmission resource has been allocated, a buffer status report message is transmitted after a transmission resource is allocated. This advantageously simplifies the procedure for transmitting a buffer status report message.

Brief Description of the Drawings

[14] FIG. 1 is a flowchart showing an exemplary scheme for periodically reporting the buffer status according to the prior art;

[15] FIG. 2 is a block diagram showing an exemplary structure of an LTE mobile communication system;

[16] FIG. 3 shows a protocol stack of an LTE mobile communication system;

[17] FIG. 4 is a flowchart showing the overall operation according to an embodiment of the present invention;

[18] FIG. 5 is a flowchart showing the operation of a UE according to an embodiment of the present invention;

[19] FIG. 6 is a flowchart showing an operation for setting a Node B-estimated buffer status parameter by a UE according to an embodiment of the present invention;

[20] FIG. 7 is another flowchart showing an operation for setting a Node B-estimated buffer status parameter by a UE according to an embodiment of the present invention; and

[21] FIG. 8 is a block diagram showing a UE device according to an embodiment of the present invention.

Best Mode for Carrying Out the Invention

[22] Hereinafter, the operation principle according to exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. In the following description of the present invention, a detailed description of known functions and configurations incorporated herein isomitted to avoid making the subject matter of the present invention unclear.The terminology used herein is

defined based on consideration of relevant functionality according to the present invention, and may vary depending on the intention or practice of the user or operator. Therefore,the definition must be understood based on the overall context of the specification.

[23] According to the present invention, the buffer status is periodically reported in the following manner: if there is a possibility that the Node B will allocate a transmission resource to the UE in the near future, the UE transmit a buffer status report message to the Node B after the transmission resource is allocated to the UE. On the other hand, if there is no possibilitythat the Node B will allocate a transmission resource to the UE, the UE transmit a buffer status report message to the Node B as soon as a buffer status report is triggered.

[24] It is to be noted that, although embodiments of the present invention will be described with reference to an LTE (Long Term Evolution) system as an example, the present invention is not limited to it and is applicable to any type of communication system.

[25] The LTE system, to which the present invention is applied, will now be described briefly prior to descriptions of embodiments of thepresent invention.

[26] FIG. 2 shows an exemplary structure of an LTE mobile communication system to which the present invention is applied.

[27] Referring to FIG. 2, E-RANs (Evolved UMTS Radio Access Networks) 210 and 212 have a simple two-node structure including evolved Node Bs (hereinafter, referred to as ENBs or Node Bs) 220, 222, 224, 226, and 228 and anchor nodes 230 and 232. The UE (User Equipment) 201 accesses the IP (Internet Protocol) network by means of the E-RANs 210 and 212.

[28] The ENBs 220-228 correspond to existing Node Bs in the UMTS system, and are connected to the UE 201 via wireless channels. The ENBs 220-228 aggregate information regarding the conditions of UE 201 and schedulesthe UE 201, and are in charge of functions regarding wireless resource management. The ENBs 220-228 are provided with a control protocol, such as RRC (Radio Resource Control).

[29] In order to realize a maximum transmission rate of 100Mbps, the LTE employs the OFDM (Orthogonal Frequency Division Multiplexing) as the wireless access technology in the 20Mhz bandwidth. In addition, the LTE adopts an AMC (Adaptive Modulation& Coding) scheme, in which the modulation scheme and the channel coding ratio are determined according to the channel condition of the UE.

[30] FIG. 3 shows a protocol stack of an LTE mobile communication system to which the present invention is applied.

[31] Referring to FIG. 3, PDCP (Packet Data Convergence Protocol) layers 305 and 340 are adapted for compression/decompression and ciphering/deciphering of IP headers.

In RLC (Radio Link Control) layers 310 and 335, a PDCP PDU (Packet Data Unit) is reconstructed to an appropriate size (hereinafter, a packet outputted from a specific protocol entity is referred to as a PDU of the protocol), and the reconstructed packets are subjected to an ARQ (Automatic Repeat reQuest) operation. The PDCP layers 305 and 340 and the RLC layers 310 and 335 constitute at least one PDCP entity (i.e. PDCP device) or at least one RLC entity (i.e. RLC device), which can be constructed for each service or flow when communication begins, and process data packets by using each entity. As shown in FIG. 3, the PDCP layers 305 and 340 are located on the UE and the anchor node, respectively, and the RLC layers 310 and 335 are located on the UE and the ENB, respectively.

[32] MAC layers 315 and 330 are connected with various RLC entities, and are adapted to multiplex RLC PDUs into MAC PDUs and demultiplex MAC PDUs into RLC PDUs.

