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(54) METHOD AND APPARATUS FOR RADIO LINK CONTROL IN CELLULAR RADIO COMMUNICATION SYSTEM SUPPORTING CARRIER AGGREGATION

VERFAHREN UND VORRICHTUNG ZUR FUNKVERBINDUNGSSTEUERUNG IN EINEM ZELLULÄREN FUNKKOMMUNIKATIONSSYSTEM, DAS DIE TRÄGERAGGREGATION UNTERSTÜTZT

PROCÉDÉ ET APPAREIL DE COMMANDE DE LIAISON RADIO DANS UN SYSTÈME DE RADIOCOMMUNICATION CELLULAIRE SUPPORTANT UNE AGRÉGATION DE PORTEUSES

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Description

1. Field of the Invention:

[0001] The present invention relates to a cellular radio communication system and, in particular, to a method and apparatus for controlling radio link based on whether radio link failure is detected.

2. Description of the Related Art:

[0002] Recently, many researches are being conducted on the Orthogonal Frequency Division Multiple Access (OFDMA) and Single Carrier Frequency Division Multiple Access (SC-FDMA) as useful schemes for high speed data transmission over a radio channel. In such multiple access schemes, the user-specific data and/or control information are mapped to time-frequency resources without overlapped from each other, i.e. maintaining orthogonality, to identify the user-specific data and/or control information.

[0003] In a cellular communication system, one of the significant factors to provide high-speed wireless data service is bandwidth scalability for dynamic resource allocation. For example, Long Term Evolution (LTE) system can support the bandwidths of 20/15/10/5/3/1.4 MHz. The carriers can provide services with at least one of the bandwidths, and the user equipments can have different capabilities such that some supports only 1.4MHz bandwidth and others up to 20MHz bandwidth. The LTE-Advanced (LTE-A) system, aiming at achieving the requirements of the IMT-Advanced service, can provide broadband service by aggregating carries up to 100MHz.

[0004] The LTE-A system needs the bandwidth wider than that of LTE system for high-speed data transmission. Simultaneously, the LTE-A system needs to be backward compatible with the LTE system such that the LTE UEs can access the services of the LTE-Advanced system. For this purpose, the entire system bandwidth of the LTE-A system is divided into sub-bands or component carriers that have a bandwidth supporting transmission or reception of the LTE UE and can be aggregated for supporting the high speed data transmission of the LTE-A system in the transmission/reception process of the legacy LTE system per component carrier.

[0005] Meanwhile, if the radio rank quality between a transmitter and a receiver is degraded below a predetermined level, it is difficult to expect the normal data communication. Accordingly, the UE or the eNB monitors the radio rank quality to determine the Radio Link Failure (hereinafter, referred to as RLF) and performs the operation corresponding to the RLF. A description is made of a procedure for a UE to determine whether RLF occurs in the legacy system not supporting carrier aggregation with reference to FIG. 1.

[0006] The UE connects to an eNB to transmit and receive data (108), recognizes, if the radio link quality with the base station degrades continuously for a predetermined observation period, the problem of the radio link (110), and determines, if the radio link quality does not recovered for a predetermined time T1 (112), occurrence of RLF (104). If the RLF is detected, the UE attempts to connect to a cell having the best radio link quality among the neighbor cells for a predetermined time duration T2 (114) to continue, if the attempt is successful, data transmission/reception and end, if the attempt fails, end all the transmission/reception operations and transition to idle mode (116).

[0007] The procedure related to the RLF is defined for the conventional system without consideration of carrier aggregation and thus there is a need to define a procedure for controlling the radio link depending on whether RLF occurs or not in the wireless communication system supporting carrier aggregation.

[0008] In "Introduction of Dual-Cell HSDPA Operation on Adjacent Carriers" (ERICSSON: 3GPP DRAFT; R1-083974; Prague, Czech Republic; 6 October 2008; XP050317277) characteristics of the physical layer procedures in the FDD mode of UTRA are specified.

[0009] "Discussion on RLF in DC-HSDPA" (HUAWEI: 3GPP DRAFT; R2-084402; 11 August 2008; XP050319471) addresses radio link failure (RLF) in a Dual-Cell HSDPA (DC-HSDPA) on adjacent carriers.

SUMMARY OF THE INVENTION

Problem to be Solved

[0010] In order to solve the above problems, the present invention provides a method and apparatus for controlling radio links by determining whether the radio link failure occurs in the wireless communication implementing wide bandwidth by aggregating carriers.

Means for Solving the Problem

[0011] In order to achieve the above objective, a radio link control method of a terminal for a cellular radio communication system supporting carrier aggregation is provided, as defined in claim 1.

[0012] Also, a radio link control apparatus of a terminal for a cellular radio communication system supporting carrier aggregation is provided, as defined in claim 8.

Advantageous effects

[0013] As described above, in the system implementing wide transmission by aggregating carriers such as LTE-A, the present invention determines the radio link failure efficiently by reducing unnecessary radio link failure determinations. According to the present invention, it is possible to maintain the continuity of data transmission and reduce transmission delay caused by neighbor cell connection attempts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIG. 1 is diagram illustrating a procedure for determining radio link failure in a conventional LTE system.

FIG. 2 is a diagram illustrating the concept for determining a radio link failure in a LTE-A system.

FIG. 3 is a flowchart illustrating a procedure for determining radio link failure in a wireless communication system according to an embodiment of the present invention.

FIG. 4 is a diagram illustrating a method for calculating radio link quality of CCC in the LTE-A system according to an example of the present invention.

FIG. 5 is a diagram illustrating a method for calculating radio link quality of CCC in the LTE-A system according to another embodiment of the present invention.

FIG. 6 is a diagram illustrating a method for determining radio link quality recovery of CCC in the LTE-A system according to an example of the present invention.

FIG. 7 is a diagram illustrating a method for determining radio link quality recovery of CCC in the LTE-A system according to another embodiment of the present invention.

FIG. 8 is a block diagram illustrating an apparatus for determining radio link failure of the UE according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0015] Detailed description of well-known functions and structures incorporated herein may be omitted to avoid obscuring the subject matter of the present invention. Exemplary embodiments of the present invention are described with reference to the accompanying drawings in detail. In addition, terms used in the following description of the present invention are prepared in view of functions thereof, so they will be changed depending on the intention of users, operators, or custom. Thus, definition of the terms must be determined based on the whole content of the specification.

[0016] Although the description is directed to the Advanced E-UTRA (or LTE-A) supporting carrier aggregation in the following embodiments of the present invention, it will be understood by those skilled in the art that the present invention can be applied to other communication systems supporting the similar technical background and channel format with a slight modification without departing from the scope of the invention.

[0017] The present invention proposed a method and apparatus for determining radio link failure in the wireless communication system securing wideband through carrier aggregation proposed as the subject matter of the present invention. Particularly, when the LTE-A system implements the wide transmission bandwidth by aggregating the LTE carriers, it is necessary to minimize the occurrence probability of the radio link failure so as to improve reliability of data communication and reduce the transmission delay.

[0018] The subject matter of the present invention is described in detail hereinafter with reference to FIG. 2. FIG. 2 is a diagram illustrating the concept for determining a radio link failure in a LTE-A system according to an embodiment of the present invention.

[0019] The UE measures the radio link quality of each of the component carriers. The configuration information on the component carriers aggregated is notified to the UE by the eNB via signaling. For simplifying the explanation, a group of the aggregated component carriers is called Configured Component Carriers (CCC) hereinafter. The CCC includes at least one anchor carrier, and the anchor carrier works as a reference point for providing control information to the UE or the mobility control of the UE.

[0020] The UE measures the received signal strength of the reference signal (hereinafter, 'RS') of each component carrier receiving from the eNB for a predetermined duration and compares the received signal strength with the threshold Qout predetermined per component carrier to determine whether the radio link quality of the component carrier is good or bad (strong or weak). The threshold value Qout defined per component carrier is the received signal strength of RS corresponding to a Block Error Rate (BLER) of Physical Downlink Control Channel (PDCCH) and determined according to the bandwidth of the component carrier and a number of transmit antennas.

