



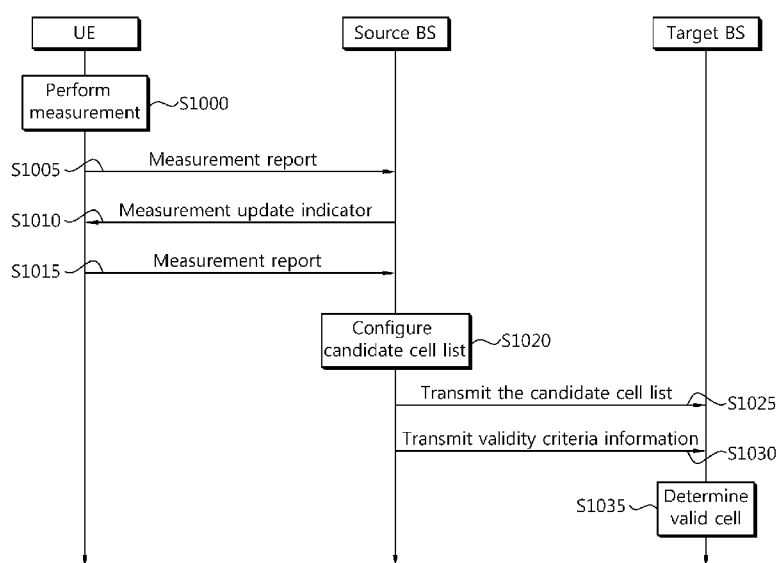
- (51) **International Patent Classification:**
H04W 36/30 (2009.01) *H04W 88/08* (2009.01)
H04W 36/38 (2009.01)
- (21) **International Application Number:**
PCT/KR2012/001875
- (22) **International Filing Date:**
15 March 2012 (15.03.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
10-2011-0023085 15 March 2011 (15.03.2011) KR
- (71) **Applicant (for all designated States except US):**
PANTECH CO., LTD. [KR/KR]; Pantech R&D Center, I-2 DMC, Sangam-dong, Mapo-gu, Seoul 121-270 (KR).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** **JUNG, Myung Cheul** [KR/KR]; Pantech Bldg., I-2 DMC, Sangam-dong, Mapo-gu, Seoul 121-270 (KR). **KWON, Ki Bum** [KR/KR]; Pantech Bldg., I-2 DMC, Sangam-dong, Mapo-gu, Seoul 121-270 (KR). **AHN, Jae Hyun** [KR/KR]; Pantech Bldg., I-2 DMC, Sangam-dong, Mapo-gu, Seoul 121-270 (KR).
- (74) **Agent:** **OH, Jae Eon**; Essen Patent & Law Firm, 2F. Sam-heung Yeoksam Bldg., 735-10 Yeoksam-dong, Gangnam-gu, Seoul 135-080 (KR).
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) **Title:** APPARATUS AND METHOD FOR PERFORMING HANDOVER IN MULTIPLE COMPONENT CARRIER SYSTEM

[Fig. 10a]



(57) **Abstract:** The present invention relates to an apparatus and method for performing handover in a multiple component carrier system. The present invention discloses a state information generation unit for generating a candidate cell list in which the secondary serving cells are arranged based on the measurement results and generating validity criteria information which is a criterion used to determine the validity of the measurement results. According to the present invention, at the time of handover, a source BS and a target BS can accurately know a service providing situation before handover.

Description

Title of Invention: APPARATUS AND METHOD FOR PERFORMING HANDOVER IN MULTIPLE COMPONENT CARRIER SYSTEM

Technical Field

- [1] The present invention relates to wireless communication and, more particularly, to an apparatus and method for performing handover in a multiple component carrier system.

Background Art

- [2] Cellular is a concept which has been introduced to overcome limitations to service areas and limitations to the frequency and subscriber capacity. Cellular is a method of providing coverage by changing a single high-output base station into a plurality of low-output base stations. That is, a mobile communication service area is divided into several small cells, different frequencies are allocated to neighbor cells, and the same frequency band is used in two cells not having interference therebetween because they are sufficiently spaced apart from each other so that the frequency can be spatially reused.
- [3] Handover or handoff refers to a function in which, when user equipment gets out of a current communication service area (hereinafter referred to as a serving cell) and moves to a neighbor communication service area (hereinafter referred to as a neighbor cell), the user equipment is automatically tuned with a new traffic channel of the neighbor cell, thus continuing to maintain a traffic state. User equipment that communicates with a specific base station (hereinafter referred to as a source base station) is linked to another neighbor base station (hereinafter referred to as a target base station) when the intensity of a signal in the source base station becomes weak. When handover is performed, a problem, such as call disconnection occurring when user equipment moves to a neighbor cell, can be solved.
- [4] In general, a wireless communication system uses one bandwidth for data transmission. For example, the 2nd generation wireless communication system uses a bandwidth of 200 KHz to 1.25 MHz, and the 3rd generation wireless communication system uses a bandwidth of 5 MHz to 10 MHz. In order to support an increasing transmission capacity, the bandwidth of the recent 3GPP LTE or 802.16m continues to be extended up to 20 MHz or higher. To increase the bandwidth may be considered to be indispensable in order to increase the transmission capacity, but to support a great bandwidth even when the quality of service required is low may generate great power consumption.