[33] Physical layers 320 and 325 are adapted to channel-code anchor layer data (i.e. MAC PDUs), modulate them into OFDM symbols, and transmit them through wireless channels. In addition, the physical layers 320 and 325 receive OFDM symbols via wireless channels, demodulate and channel-decode them, and transfer them to the anchor layer.

[34] The UE according to an embodiment of thepresent invention has a Node B-estimated buffer status (hereinafter, referred to as EBS) parameter, a first timer, and a second timer.

[35] The EBS parameter corresponds to the buffer status of the UE as estimated by the Node B, and is managed by the UE. The EBS has a value corresponding to either "empty" or "non-empty".

[36] It means that, if the EBS is set to "empty", the Node B regards that the buffer of the UE is empty. Therefore, there is no possibility that the Node B will allocate a transmission resource to the UE unless the UE separately reports the buffer status.

[37] It means that, if the EBS is set to "non-empty", the Node B regards that data is stored in the buffer of the UE. Therefore, there is a possibilitythat the Node B will allocate a transmission resource to the UE, even if the UE does not separately report the buffer status.

[38] According to an embodiment of the present invention, the UE checks the EBS every time it has to make the periodic buffer status report, and, if the EBS is "non-empty", the UE stands by for a predetermined period of time without transmitting a buffer status report message. If the UE is allocated a transmission resource thereto for theperiod of time, the UE transmits a buffer status report message to the Node B by using the allocated transmission resource. If the UE fails to be allocated a transmission resource until the period of time elapses, the UE is allocated a transmission resource for a buffer status report thereto accordingto a predetermined procedure (e.g.

scheduling request) as in the case of the prior art, and transmits a bufferstatus report message by using the allocated transmission resource. On the other hand, if the EBS is "empty", the UE is allocated a transmission resource for a buffer status report thereto accordingto a predetermined procedure with no standby, and transmits a buffer status report message to the Node B by using the allocated transmission resource.

[39] Forconvenience of description, the procedure for transmitting a buffer status report message according to the present invention will now be divided into two and described accordingly.

[40] - The first buffer status report message transmission procedure: it is used when there is no uplink transmission resource for piggybacking a buffer status report message. For example, the UE transmits a small-size uplink signal, such as a scheduling request, to theNode B, which then is allocated a predetermined transmission resource in response of the uplink signal from the Node B. The allocated transmission resource is used to transmit a buffer status report message to the Node B.

[41] - The second buffer status report message transmission procedure: it is used when there is an uplink transmission resource for piggybacking a buffer status report message. The UE piggybacks a buffer status report message onto uplink data and transmits it.

[42] FIG. 4 shows the overall operation according to an embodiment of the present invention.

[43] Referring to FIG. 4, a specific situation occurs at a point of time, in which the UE 405 must make a periodic buffer status report (415). For example, if the first timer that been activated after completely transmitting the preceding buffer status report message expires, the UE recognizes that it must make a periodic buffer status report.

[44] The UE checks the EBS at that point of time and, if the EBS corresponds to "non-empty", determines that the Node B is likely to allocate a transmission resource to the UE in the near future. Then, the UE activates the secondtimer and stands by without transmitting a buffer status report message in response (420).

[45] If the Node B allocates a transmission resource to the UE before the second timer expires (425), the UE transmits a buffer status report message to the Node B according to the above-mentioned second bufferstatus report message transmission procedure (430). In other words, the UE piggybacks a buffer stature report message onto data transmitted through the uplink, and transmits it. After the buffer status report message has been completely transmitted, the UE activates the first timer to check the point of time to transmit the next periodic buffer status report message.

[46] On the other hand, if the Node B fails to allocate a transmissionresource to the UE until the second timer expires (435), the UE transmits a buffer status report message to the Node B according to the above-mentioned first buffer status report message-

transmission procedure (440). Particularly, the UE transmitsan uplink signal (e.g. scheduling request) through the uplink so that a transmission resource is allocated. Then, the UE transmits a buffer status report message by using the allocated transmission resource. After the buffer status report message has been completely transmitted, the UE activates the first timer to check the point of time to transmit the next periodic buffer status report message (445).

[47] If the first time expires and if the UE is supposed to proceed with a periodic buffer stature report (450), the UE checks the EBS again. If the EBS has been set to "empty"(455), i.e. if there is no possibility that a transmission resource will be allocated to the UE within a predetermined period of time, the UE transmits a buffer status report message to the Node B accordingto the first buffer status report message transmission procedure (460). Particularly, the UE transmits an uplink signal (e.g. scheduling request) so that a transmission resource is allocated. Then, the UE transmits a buffer status reportmessage by using the allocated transmission resource. After the buffer status report message has been completely transmitted, the UE activates the first timer to check the point of time to transmit the next periodic buffer status report message (465).