[0021] In more detail, the UE measures the radio link quality between the UE and the anchor carrier based on the received signal strength of the RS of the anchor carrier for a predetermined time duration (201). If the radio link quality measured to the anchor carrier is worse than the Qout defined for the anchor carrier over a predetermined time duration, the UE measures the radio link qualities of the rest component carriers (202) except for the anchor carrier rather than premature determination of radio link failure and compares the radio link qualities with the corresponding Qout values (204). If at least one of the component carriers has the radio link quality better than the corresponding threshold Qout, the UE configures a new CCC with the component carriers having the good radio link qualities.

[0022] Otherwise, if all the component carriers have the radio link qualities worse than the corresponding threshold Qout values, the UE determines radio link failure in the current cell (203) and attempt access to neighbor cells (205). At this time, if failing access to the neighbor cells, the UE ends the communication with the base station and enters idle state.

[0023] The radio link failure determination method of the present invention can be applied regardless of wheth-

er the aggregated component carriers are consecutive or non-consecutive in frequency domain and without limitation on the number of component carriers.

[0024] The radio link failure determination method proposed in the present invention is described in detail through following embodiments.

[0025] FIG. 3 is a flowchart illustrating a procedure for a UE to determine radio link failure in a wireless communication system implementing wide bandwidth through carrier aggregation.

[0026] At step 302, the UE measures radio link quality of each component carrier. The UE measures the radio link quality for each component carrier with the received signal strength of RS received on the corresponding component carrier and calculates total radio link quality of the CCC.

[0027] At step 304, the UE determines whether at least one component carrier has the measurement result equal to or greater than the corresponding threshold value in the CCC. If there is at least one component carrier having the measurement result equal to or greater than the threshold value, the UE compares the radio link quality of the anchor carrier with the threshold value to determine whether the radio link quality is good or bad at step 314. If it is determined that the radio link quality of the anchor carrier is good, i.e., equal to or greater than the threshold value, the UE maintains current anchor carrier and CCE as they are and keeps the connection state (CONNECTED_STATE) with the base station at step 316. Otherwise if it is determined that the radio link quality of the anchor carrier is bad, i.e., less than the threshold value, the UE reconfigures the CCC with the component carriers, except for the anchor carrier, within the current CCE and keeps the connection state (CONNECTED_STATE).

[0028] At this time, the UE requests the eNB to set a new CCE with the component carriers of which radio link qualities are equal to greater than the threshold values and sets the component carrier having the best radio link quality as a new anchor carrier via signaling. The eNB can accept the request of the UE entirely or send the control information for adjusting the request to the UE and thus completes the reconfiguration.

[0029] Meanwhile, if all the component carriers have the measurement results less than the threshold value at step 304, the UE determines whether the radio link quality of the CCC is recovered before a predetermined time (timer T1) at step 306. As a result of step 306, if the radio link quality of the CCC is recovered, the UE branches the procedure to step 314.

[0030] If the radio link quality of the CCC is not recovered before the time T1 expires at step 306, the UE branches the procedure to step 308 to determine the occurrence of radio link failure in the CCE and measure the radio link qualities of the neighbor cells. Next, the UE attempts connection to the neighbor cell having the greatest (superior) radio link quality at step 310 and, if the connection is established successfully before a predetermined timer T2 expires, resets the corresponding neighbor cell as the anchor carrier while maintaining the connection state (CONNECTED_STATE) at step 320.

[0031] At this time, the UE requests the eNB to resets the neighbor cell having the best radio link quality as the anchor carrier via signaling. The eNB can accept the request of the UE entirely or send the control information adjusting the request to the UE and thus completes the reconfiguration. If the connection to the neighbor cell fails at step 310, the UE ends the connection with the eNB and enters the idle state.

[0032] T0, T1, and T2 representing time values are predetermined, and the eNB notifies the UE of these values via signaling or shared as the fixed values between the UE and the eNB.

[0033] How to determine the radio link quality of the CCC at step 304 of FIG. 3 is described hereinafter in more detail with reference to FIG. 4.

[0034] FIG. 4 is a diagram illustrating step 304 for calculating the radio link quality of the CCC in more detail according to an example of the present invention.

[0035] Defining the function for calculating the radio link quality of CCC as f(.), the function f(.) calculates the radio link quality 404 of the CCC with the input values of radio link qualities 1, 2, ..., k 401 of individual component carriers constituting the CCC and Qout1, Qout2, ..., Qoutk 403 of individual component carriers. The function f(.) compares the radio link qualities of the individual component carriers with the component carrier-specific threshold values and, if at least one component carrier maintains the radio link quality equal to or greater than the corresponding threshold value before the expiry of T0, determines that the radio link quality of the CCC is excellent (or good, used in the same meaning herein) and, otherwise if all the component carriers maintain the radio link qualities less than the corresponding threshold values before the expiry of T0, determines that the radio link quality of CCC is poor (or bad, used in the same meaning herein).

[0036] In the present invention, when at least one component carrier maintains the radio link quality equal to or greater than the threshold value, it is restricted that the UE makes a premature determination of radio link failure due to some component carriers having bad radio link qualities even though there is the component carrier maintaining good radio link quality in the CCC, thereby maintaining the continuity of data transmission and reducing transmission delay caused by unnecessary neighbor cell connection attempts.

[0037] Here, the threshold values Qout1, Qout2, and Qoutk 403 defined for individual component carriers correspond to the received signal strengths of RSs represented by Block Error Rate (BLER) of Physical Downlink Control Channel (PDCCH) and are determined depending on the bandwidths of individual component carriers and the number of transmit antennas.

[0038] A description is made of the definition of another operation of function f(.) for calculating the radio link qual-

ity of the CCC hereinafter with reference to FIG. 5. FIG. is a diagram illustrating step 304 for calculating the radio link quality of the CCC in more detail according to another embodiment of the present invention.

[0039] In FIG. 5, the radio link quality of the CCC is calculated by applying weights to the component carriers constituting the CCC according to the importance of the component carriers. The importance of the component carrier is determined whether the corresponding component carrier is the anchor carrier or carrying the physical control channel for the UE.

[0040] In FIG. 5, the radio link quality of the CCC is determined with the additional input values of $\alpha 1$, $\alpha 2$, ..., αk 504 as compared to FIG 4. $\alpha 1$, $\alpha 2$, ..., αk 504 are the weights applied to the individual component carriers and each is set to1 for the anchor carrier and 0 for non-anchor carrier. In this case, the radio link quality of the CCC can be calculated directly from the radio link quality of the anchor carrier. That is, if the radio link quality of the anchor carrier to which the weight is applied is worse than the threshold value Qout of the anchor carrier for the time duration T0, it is determined that the radio link quality of the CCE is bad even though there is any component carrier having good radio link quality among the rest component carriers. This means that the component carriers having the weight of 0 do not influence the calculation of radio link quality of the CCC, but the radio link quality of the component carrier having the weight of 1 is input to the function f(.) of FIG. to influence the result. The weights $\alpha 1$, $\alpha 2$, ..., αk 504 are notified to the UE by the eNB via signaling in CCE configuration or reconfiguration process.

[0041] However to determine the recovery of the radio link quality of CCC over a predetermined value before the expiry of the timer T1 at step 306 of FIG. 3 is described hereinafter in more detail with reference to fig. 6.

[0042] FIG. 6 is a diagram illustrating step 306 for determining whether the radio link quality of the CCC is recovered according to an example of the present invention.

[0043] Here, if the function for determining whether the radio link quality of the CCE is recovered is defined as g(.), the function g(.) calculates the radio link quality recovery 604 of the CCC with the input values of the radio link qualities 1, 2, ... , k 601 and the component carriers threshold values Qin1, Qin2, ..., Qink 603.

[0044] The function g(.) compares the radio link quality of each of the component carriers with the threshold value of the corresponding component carrier and, if at least one of the component carriers maintains the good quality equal to or greater than the threshold value for the time duration T1, determines the recovery of the radio link quality of the CCC and, otherwise if all the component carrier maintain the bad qualities less than the corresponding threshold values, determines recovery failure of radio link quality of the CCC.

[0045] Through the above described operations, the present invention prevent the UE from making a premature determination of radio link failure due to some component carriers having bad radio link qualities even though there is the component carrier maintaining good radio link quality in the CCC, thereby maintaining the continuity of data transmission and reducing transmission delay caused by unnecessary neighbor cell connection attempts.