- [5] There is emerging a multiple component carrier system in which a carrier having one bandwidth and the center frequency is defined and data is transmitted or received through a plurality of the carriers using a wide band. A narrow band and a wide band are supported at the same time by using one or more carriers. For example, if one carrier corresponds to a bandwidth of 5 MHz, a maximum 20 MHz bandwidth is supported by using four carriers.
- [6] In the prior art, since only handover in a base station using a single component carrier is taken into consideration, the base station has only to perform handover with consideration taken of only a single cell measured and reported by user equipment.
- [7] In case of a multiple component carrier system, however, in order to maintain quality of service, a handover procedure must be performed by taking multiple component carriers into consideration. To this end, a target base station must perform the handover procedure so that user equipment can use necessary component carriers in order to maintain quality of service equivalent to quality of service provided by a source base station. In this case, it is difficult to configure component carriers of an adequate level or appropriate component carriers because the target base station does not accurately know the situation in which the quality of service was provided to the user equipment before the handover. Accordingly, there is a need for an apparatus and method for performing handover by taking multiple component carriers into consideration.

Disclosure of Invention

Technical Problem

- [8] An object of the present invention is to provide an apparatus and method for performing handover in a multiple component carrier system.
- [9] Another object of the present invention is to provide an apparatus and method in which a source base station instructs user equipment to make a measurement report in a multiple component carrier system.
- [10] Yet another object of the present invention is to provide an apparatus and method for providing a candidate cell list necessary to configure a secondary serving cell to a target base station in a multiple component carrier system.
- [11] Further yet another object of the present invention is to provide an apparatus and method for providing basic information necessary to determine the validity of a measurement result to a target base station in a multiple component carrier system.
- [12] Still yet another object of the present invention is to provide an apparatus and method for selecting a valid cell using basic information necessary to determine the validity of a measurement result in a multiple component carrier system.

Solution to Problem

- [13] According to an aspect of the present invention, User Equipment (UE) for

performing a handover procedure in a multiple component carrier system includes a measurement unit for deducing a first measurement result for each of serving cells by obtaining measurement samples through filtering in a physical layer level and performing filtering in a high layer level based on Radio Resource Control (RRC) configuration parameters for the measurement samples, wherein the UE transmits the first measurement results to a source Base Station (BS).

[14] According to another aspect of the present invention, a source BS for performing a handover procedure for UE in a multiple component carrier system includes a source-side reception unit for receiving a first measurement result for each of secondary serving cells, configured in the UE, from the UE; a state information generation unit for generating a candidate cell list in which the secondary serving cells are arranged based on the first measurement results and generating validity criteria information which is a criterion used to determine the validity of the first measurement results; and a source-side transmission unit for transmitting the candidate cell list and the validity criteria information to a target BS.

[15] According to yet another aspect of the present invention, a method of a source BS performing a handover procedure in a multiple component carrier system includes receiving a first measurement result for each of secondary serving cells, configured in UE, from the UE; generating a candidate cell list in which the secondary serving cells are arranged based on the first measurement results; generating validity criteria information which is a criterion used to determine the validity of the first measurement results; and transmitting the candidate cell list and the validity criteria information to a target BS.

[16] According to further yet another aspect of the present invention, a target BS for performing a handover procedure for UE in a multiple component carrier system includes a target-side reception unit for receiving, from a source BS, at least one of a candidate cell list in which secondary serving cells configured in the UE are arranged based on measurement results for the secondary serving cells and validity criteria information which is a criterion used to determine the validity of the measurement results; a valid cell criteria unit for determining a valid cell based on the validity criteria information and states of the secondary serving cells indicated in the candidate cell list; and a target-side transmission unit for transmitting a handover request ACK message, including the valid cell list indicating the determined valid cell, to the source BS.

[17] According to still yet another aspect of the present invention, a method of a target BS performing a handover procedure in a multiple component carrier system includes receiving, from a source BS, a candidate cell list in which secondary serving cells configured in UE are arranged based on measurement results for the secondary serving

cells; receiving, from the source BS, validity criteria information which is a criterion used to determine the validity of the measurement results; determining a valid cell based on the validity criteria information and states of the secondary serving cells indicated in the candidate cell list; and transmitting a handover request ACK message, including a valid cell list indicating the determined valid cell, to the source BS.