[48] FIG. 5 shows the operation of the UE according to an embodiment of the present invention.

[49] Referring to FIG. 5, if a buffer status report is triggered in step 505, the UE proceeds to step 510 and checks the EBS.

[50] If the EBS corresponds to "empty", the UE proceeds to step 515 and conducts the first buffer status report message transmission procedure.

[51] In order to conduct the first buffer status report message transmission procedure, the UE transmits a scheduling request signal by using a physical channel in order to request resource allocation for transmitting a buffer status report in step 515. After a transmission resource is allocated in step 520, the UE transmits a buffer status report message by using the allocated transmission request in step 525. Then, the UE activates the first timer for a periodic buffer status report in step 545.

[52] On the other hand, if the EBS corresponds to "non-empty", i.e. if there is a possibility that the Node B will allocate a transmission resource to the UE without a separate scheduling request of the UE, the UE proceeds to step 530 and activates the second timer in order to conduct the second buffer status report message transmission procedure.

[53] If a transmission resource is allocated to the UE before the second timer expires, the UE proceeds to step 540. Then, the UE piggybacks a buffer status report message onto uplink data, which is transmitted based on the allocated transmission resource, and transmits the buffer status report message. The UE then proceeds to step 545 and

activates the first timer for a periodic buffer status report.

[54] On the other hand, if no transmission resource is allocated until the second timer expires, the UE proceeds to step 515 and follows the above-mentioned first buffer status report message transmission procedure.

[55] The shorter the first timer is set for the periodic buffer status report, the more frequently the UE transmits a buffer status report message, which results in unnecessary data transmission. If the first timer is set to be excessively long when the UE is executing a delay-sensitive service, the buffer status report message transmission may be delayed, which degrades the service quality. Therefore, the first timer is set based on consideration of the type of service executed by the UE, the required service quality, etc.

[56] Those skilled in the art can understand that, if the secondtimer has been activated, the Node B is aware of the fact that there is uplink data to be transmitted from the buffer of the UE. Therefore, as long as the Node B has a transmission resource to allocate, the Node B will allocate it to the UE. However, if the UE presumes the Node B to be aware of the fact that the UE has transmission data while the Node B actually considers that the UE has no transmission data, the Node B will allocate no transmission resource no matter how long the UE may wait. In order to prevent the UE from waiting forever in such a situation, the present invention proposes that the second timer be used. Considering that such an erroneous situation rarely occurs in a normal network, the second timer preferably has a sufficiently large setup value.

[57] As mentioned above, the EBS is a parameter for storing a value corresponding to an estimation made by the UE regarding how the Node B will recognize the buffer condition of the UE.

[58] In order to ensure that the EBS has a value reflecting the accurate buffer condition of the UE as recognized by the Node B, the UE transmits the last data together with a "last data indicator" according to the present invention. If the Node B receives data containing a last data indicator from the UE, the Node B recognizes that there is no more data stored in the bufferof the UE. After the data containing the last data indicator has been completely transmitted, the UE sets the EBS to "empty".

[59] It is to be noted that the UE uses all transmission resources allocated by the Node B. It means that, if a padding has been inserted into data transmitted by the UE, the UE has no more data to transmit. Therefore, the last data indicator may be replaced with a padding. More particularly, if the UE has a sufficient amount of allocated transmission resources so that it can insert a padding into the last data, the last data indicator is not necessarily inserted because the padding acts as the last data indicator. Therefore, if the Node B receives data containing a padding, the Node B determines that the corresponding UE has no data, even if no last data indicator has been found to be inserted

therein.

[60] FIG. 6 shows a detailed process for setting the EBS by the UE.

[61] Referring to FIG. 6, as the UE 605 switches from an idle state to a connected state, the UE initializes the EBS as "empty" (615), and transmits the first buffer status report message to the Node B 610 (620). After the UE 605 is allocated a transmission resource from the Node B 610 (625), the UE 605 sets the EBS to "non-empty" (630), and transmits uplink data by using the allocated transmission resource (635).

[62] If the time comes to transmit the last data stored in the buffer while the EBS has been set to "non-empty" (645), the UE 605 piggybacks a last data indicator into the last data and transmits them together (650). After the data containing the last data indicator has been completely transmitted, the UE 605 sets the EBS to "empty" (655).