[0046] The threshold values Qin1, Qin2, ..., Qink 603 defined for individual component carriers correspond to the received signal strengths of the RSs represented by Block Error Rate (BLER) of Physical Downlink Control Channel (PDCCH) and are determined based on the bandwidths of the component carriers and the number of transmit antennas.

[0047] A description is made of the definition of another operation of function g(.) for determining the radio link quality recovery of the CCC herein after with reference to FIG. 7. FIG. 7 is a diagram illustrating step 306 for determining the radio link quality recovery of the CCC according to another embodiment of the present invention.

[0048] In FIG. 7, whether the radio link quality of the CCE is recovered is calculated with the weight applied according to the importance of the component carrier in the CCE. The importance of the component carrier is determined whether the corresponding component carrier is the anchor carrier or carrying the physical control channel for the UE. In FIG. 7, the radio link quality of the CCC is determined with the additional input values of $\beta 1$, $\beta 2$, ..., βk 704 as compared to FIG. 6. $\beta 1$, $\beta 2$, ..., βk 704 are the weights applied to the individual component carriers and each is set to 1 for the anchor carrier and 0 for non-anchor carrier.

[0049] In this case, the radio link quality of the CCC can be calculated directly from the radio link quality of the anchor carrier. That is, if the radio link quality of the anchor carrier to which the weight is applied is worse than the threshold value Qin of the anchor carrier for the time duration T1, it is determined that the radio link quality of the CCE is not recovered even though there is any component carrier having good radio link quality among the rest component carriers. This means that the component carriers having the weight of 0 do not influence the calculation of radio link quality recovery of the CCC, but only the radio link quality of the component carrier having the weight of 1 is input to the function g(.) of FIG. 6 to influence the result. The weights . $\beta 1$, $\beta 2$, ..., βk 704 are notified to the UE by the eNB via signaling in CCE configuration or reconfiguration process.

[0050] FIG. 8 is a block diagram illustrating a configuration a receiver of the UE for determining radio link failure according to an embodiment of the present invention.

[0051] The RF/IF receiver 810 configures the bandwidth and reception center frequency to receiving the downlink signal on the CCE set for the UE under the control of the RF/IF controller 811.

[0052] The FFT 800 performs Fourier Transform on the received downlink OFDM signal and outputs individ-

ual subcarrier reception symbols. The reception symbols are input to the decoder of the corresponding channel by means of the carrier symbol de-mapper 801.

[0053] The Physical Downlink Shared Channel (PDSCH) and Physical Downlink Control Channel (PDCCH) symbol decoders 802 and 803 performs decoding on the subcarrier reception symbols of the corresponding channels to acquire data and control information.

[0054] The RS symbol receiver 804 extracts RS from the signal received by the UE and use the RS for channel estimating and compensating on the PDSCH and PDCCH and determining whether the radio link failure occurred.

[0055] The radio link failure controller (RLF controller) 805 measures the radio link qualities of the component carriers based on the RSs of the respective component carriers and determine the radio link failure based on the measurement result.

[0056] In more detail, the RLF controller measures the radio link quality of each component carrier using the RS on one or more component carriers. According to an embodiment of the present invention, the radio link failure controller can measure the radio link quality by applying weight to each component carrier.

[0057] If at least one of the radio link qualities measured on the component carriers is equal to or greater than a predetermined threshold value, the RLF controller determines that the radio link quality of a set of the component carriers is good and thus maintains the connection state with the current eNB.

[0058] In this case, the radio link failure controller measures the radio link quality of the anchor carrier and, if the measured radio link quality of the anchor carrier is equal to or greater than the threshold value of the anchor carrier, controls to maintains the current anchor carrier.

[0059] However, if the measured radio link quality of the anchor carrier is less than the threshold value of the anchor carrier, the radio link failure controller can control to reconfigure the set of the component carrier with the component carrier except for the anchor carrier in the component carrier set. In this case, the radio link failure controller can select the component carrier having the best radio link quality as a new anchor carrier.

[0060] Meanwhile, if the radio link qualities of all the component carriers are less than the threshold values, the RLF controller determines that the radio link quality of the component carrier set is bad so as to end the connection state with the current eNB.

[0061] In this case, the radio link failure controller determines whether the radio link quality of the component carrier set is recovered before the expiry of a predetermined time duration. According to an embodiment of the present invention, the radio link failure controller can determine the radio link quality recovery by applying weight to each component carrier.

[0062] If the radio link quality is not recovered to a good state, the radio link failure controller determines the radio link failure of the current radio link in the current component carrier set and measures the radio link quality of neighbor cells. Afterward, the radio link failure controller can control to attempt connection to the neighbor cell having the best radio link quality.

[0063] If it is failed to connect to the neighbor cells, the radio link failure controller ends the connection with the eNB and enters idle state.

[0064] In order to control the operations as above, the radio link failure controller controls the RF/IF controller 811 to search, when the radio link failure is determined, for the neighbor cell having the best radio link quality and controls the transmitter 806 to connect to the neighbor cell having the best radio link quality. If it is failed to connect to the neighbor cell before the expiry of T2, the radio link failure controller 805 controls the transmitter 806 to stop transmission and controls the PDSCH and PDCCH symbol decoders 802 and 803 to stop the normal data reception operations and then enter idle state.

[0065] The specification and drawings are to be regarded in an illustrative rather than a restrictive sense in order to help understand the present invention. It is obvious to those skilled in the art that various modifications and changes can be made thereto without departing from the broader scope of the invention.

Claims

1. A method for radio link control by a terminal in a cellular radio communication system supporting carrier aggregation, comprising:

measuring (302) radio link qualities of more than one component carrier among a component carriers set;

determining (304) whether at least one of the measured radio link qualities is equal to or greater than a threshold value;

determining, when at least one of the measured radio link qualities is equal to or greater than the threshold value and at least one of the measured radio link qualities is less than the threshold value, that the radio link quality of the component carriers set is good;

maintaining, when the radio link quality of the component carriers set is good, connection state with a current base station;

determining, when all of the measured radio link qualities are less than the threshold value, the radio link quality of the component carriers set is bad; and

releasing, when the radio link quality of the component carriers set is bad, connection state with a current base station, **characterized in that** the method further comprises applying a weight to the measured radio link qualities said weight being determined based on at least one of whether the component carrier is an anchor car-

rier or whether the component carrier carries a physical control channel for the terminal.

2. The method of claim 1, wherein maintaining connection state comprises:

measuring (314) a radio link quality of an anchor carrier (201);
maintaining (316), when the radio link quality of the anchor carrier is equal to or greater than a threshold value of the anchor carrier, the current anchor carrier; and
reconfiguring (318), when the radio link quality of the anchor carrier is less than the threshold value of the anchor carrier, the component carriers set with rest component carriers (202) which are component carriers of the component carriers set except for the anchor carrier.

3. The method of claim 2, wherein reconfiguring the component carriers set further comprises selecting the component carrier having a best radio link quality as a new anchor carrier.

4. The method of claim 1, wherein releasing the connection state comprises:

determining (306) whether the radio link quality of the component carriers set is recovered before expiry of a predetermined time;
determining (308), when the radio link quality of the component carriers set is not recovered, that the radio link failure has occurred in the current component carriers set;
measuring (308), when the radio link failure has occurred, radio link qualities of neighbor cells; and
attempting (310) connection to one of the neighbor cells having best radio link quality.

5. The method of claim 4, further comprising:

ending, when the connection to the neighbor cell fails, the connection state with the current base station; and
entering idle state (312).

6. The method of claim 1, wherein measuring radio link qualities comprises applying the weight to each component carrier.

7. The method of claim 4, wherein determining whether the radio link quality of the component carriers set is recovered comprises:

applying the weight to each component carrier; and
determining whether the radio link quality to which the weight is applied is recovered.

8. A terminal for radio link control in a cellular radio communication system supporting carrier aggregation, comprising:

an reference signal, RS, subcarrier symbol receiver which receives reference signals for at least one component carrier of a component carriers set; and
a radio link failure controller configured to:

measure radio link qualities of more than one component carrier among a component carriers set using the reference signals provided by the RS subcarrier symbol receiver,
determine, when at least one of the measured radio link qualities is equal to or greater than the threshold value and at least one of the measured radio link qualities is less than the threshold value, that the radio link quality of the component carriers set is good,
maintain, when the radio link quality of the component carriers set is good, connection state with a current base station,
determine, when all of the measured radio link qualities are less than the threshold value, the radio link quality of the component carriers set is bad, and
release, when the radio link quality of the component carriers set is bad, connection state with a current base station, **characterized in that** the radio link failure controller is further configured to apply a weight to the measured radio link qualities said weight being determined based on at least one of whether the component carrier is an anchor carrier or whether the component carrier carries a physical control channel for the terminal.