Advantageous Effects of Invention

- [18] In accordance with the present invention, a source base station and a target base station can accurately know a situation providing situation before handover in a multiple component carrier system handover. Accordingly, an optimal secondary serving cell can be configured for user equipment right after handover.

Brief Description of Drawings

- [19] FIG. 1 is a diagram showing a wireless communication system;
- [20] FIG. 2 is an explanatory diagram illustrating an intra-band contiguous carrier aggregation;
- [21] FIG. 3 is an explanatory diagram illustrating an intra-band non-contiguous carrier aggregation;
- [22] FIG. 4 is an explanatory diagram illustrating an inter-band carrier aggregation;
- [23] FIG. 5 shows an example of a protocol structure for supporting multiple carriers;
- [24] FIG. 6 shows an example of a frame structure for a multiple carrier operation;
- [25] FIG. 7 is a diagram showing linkage between a downlink component carrier and an uplink component carrier in a multiple carrier system;
- [26] FIG. 8 is an explanatory diagram illustrating the concept of a serving cell and a neighbor cell;
- [27] FIG. 9 is an explanatory diagram illustrating the concept of a primary serving cell and a secondary serving cell;
- [28] FIG. 10a is a flowchart schematically illustrating a method of performing handover in a multiple component carrier system according to an example of the present invention;
- [29] FIG. 10b is a block diagram showing the measurement unit of user equipment according to the present invention;
- [30] FIG. 11 is a flowchart illustrating a method of user equipment performing handover in a multiple component carrier system according to an example of the present invention;
- [31] FIG. 12 is a flowchart illustrating a method of a source base station performing handover in a multiple component carrier system according to an example of the present invention;
- [32] FIG. 13 is a flowchart illustrating a method of a target base station performing

handover in a multiple component carrier system according to an example of the present invention;

[33] FIG. 14 is an explanatory diagram illustrating a scenario in which user equipment performs handover according to the present invention; and

[34] FIG. 15 is a block diagram of a source base station and a target base station according to an example of the present invention.

Mode for the Invention

[35] Some embodiments of the present invention will now be described in detail with reference to the accompanying drawings. It is to be noted that in assigning reference numerals to respective elements in the drawings, the same reference numerals designate the same elements although they are shown in different drawings. Furthermore, in describing the embodiments of the present invention, a detailed description of known constructions or functions will be omitted if it is deemed to make the gist of the present invention unnecessarily vague.

[36] Furthermore, in describing the elements of this specification, terminologies, such as the first, the second, A, B, (a), and (b), may be used. The terminologies are used to only distinguish elements from one another, but the essence, sequence and the like of the elements are not limited by the terminologies. Furthermore, in the case where one element is described to be "connected", "coupled", or "linked" to the other element, the one element may be directly connected or coupled to the other element, but it is understood that a third element may be "connected", "coupled", or "linked" between the elements.

[37] Furthermore, in this specification, a wireless communication network is chiefly described. However, tasks performed in the wireless communication network may be performed in a process in which a system (e.g., a base station) managing the wireless communication network controls the communication network and sends data or may be performed in user equipment connected to the wireless communication network.

[38] FIG. 1 is a diagram showing a wireless communication system. The wireless communication system may be a network structure including an Evolved-Universal Mobile Telecommunications System (E-UMTS). The E-UMTS system may also be called a Long Term Evolution (LTE) system. The wireless communication systems are widely deployed in order to provide various types of communication services, such as voice and packet data.

[39] Multiple access schemes applied to the wireless communication system are not limited. A variety of multiple access schemes, such as Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Orthogonal Frequency Division Multiple Access (OFDMA), Single

Carrier Frequency Division Multiple Access (SC-FDMA), OFDM-FDMA, OFDM-TDMA, and OFDM-CDMA, may be used.

[40] Here, uplink transmission and downlink transmission may be performed in accordance with a Time Division Duplex (TDD) scheme using different times or a Frequency Division Duplex (FDD) scheme using different frequencies.

[41] Referring to FIG. 1, an E-UTRAN includes at least one Base Station (BS) 20 providing a control plane and a user plane. User Equipment (UE) 10 may be fixed or mobile and may also be called another terminology, such as a Mobile Station (MS), an Advanced MS (AMS), a User Terminal (UT), a Subscriber Station (SS), or a wireless device.

[42] The BS 20 commonly refers to a fixed station communicating with the UEs 10, and it may also be called another terminology, such as an evolved-NodeB (eNB), a Base Transceiver System (BTS), or an access point. The BS 20 can provide at least one cell to the UE 10. The cell may mean a geographical area where the BS 20 provides communication service or may mean a specific frequency band. An interface for user traffic or control traffic transmission may be used between the BSs 20. A source BS 21 refers to a BS now having a radio bearer set up with the UE 10, and a target BS 22 refers to a BS to which the UE 10 tries to perform handover in order to set up a new radio bearer after breaking the existing radio bearer with the source BS 21.