[63] FIG. 7 is a flowchart showing a process for setting the EBS by the UE.

[64] Referring to FIG. 7, the UE initializes the EBS as "empty"when it initially switches from an initial state to a connected state (705). If a transmission resource is allocated to the UE while the EBS has been set to "empty" (710), the UE sets the EBS to "non-empty"(715). The UE maintains the EBS as "non-empty"until the data containing the last data indicator has been completely transmitted. If the data containing the last data indicator has been completely transmitted (720), the UE initializes the EBS as "empty" again (705). The UE repeats this operation.

[65] Although an embodiment of the present invention has been described on an assumption that the buffer status report is triggered periodically, the present invention is not limited to that assumptionand is applicable to a case, for example, in which the buffer stature report is triggered in response to a specific event. More particularly, according to the present invention, when a buffer status reportthat has been set to be generated periodically is triggered, the UE checks the EBS and, if the EBS is "non-empty", activates the second timer. If the UE is allocated an uplink transmission resource from the Node B before the second timer expires, the UE transmits a buffer status report by using the allocated uplink transmission resource.

[66] As such, the present invention can be summarized as follows: if there is a possibility that the Node B will allocate a transmissionresource to the UE within a short period of time after a buffer status report is triggered, the explicit transmission resource request process of the UE based on buffer status report message transmission, for example, is delayed. This operation is not limited to the periodic buffer status report, and is applicable to a buffer status report triggered by a non-periodic event. For example, assuming that a buffer status report has been triggered by the generating of data having a priority higher than that of data currently stored in the UE, the UE checks the EBS and, if the EBS is "non-empty", activates the second timer. The UE transmits no buffer status report message as long as the second timer is working, but waits for the Node B

to allocate a transmission resource to the UE according to a predetermined scheduling-operation. Those skilled in the art can easily understand that, if no transmission resource is allocated until the second timer expires, the UE transmits buffer status report message to explicitly request the Node B to be allocated a transmission resource.

[67] FIG. 8 is a block diagram showing a UE device according to an embodiment of the present invention.

[68] Referring to FIG. 8, the UE according to an embodiment of the present invention includes a transmission buffer 805, a buffer status report controller 810, a transmission resource allocation request unit 815, a transmission controller 820, a multiplexer 825, and a transceiver 830.

[69] The transmission buffer 805 stores anchor layer data, and transmits data to the multiplexer 825 under the control of the transmission controller 820.

[70] The buffer status report controller 810 generates a buffer status report messages if a predetermined condition is satisfied, and transfers it to the multiplexer 825. The buffer status report messages contains information including the amount of data stored in the transmission buffer 805, the priority, etc.

[71] The buffer status report controller 810 manages the EBS, and activates the first timer to be informed of the time to periodically provide a buffer status report message. If the time for periodic reporting has arrived, the buffer status report controller 810 checks the EBS and decides whether or not to activate the secondtimer. Particularly, the buffer status report controller 810 activates the second timer if the EBS is "non-empty". If a transmission resource is allocated before the second timer expires, the bufferstatus report controller 810 generates a buffer status report message and transfers it to the multiplexer 825 so that it is transmitted together with data by using the allocated transmission resource.

[72] If the EBS is "empty"or if no transmission resource is allocated until the second timer expires while the EBS is "non-empty", the buffer status report controller 810 instructs the transmission resource allocation request unit 815 to transmit a transmission resource allocation request signal. After a transmission resource is allocated, the buffer status report controller 810 generates a buffer status report message and transfers it to the multiplexer 825.

[73] At the request of the buffer status report controller 810, the transmission resource allocation request unit 815 transmits a transmission resource allocation request signal to the Node B via the transceiver 830 by using uplink transmission resources according to a predetermined procedure.

[74] The transmission controller 820 receives a downlink control channel via the transceiver 830 and checks if there is an allocated transmission resource. If so, the transmission controller 820 instructs the transmission buffer 805 or the buffer status

report controller 810 to transfer data to the multiplexer 825.

[75] The multiplexer 825 multiplexes the data, which has been transferred by the transmission buffer 805 or the buffer status report controller 810, into a single packet and transmits it to the transceiver 830.

[76] The transceiver 830 transmits the packet, which has been transferred by the multiplexer 825, via a wireless channel; it transmits a signal, which has been transferred by the transmission resource allocation request unit 815, via the wireless channel; and it transfers a downlink control channel signal, which has been received via the wireless channel, to the transmission controller 820.