9. The terminal of claim 8, wherein the radio link failure controller is configured to:

measure a radio link quality of an anchor carrier;
maintain, when the radio link quality of the anchor carrier is equal to or greater than a threshold value of the anchor carrier, the current anchor carrier; and
reconfigure, when the radio link quality of the anchor carrier is less than the threshold value of the anchor carrier, the component carriers set with rest component carriers which are component carriers of the component carriers set except for the anchor carrier.

10. The terminal of claim 9, wherein the radio link failure controller is configured to select the component car-

rier having a best radio link quality as a new anchor carrier.

11. The terminal of claim 8, wherein the radio link failure controller is configured to:

determine whether the radio link quality of the component carriers set is recovered before expiry of a predetermined time,
determine, when the radio link quality of the component carriers group is not recovered, that the radio link failure has occurred in the current component carriers set,
measure, when the radio link failure has occurred, radio link qualities of neighbor cells, and attempt connection to one of the neighbor cells having best radio link quality.

12. The terminal of claim 8, wherein the radio link failure controller is configured to apply the weight to each component carrier.

13. The terminal of claim 10, wherein the radio link failure controller is configured to:

apply the weight to each component carrier, and determine whether the radio link quality to which the weight is applied is recovered.

Patentansprüche

1. Verfahren für eine Funkverbindungssteuerung durch ein Endgerät in einem zellulären Funkkommunikationssystem, das eine Trägeraggregation unterstützt, umfassend:

Messen (302) der Funkverbindungsqualitäten von mehr als einem Komponententräger aus einem Komponententrägersatz,
Bestimmen (304), ob wenigstens eine der gemessenen Funkverbindungsqualitäten gleich oder größer als ein Schwellwert ist,
Bestimmen, wenn wenigstens eine der gemessenen Funkverbindungsqualitäten gleich oder größer als der Schwellwert ist und wenigstens eine der gemessenen Funkverbindungsqualitäten kleiner als der Schwellwert ist, dass die Funkverbindungsqualität des Komponententrägersatzes gut ist,
Aufrechterhalten, wenn die Funkverbindungsqualität des Komponententrägersatzes gut ist, des Verbindungszustands mit einer aktuellen Basisstation,
Bestimmen, wenn alle der gemessenen Funkverbindungsqualitäten kleiner als der Schwellwert sind, dass die Funkverbindungsqualität des Komponententrägersatzes schlecht ist, und
Aufgeben, wenn die Funkverbindungsqualität des Komponententrägersatzes schlecht ist, des Verbindungszustands mit einer aktuellen Basisstation,
dadurch gekennzeichnet, dass das Verfahren weiterhin das Anwenden einer Gewichtung auf die gemessenen Funkverbindungsqualitäten umfasst, wobei die Gewichtung basierend wenigstens darauf bestimmt wird, ob der Komponententräger ein Ankerträger ist oder ob der Komponententräger einen physikalischen Steuerkanal für das Endgerät trägt.

2. Verfahren nach Anspruch 1, wobei das Aufrechterhalten des Verbindungszustands umfasst:

Messen (314) der Funkverbindungsqualität eines Ankerträgers (201),
Aufrechterhalten (316), wenn die Funkverbindungsqualität des Ankerträgers gleich oder größer als ein Schwellwert des Ankerträgers ist, des aktuellen Ankerträgers, und
Neukonfigurieren (318), wenn die Funkverbindungsqualität des Ankerträgers kleiner als der Schwellwert des Ankerträgers ist, des Komponententrägersatzes mit restlichen Komponententrägern (202), die Komponententräger des Komponententrägersatzes mit Ausnahme des Ankerträgers sind.

3. Verfahren nach Anspruch 2, wobei das Neukonfigurieren des Komponententrägersatzes weiterhin das Auswählen des Komponententrägers mit der besten Funkverbindungsqualität als einen neuen Ankerträger umfasst.

4. Verfahren nach Anspruch 1, wobei das Aufgeben des Verbindungszustands umfasst:

Bestimmen (306), ob die Funkverbindungsqualität des Komponententrägersatzes vor Ablauf einer vorbestimmten Zeit wiederhergestellt wird,
Bestimmen (308), wenn die Funkverbindungsqualität des Komponententrägersatzes nicht wiederhergestellt wird, dass ein Funkverbindungsfehler in dem aktuellen Komponententrägersatz aufgetreten ist,
Messen (308), wenn der Funkverbindungsfehler aufgetreten ist, der Funkverbindungsqualitäten von benachbarten Zellen, und
Versuchen (310) einer Verbindung zu einer der benachbarten Zellen mit der besten Funkverbindungsqualität.

5. Verfahren nach Anspruch 4, das weiterhin umfasst:

Beenden, wenn die Verbindung zu der benach-

barten Zelle fehlschlägt, des Verbindungszustands mit der aktuellen Basisstation, und
Eintreten in einen Ruhezustand (312).

6. Verfahren nach Anspruch 1, wobei das Messen der Funkverbindungsqualitäten das Anwenden der Gewichtung auf jeden Komponententräger umfasst.

7. Verfahren nach Anspruch 4, wobei das Bestimmen, ob die Funkverbindungsqualität des Komponententrägersatzes wiederhergestellt wird, umfasst:

Anwenden der Gewichtung auf jeden Komponententräger, und
Bestimmen, ob die Funkverbindungsqualität, auf die die Gewichtung angewendet wird, wiederhergestellt wird.

8. Endgerät für eine Funkverbindungssteuerung in einem zellulären Funkkommunikationssystem, das eine Trägeraggregation unterstützt, umfassend:

einen Referenzsignal (RS)-Subträger-Symbolempfänger, der Referenzsignale für wenigstens einen Komponententräger eines Komponententrägersatzes empfängt, und
eine Funkverbindungsfehler-Steuereinrichtung, die konfiguriert ist zum:

Messen der Funkverbindungsqualitäten von mehr als einem Komponententräger aus einem Komponententrägersatz unter Verwendung der durch den RS-Subträger-Symbolempfänger vorgesehenen Referenzsignale,
Bestimmen, wenn wenigstens eine der gemessenen Funkverbindungsqualitäten gleich oder größer als der Schwellwert ist und wenigstens eine der gemessenen Funkverbindungsqualitäten kleiner als der Schwellwert ist, dass die Funkverbindungsqualität des Komponententrägersatzes gut ist,
Aufrechterhalten, wenn die Funkverbindungsqualität des Komponententrägersatzes gut ist, des Verbindungszustands mit einer aktuellen Basisstation,
Bestimmen, wenn alle der gemessenen Funkverbindungsqualitäten kleiner als der Schwellwert sind, dass die Funkverbindungsqualität des Komponententrägersatzes schlecht ist, und
Aufgeben, wenn die Funkverbindungsqualität des Komponententrägersatzes schlecht ist, des Verbindungszustands mit einer aktuellen Basisstation,
dadurch gekennzeichnet, dass die Funkverbindungsfehler-Steuereinrichtung weiterhin konfiguriert ist zum Anwenden einer Gewichtung auf die gemessenen Funkverbindungsqualitäten, wobei die Gewichtung basierend wenigstens darauf bestimmt wird, ob der Komponententräger ein Ankerträger ist oder ob der Komponententräger einen physikalischen Steuerkanal für den Anschluss trägt.

9. Endgerät nach Anspruch 8, wobei die Funkverbindungsfehler-Steuereinrichtung konfiguriert ist zum:

Messen einer Funkverbindungsqualität eines Ankerträgers,
Aufrechterhalten, wenn die Funkverbindungsqualität des Ankerträgers gleich oder größer als ein Schwellwert des Ankerträgers ist, des aktuellen Ankerträgers, und Neukonfigurieren, wenn die Funkverbindungsqualität des Ankerträgers kleiner als der Schwellwert des Ankerträgers ist, des Komponententrägersatzes mit restlichen Komponententrägern, die Komponententräger des Komponententrägersatzes mit Ausnahme des Ankerträgers sind.