[77] 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 reporting a buffer status to a Node B by a user equipment in a mobile communication system, the method comprising the steps of:
checking if there is data to be transmitted to the Node B when a buffer status report event occurs; and
transmitting the data together with the buffer status report by using a resource allocated first after the bufferstatus report event has occurred when there is data to be transmitted to the Node B.

[2] The method as claimed in claim 1, wherein the transmitting step comprises the steps of:
activating a timer when there is data to be transmitted to the Node B;
transmitting the buffer status report together with the data by using the allocated resource when the resource is allocated before the timer expires; and
transmitting a scheduling request to the Node B so that resource allocation occurs, when the resource is not allocated before the timer expires, and
transmitting the buffer status report by using the allocated resource after the resource is allocated.

[3] The method as claimed in claim 1, further comprising a step of transmitting a scheduling request to the Node B so that resource allocation occurs, when there is no data to be transmitted to the Node B, and transmitting the buffer status report by using the allocated resource after the resource is allocated.

[4] The method as claimed in claim 1, further comprising a step of setting an estimated buffer status to "empty" when there is no data to be transmitted to the Node B, the estimated buffer status indicating a buffer status of the user equipment estimated by the Node B, and setting the estimated buffer status to "non-empty"when there is data to be transmitted to the Node B.

[5] The method as claimed in claim 4, further comprising a step of setting the estimated buffer status to "empty"when the user equipment switches from an idle state to a standby state and setting the estimated buffer status to "non-empty" after the resource is allocated.

[6] The method as claimed in claim 4, further comprising a step of piggybacking an indicator onto data when the data is the last data transmitted to the Node B, the indicator informing that the data is the last data, and setting the estimated buffer status to "empty" after the last data is transmitted.

[7] A user equipment apparatus for reporting a buffer status to a Node B in a mobile communication system, the apparatus comprising:
a transmission buffer for storing data to be transmitted to an anchor layer;

a buffer status report controller for generating a buffer status report message regarding data stored in the transmission buffer when a buffer status report event occurs;

a transmission resource allocation request unit for requesting the Node B to allocate a resource;

a transceiver for multiplexing data transferred from the transmission buffer and the buffer status report controller, transmitting the data to the Node B, and transmitting a resource allocation request to the Node B at a request of the transmission resource allocation request unit; and

a transmission controller for receiving a control channel via the transceiver, checkingif a resource has been allocated by the Node B, and transmitting a check result to the buffer status report controller, wherein

the buffer status report controller is adapted to generate the buffer status report message after receiving a first report on resource allocation from the transmission controller after the buffer status report event has occurred when there is data to be transmitted to the transmission buffer, and

the transceiver is adapted to transmit the data together with the buffer status report messageby using the allocated resource.

[8] The apparatus as claimed in claim 7, wherein the buffer status report controller is adapted to activate a timer when the transmission buffer has data to be transmitted, generate the buffer status report message when the report on resource allocation is received from the transmission controller before the timer expires, transfer the buffer status reportmessage to the transceiver, and control the transmission resource allocation request unit so as to request resource allocation when no resource allocation report is received from the transmission controller before the timer expires.

[9] The apparatus as claimed in claim 7, wherein the buffer status report controller is adapted to instruct the transmission resource allocation request unit to make a transmission resource allocation request when the transmission buffer has no data to be transmitted, generate the buffer status report message after a transmission report is received from the transmission controller at the transmission resource allocation request, and transfer the buffer status report message to the transceiver.

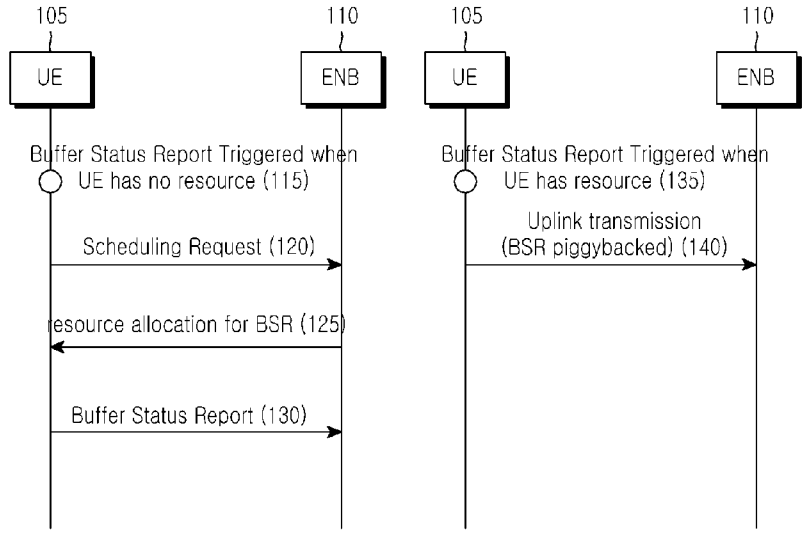
[10] The apparatus as claimed in claim 7, wherein the buffer status report controller is adapted to manage an estimated buffer status indicating a buffer status of the user equipment estimated by the Node B, set the estimated buffer status to "empty" when the transmission buffer has no data to be transmitted, and set the estimated buffer status to "non-empty" when the transmission buffer has data to be

transmitted.