10. Endgerät nach Anspruch 9, wobei die Funkverbindungsfehler-Steuereinrichtung konfiguriert ist zum Auswählen des Komponententrägers mit der besten Funkverbindungsqualität als einen neuen Ankerträger.

11. Endgerät nach Anspruch 8, wobei die Funkverbindungsfehler-Steuereinrichtung konfiguriert ist zum:

Bestimmen, ob die Funkverbindungsqualität des Komponententrägersatzes vor Ablauf einer vorbestimmten Zeit wiederhergestellt wird,
Bestimmen, wenn die Funkverbindungsqualität des Komponententrägersatzes nicht wiederhergestellt wird, dass ein Funkverbindungsfehler in dem aktuellen Komponententrägersatz aufgetreten ist,
Messen, wenn der Funkverbindungsfehler aufgetreten ist, der Funkverbindungsqualitäten von benachbarten Zellen, und
Versuchen einer Verbindung zu einer der benachbarten Zellen mit der besten Funkverbindungsqualität.

12. Endgerät nach Anspruch 8, wobei die Funkverbindungsfehler-Steuereinrichtung konfiguriert ist zum Anwenden der Gewichtung auf jeden Komponententräger.

13. Endgerät nach Anspruch 10, wobei die Funkverbindungsfehler-Steuereinrichtung konfiguriert ist zum:

Anwenden der Gewichtung auf jeden Kompo-

nententräger, und
Bestimmen, ob die Funkverbindungsqualität, auf die die Gewichtung angewendet wird, wiederhergestellt wird.

Revendications

1. Procédé pour un contrôle de liaison radio par un terminal dans un système de radiocommunication cellulaire prenant en charge une agrégation de porteuses, comprenant les étapes suivantes :

mesurer (302) des qualités de liaison radio de plusieurs porteuses composantes parmi un ensemble de porteuses composantes ;
déterminer (304) si au moins une des qualités de liaison radio mesurées est égale ou supérieure à une valeur de seuil ;
déterminer, lorsqu'au moins une des qualités de liaison radio mesurées est égale ou supérieure à la valeur de seuil et qu'au moins une des qualités de liaison radio mesurées est inférieure à la valeur de seuil, que la qualité de liaison radio de l'ensemble de porteuses composantes est bonne ;
maintenir, lorsque la qualité de liaison radio de l'ensemble de porteuses composantes est bonne, un état de connexion avec une station de base courante ;
déterminer, lorsque toutes les qualités de liaison radio mesurées sont inférieures à la valeur de seuil, que la qualité de liaison radio de l'ensemble de porteuses composantes est mauvaise ; et
libérer, lorsque la qualité de liaison radio de l'ensemble de porteuses composantes est mauvaise, un état de connexion avec une station de base courante,
caractérisé en ce que le procédé comprend en outre : appliquer une pondération aux qualités de liaison radio mesurées, ladite pondération étant déterminée sur la base d'au moins un élément parmi le fait que la porteuse composante est un porteuse d'ancrage ou non, ou le fait que la porteuse composante porte un canal de contrôle physique pour le terminal ou pas.

2. Procédé selon la revendication 1, dans lequel l'étape consistant à maintenir un état de connexion comprend :

mesurer (314) une qualité de liaison radio d'une porteuse d'ancrage (201) ;
maintenir (316), lorsque la qualité de liaison radio de la porteuse d'ancrage est égale ou supérieure à une valeur de seuil de la porteuse d'ancrage, la porteuse d'ancrage courante ; et
reconfigurer (318), lorsque la qualité de liaison radio de la porteuse d'ancrage est inférieure à la valeur de seuil de la porteuse d'ancrage, l'ensemble de porteuses composantes avec des porteuses composantes restantes (202) qui sont des porteuses composantes de l'ensemble de porteuses composantes à l'exception de la porteuse d'ancrage.

3. Procédé selon la revendication 2, dans lequel l'étape consistant à reconfigurer l'ensemble de porteuses composantes comprend en outre : sélectionner la porteuse composante ayant une meilleure qualité de liaison radio comme une nouvelle porteuse d'ancrage.

4. Procédé selon la revendication 1, dans lequel l'étape consistant à libérer l'état de connexion comprend :

déterminer (306) si la qualité de liaison radio de l'ensemble de porteuses composantes est récupérée avant l'expiration d'un temps prédéterminé ;
déterminer (308), lorsque la qualité de liaison radio de l'ensemble de porteuses composantes n'est pas récupérée, que la défaillance de liaison radio a eu lieu dans l'ensemble de porteuses composantes courant ;
mesurer (308), lorsque la défaillance de liaison radio a eu lieu, des qualités de liaison radio de cellules voisines ; et
tenter (310) une connexion avec une des cellules voisines ayant une meilleure qualité de liaison radio.

5. Procédé selon la revendication 4, comprenant en outre :

terminer, lorsque la connexion avec la cellule voisine est défaillante, l'état de connexion avec la station de base courante ; et
entrer dans un état inactif (312).

6. Procédé selon la revendication 1, dans lequel l'étape consistant à mesurer des qualités de liaison radio comprend : appliquer la pondération à chaque porteuse composante.

7. Procédé selon la revendication 4, dans lequel l'étape consistant à déterminer si la qualité de liaison radio de l'ensemble de porteuses composantes est récupérée comprend :

appliquer la pondération à chaque porteuse composante ; et
déterminer si la qualité de liaison radio à laquelle la pondération est appliquée est récupérée.

8. Terminal pour un contrôle de liaison radio dans un

système de radiocommunication cellulaire prenant en charge une agrégation de porteuses, comprenant :

un récepteur de symbole de sous-porteuse de signal de référence, RS, qui reçoit des signaux de référence pour au moins une porteuse composante d'un ensemble de porteuses composantes ; et
un contrôleur de défaillance de liaison radio configuré pour :

mesurer des qualités de liaison radio de plusieurs porteuses composantes parmi un ensemble de porteuses composantes en utilisant les signaux de référence fournis par le récepteur de symbole de sous-porteuse RS,
déterminer, lorsqu'au moins une des qualités de liaison radio mesurées est égale ou supérieure à la valeur de seuil et qu'au moins une des qualités de liaison radio mesurées est inférieure à la valeur de seuil, que la qualité de liaison radio de l'ensemble de porteuses composantes est bonne,
maintenir, lorsque la qualité de liaison radio de l'ensemble de porteuses composantes est bonne, un état de connexion avec une station de base courante,
déterminer, lorsque toutes les qualités de liaison radio mesurées sont inférieures à la valeur de seuil, que la qualité de liaison radio de l'ensemble de porteuses composantes est mauvaise, et
libérer, lorsque la qualité de liaison radio de l'ensemble de porteuses composantes est mauvaise, un état de connexion avec une station de base courante,
caractérisé en ce que le contrôleur de défaillance de liaison radio est en outre configuré pour : appliquer une pondération aux qualités de liaison radio mesurées, ladite pondération étant déterminée sur la base d'au moins un élément parmi le fait que la porteuse composante est une porteuse d'ancrage ou non, ou le fait que la porteuse composante porte un canal de contrôle physique pour le terminal ou pas.

9. Terminal selon la revendication 8, dans lequel le contrôleur de défaillance de liaison radio est configuré pour :

mesurer une qualité de liaison radio d'une porteuse d'ancrage ;
maintenir, lorsque la qualité de liaison radio de la porteuse d'ancrage est égale ou supérieure à une valeur de seuil de la porteuse d'ancrage, la porteuse d'ancrage courante ; et
reconfigurer, lorsque la qualité de liaison radio de la porteuse d'ancrage est inférieure à la valeur de seuil de la porteuse d'ancrage, l'ensemble de porteuses composantes avec des porteuses composantes restantes qui sont des porteuses composantes de l'ensemble de porteuses composantes à l'exception de la porteuse d'ancrage.

10. Terminal selon la revendication 9, dans lequel le contrôleur de défaillance de liaison radio est configuré pour sélectionner la porteuse composante ayant une meilleure qualité de liaison radio comme une nouvelle porteuse d'ancrage.