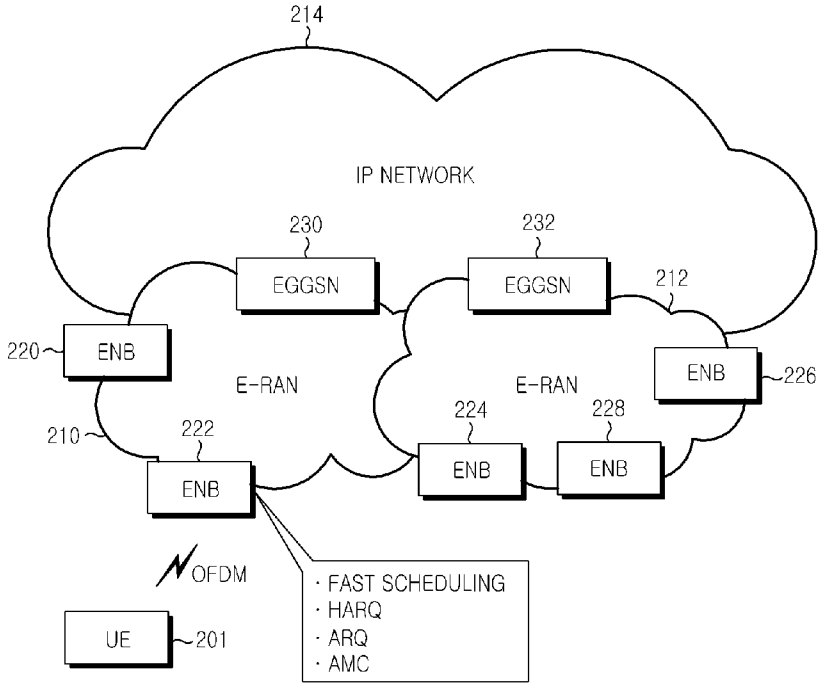
[11] The apparatus as claimed in claim 10, wherein the buffer status report controller is adaptedto set the estimated buffer status to "empty"when the user equipment switches from an idle state to a standby state and set the estimated buffer status to "non-empty" after a resource allocation report is received from the transmission controller.

[12] The apparatus as claimed in claim 10, wherein the buffer status report controller is adaptedto transmit the buffer status report message to the transceiver together with an indicator when the data in the transmission buffer is the last data, the indicator informing that the data is the last data, and set the estimated buffer status to "empty".

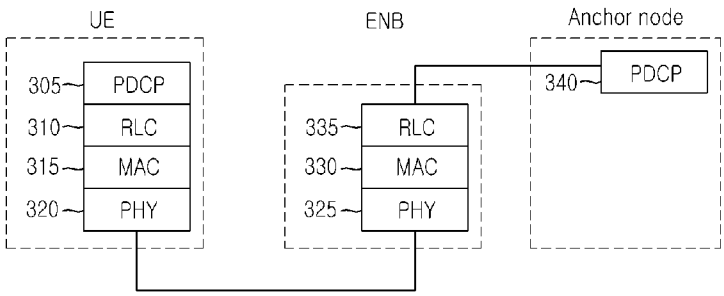
[Fig. 1]