11. Terminal selon la revendication 8, dans lequel le contrôleur de défaillance de liaison radio est configuré pour :

déterminer si la qualité de liaison radio de l'ensemble de porteuses composantes est récupérée avant l'expiration d'un temps prédéterminé,
déterminer, lorsque la qualité de liaison radio du groupe de porteuses composantes n'est pas récupérée, que la défaillance de liaison radio a eu lieu dans l'ensemble de porteuses composantes courant,
mesurer, lorsque la défaillance de liaison radio a eu lieu, des qualités de liaison radio de cellules voisines, et
tenter une connexion avec une des cellules voisines ayant une meilleure qualité de liaison radio.

12. Terminal selon la revendication 8, dans lequel le contrôleur de défaillance de liaison radio est configuré pour appliquer la pondération à chaque porteuse composante.

13. Terminal selon la revendication 10, dans lequel le contrôleur de défaillance de liaison radio est configuré pour :

appliquer la pondération à chaque porteuse composante, et
déterminer si la qualité de liaison radio à laquelle la pondération est appliquée est récupérée.

FIG. 1

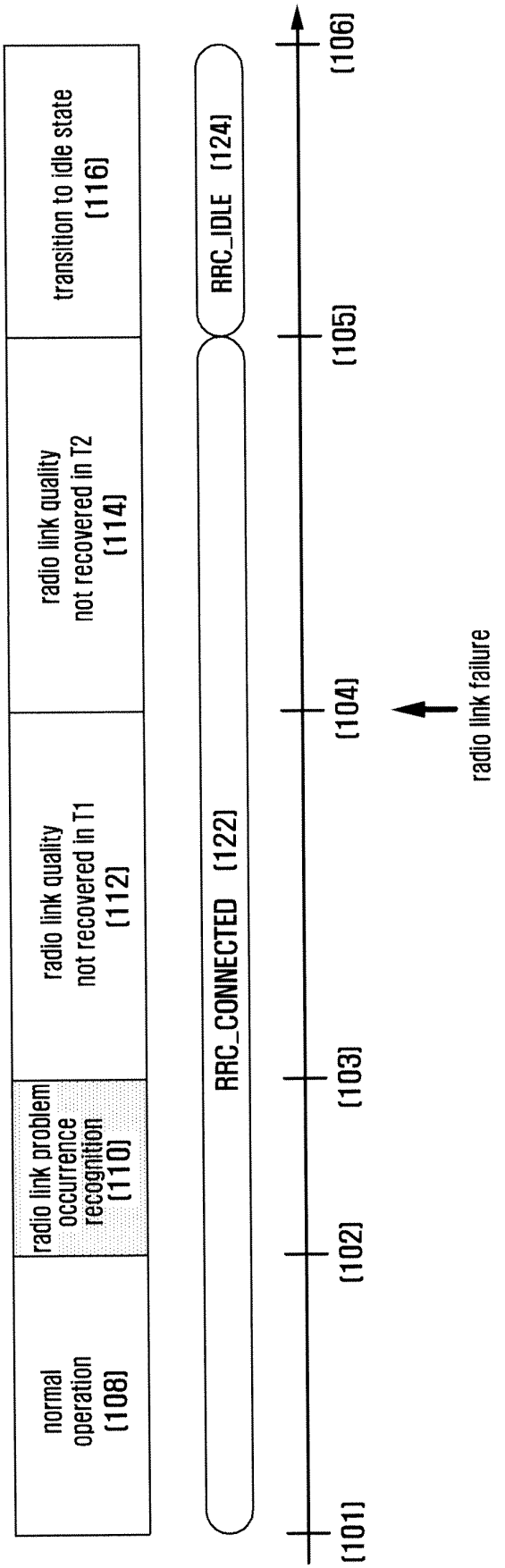

normal operation (108)
radio link problem occurrence recognition (110)
radio link quality not recovered in T1 (112)
radio link quality not recovered in T2 (114)
transition to idle state (116)
RRC_CONNECTED (122)
RRC_IDLE (124)
(101)
(102)
(103)
(104)
(105)
(106)
radio link failure

FIG. 2

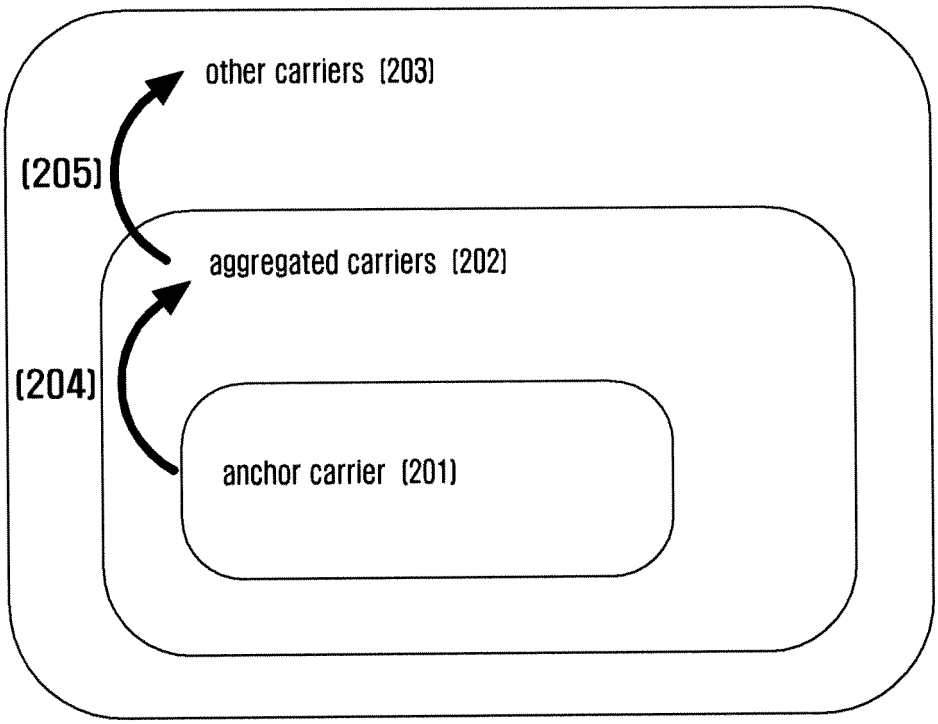

other carriers (203)
(205)
aggregated carriers (202)
(204)
anchor carrier (201)