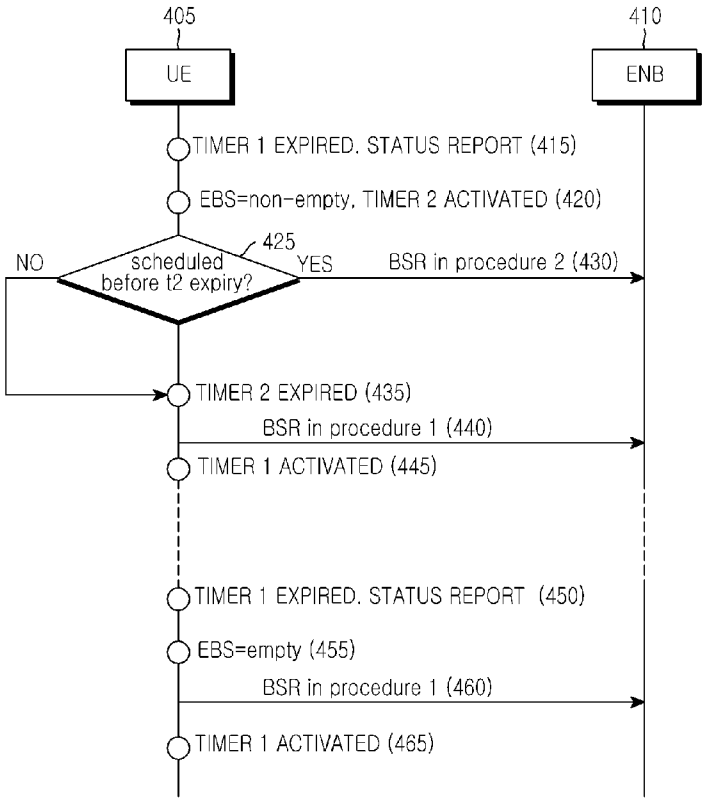
[Fig. 2]



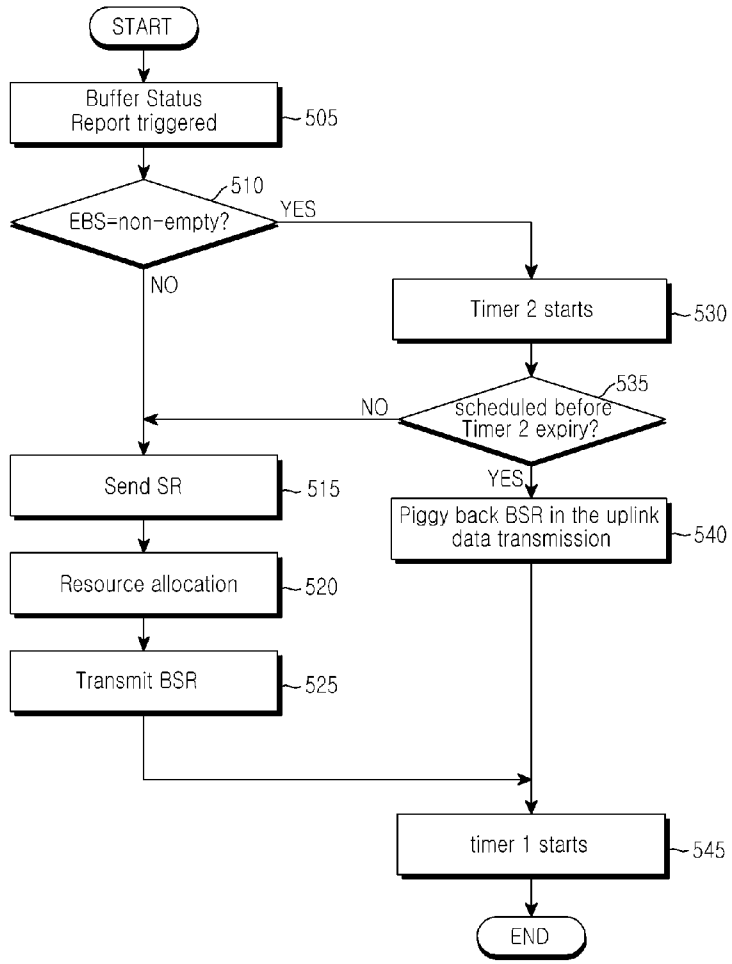
[Fig. 3]



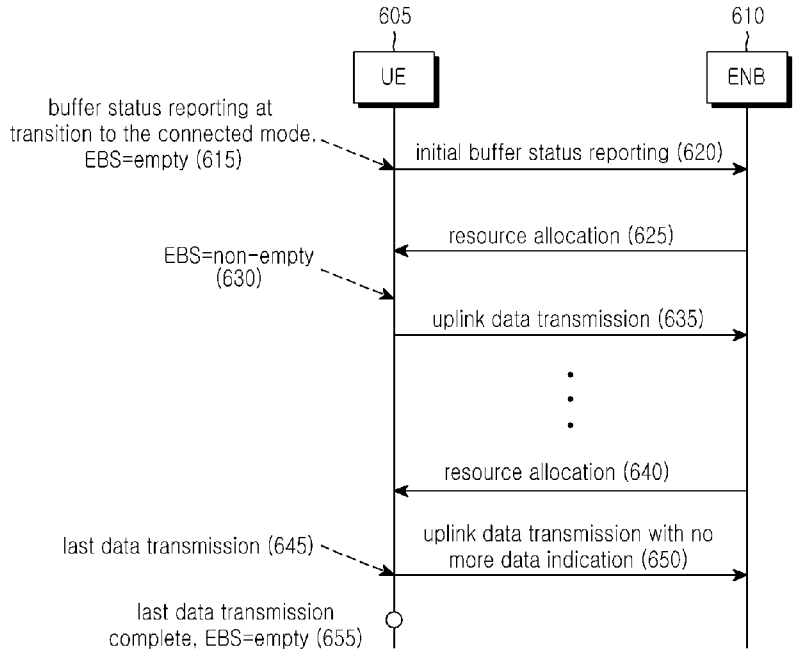
[Fig. 4]


405
410
UE
ENB
TIMER 1 EXPIRED. STATUS REPORT (415)
EBS=non-empty, TIMER 2 ACTIVATED (420)
425
NO
scheduled before t2 expiry?
YES
BSR in procedure 2 (430)
TIMER 2 EXPIRED (435)
BSR in procedure 1 (440)
TIMER 1 ACTIVATED (445)
TIMER 1 EXPIRED. STATUS REPORT (450)
EBS=empty (455)
BSR in procedure 1 (460)
TIMER 1 ACTIVATED (465)

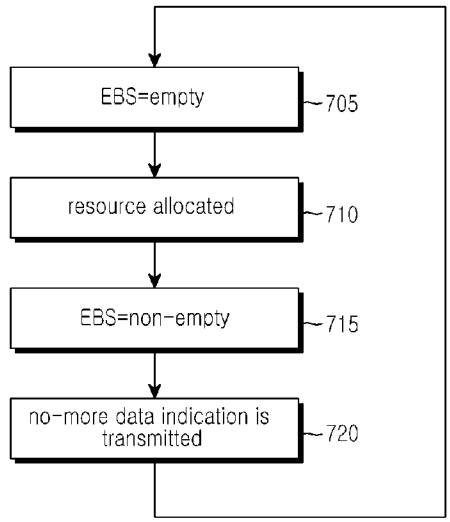
[Fig. 5]


START
Buffer Status Report triggered
505
510
EBS=non-empty?
YES
NO
Timer 2 starts
530
535
NO
scheduled before Timer 2 expiry?
YES
Send SR
515
Piggy back BSR in the uplink data transmission
540
Resource allocation
520
Transmit BSR
525
timer 1 starts
545
END

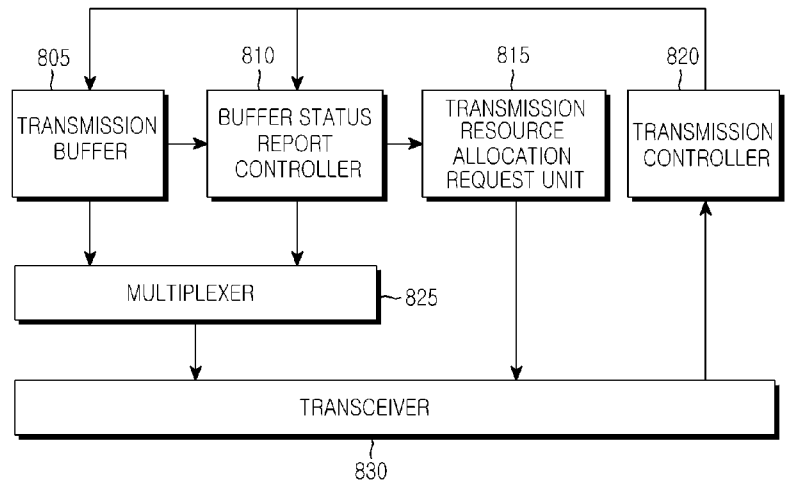
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/005667

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 7/26, H04L 12/28, 12/56, H04Q 7/00

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, UE, buffer, status, report, event 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	US2006-246847 A1 (KIM et al.) 2 November 2006 * abstract, paragraphs [0076]-[0093], figure 7 *	1-12
A	US2005-47416 A1 (HEO et al.) 3 March 2005 * abstract, paragraphs [0074]-[0082], figure 11 *	1-12
A	US2005-83943 A1 (LEE et al.) 21 April 2005 * abstract, paragraphs [0073]-[0074], figure 7 *	1-12

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

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 FEBRUARY 2008 (19.02.2008)	**19 FEBRUARY 2008 (19.02.2008)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM, Sang Woo

Telephone No. 82-42-481-8324

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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