FIG. 3

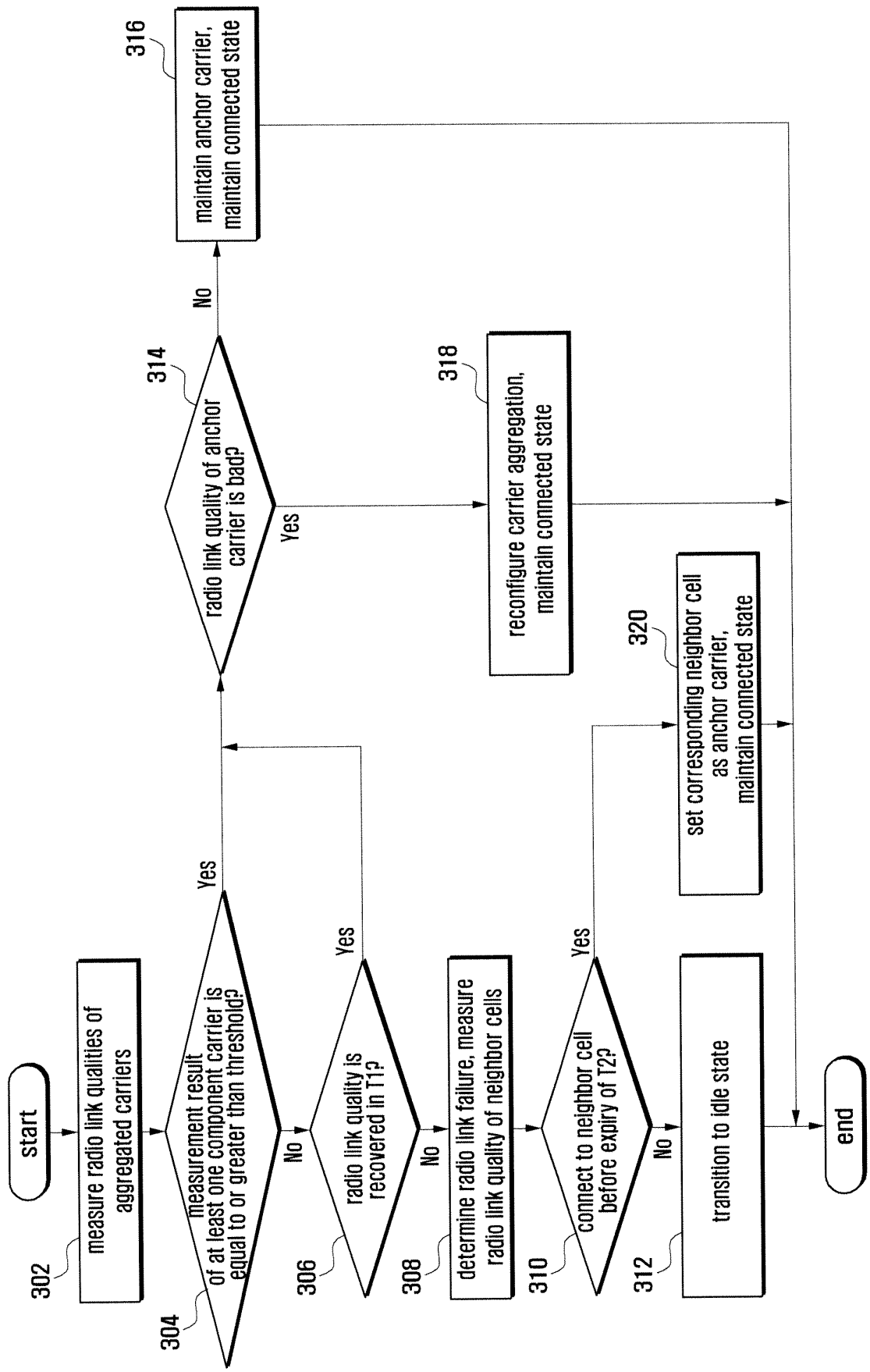

start
302
measure radio link qualities of aggregated carriers
304
measurement result of at least one component carrier is equal to or greater than threshold?
Yes
No
306
radio link quality is recovered in T1?
Yes
No
308
determine radio link failure, measure radio link quality of neighbor cells
310
connect to neighbor cell before expiry of T2?
Yes
No
312
transition to idle state
320
set corresponding neighbor cell as anchor carrier, maintain connected state
314
radio link quality of anchor carrier is bad?
Yes
No
318
reconfigure carrier aggregation, maintain connected state
316
maintain anchor carrier, maintain connected state
end

FIG. 4

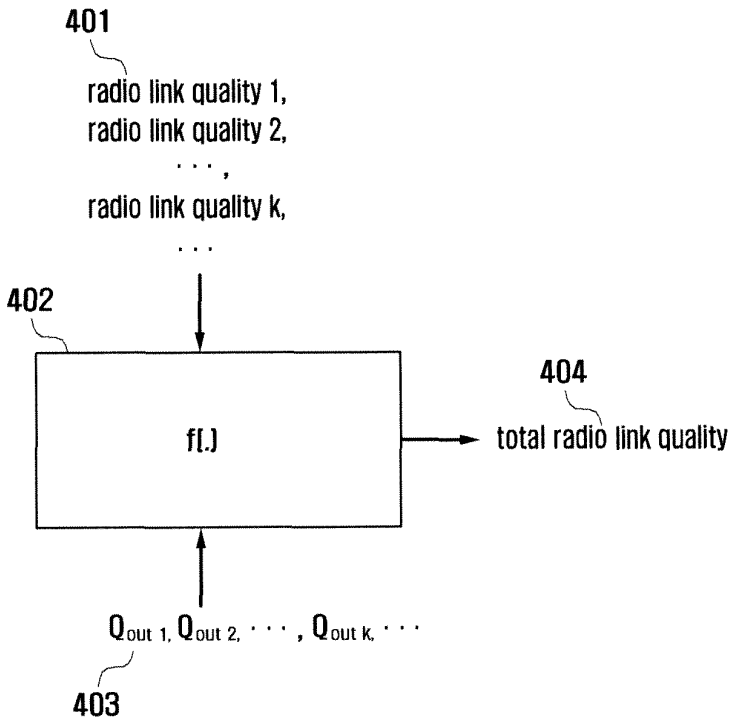

401
radio link quality 1,
radio link quality 2,
· · · ,
radio link quality k,
· · ·
402
f[.]
404
total radio link quality
$Q_{out\,1}, Q_{out\,2}, \cdots, Q_{out\,k}, \cdots$
403

FIG. 5

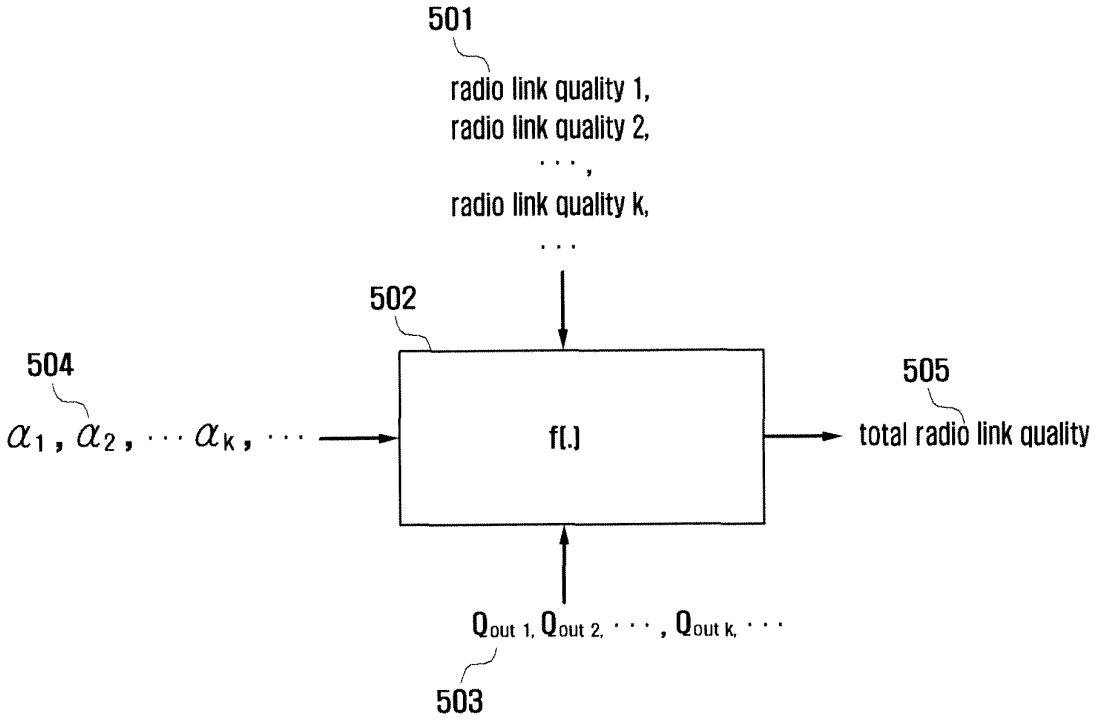

501
radio link quality 1,
radio link quality 2,
· · · ,
radio link quality k,
· · ·
502
504
$\alpha_1, \alpha_2, \cdots \alpha_k, \cdots$
f[.]
505
total radio link quality
$Q_{out\,1}, Q_{out\,2}, \cdots, Q_{out\,k}, \cdots$
503

FIG. 6

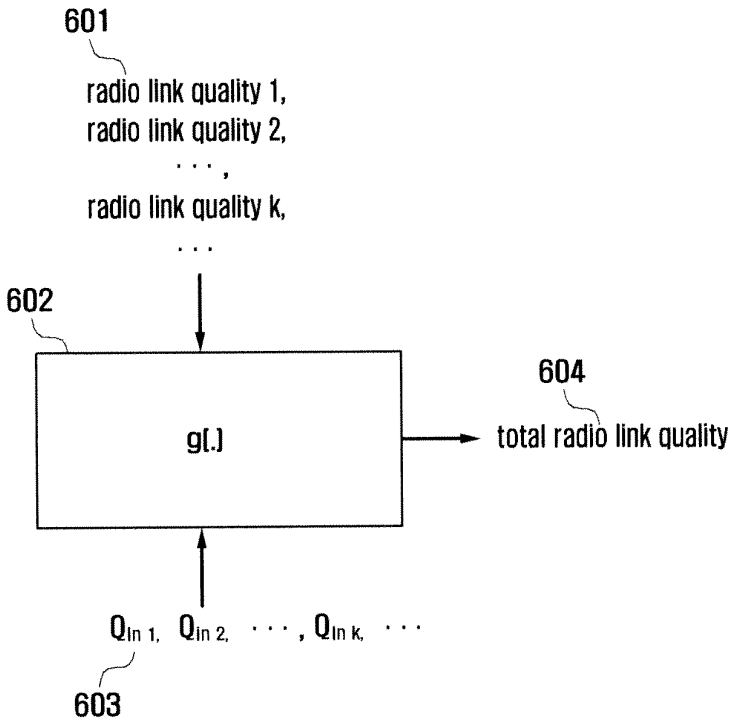

601
radio link quality 1,
radio link quality 2,
· · ·,
radio link quality k,
· · ·
602
g[.]
604
total radio link quality
Qin 1, Qin 2, · · ·, Qin k, · · ·
603

FIG. 7

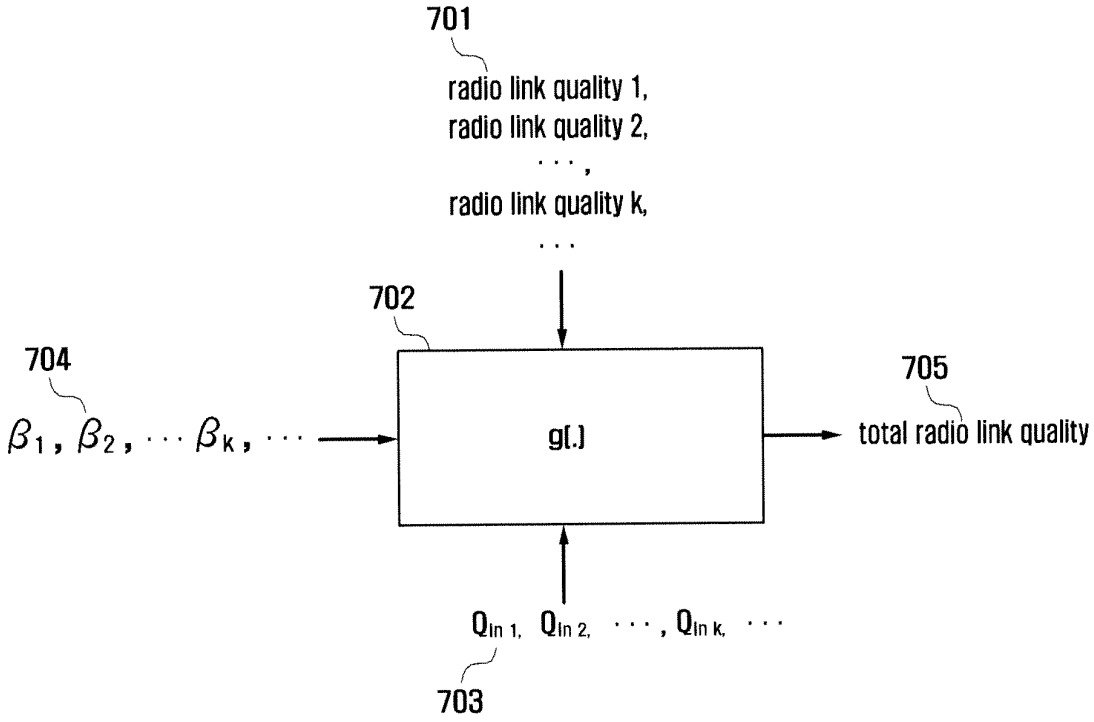
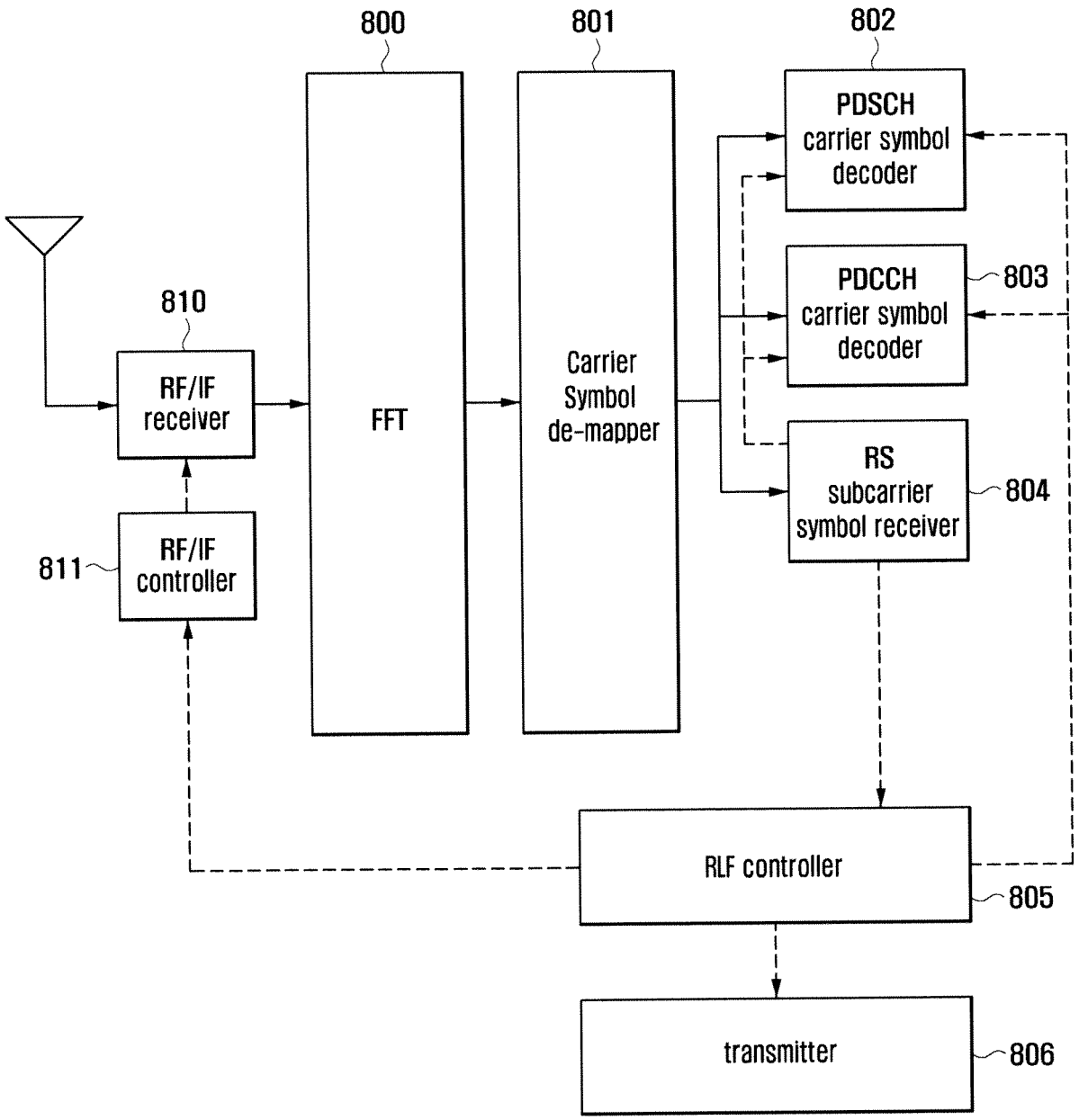

701
radio link quality 1,
radio link quality 2,
· · ·,
radio link quality k,
· · ·
702
704
β1, β2, · · · βk, · · ·
g[.]
705
total radio link quality
Qin 1, Qin 2, · · ·, Qin k, · · ·
703

FIG. 8


800
801
802
PDSCH carrier symbol decoder
PDCCH carrier symbol decoder
803
RS subcarrier symbol receiver
804
Carrier Symbol de-mapper
FFT
810
RF/IF receiver
811
RF/IF controller
RLF controller
805
transmitter
806

REFERENCES CITED IN THE DESCRIPTION

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