[43] Hereinafter, downlink refers to communication from the BS 20 to the UE 10, and uplink refers to communication from the UE 10 to the BS 20. Downlink is also called a forward link, and uplink is also called a reverse link. In downlink, a transmitter may be part of the BS 20 and a receiver may be part of the UE 10. In uplink, a transmitter may be part of the UE 10 and a receiver may be part of the BS 20.

[44] The BSs 20 may be interconnected through an X2 interface. The X2 interface is used to exchange messages between the BSs 20. The BS 20 is connected to an Evolved Packet System (EPS), more particularly, a Mobility Management Entity (MME)/Serving Gateway (S-GW) 30 through an S1 interface. The S1 interface supports a many-to-many-relation between the BSs 20 and the MME/S-GW 30. In order to provide packet data service to the MME/S-GW 30, a PDN-GW 40 is used. The PDN-GW 40 is varied according to traffic purposes or services. The PDN-GW 40 supporting specific service may be found based on Access Point Name (APN) information.

[45] Intra E-UTRAN handover is a basic handover mechanism that is used when handover is performed between E-UTRAN access networks. The intra E-UTRAN handover is composed of X2-based handover and S1-based handover. The X2-based handover is used when the UE 10 performs handover from the source BS 21 to the target BS 22 using the X2 interface. Here, the MME/S-GW 30 is not changed.

- [46] Through the S1-based handover, a first radio bearer set up among the P-GW 40, the MME/S-GW 30, the source BS 21, and the UE 10 is released, and a second radio bearer is newly set up among the P-GW 40, the MME/S-GW 30, the target BS 22, and the UE 10.
- [47] A carrier aggregation (CA) supports a plurality of carriers, and it is also called a spectrum aggregation or a bandwidth aggregation. Individual unit carriers aggregated by a carrier aggregation are called Component Carriers (hereinafter referred to as CCs). Each of the CCs is defined by a bandwidth and the center frequency. The carrier aggregation is introduced in order to support an increasing throughput, prevent an increase of costs due to the introduction of broadband Radio Frequency (RF) devices, and guarantee compatibility with the existing system. For example, assuming that 5 CCs having a bandwidth of 5 MHz are allocated, a bandwidth of 20 MHz can be supported.
- [48] The carrier aggregation may include an intra-band contiguous carrier aggregation, such as that shown in FIG. 2, an intra-band non-contiguous carrier aggregation, such as that shown in FIG. 3, and an inter-band carrier aggregation, such as that shown in FIG. 4.
- [49] Referring first to FIG. 2, the intra-band contiguous carrier aggregation is performed between CCs which are contiguous to each other within the same operation band. For example, all CC#1, CC#2, CC#3, ..., CC #N (i.e., aggregated CCs) are contiguous to each other.
- [50] Referring to FIG. 3, the intra-band non-contiguous carrier aggregation is performed between discontinuous CCs. For example, CC#1 and CC#2 (i.e., aggregated CCs) are spaced apart from each other at a specific frequency.
- [51] Referring to FIG. 4, in the inter-band carrier aggregation, one or more of a plurality of CCs are aggregated on different frequency bands. For example, a CC #1 (i.e., an aggregated CC) exists in an operation band #1 and a CC #2 (i.e., an aggregated CC) exists in an operation band #2.
- [52] The number of aggregated downlink CCs and the number of aggregated uplink CCs may be differently set. When the number of downlink CCs is identical to the number of uplink CCs, it is called a symmetric aggregation. When the number of downlink CCs is different from the number of uplink CCs, it is called an asymmetrical aggregation.
- [53] Furthermore, CCs may have different sizes (i.e., bandwidths). For example, assuming that 5 CCs are used to form a 70 MHz band, a resulting configuration may be, for example, 5 MHz CC (carrier #0) + 20 MHz CC (carrier #1) + 20 MHz CC (carrier #2) + 20 MHz CC (carrier #3) + 5 MHz CC (carrier #4).
- [54] Hereinafter, the term 'multiple carrier system' refers to a system supporting the carrier aggregation. In the multiple carrier system, a contiguous carrier aggregation or

a non-contiguous carrier aggregation or both may be used. Furthermore, either a symmetrical aggregation or an asymmetrical aggregation may be used.

[55] FIG. 5 shows an example of a protocol structure for supporting multiple carriers.

[56] Referring to FIG. 5, a common Medium Access Control (MAC) entity 510 manages a physical layer 520 using a plurality of carriers. An MAC management message transmitted on a specific carrier may be applied to different carriers. That is, the MAC management message may control other carriers including the specific carrier. The physical layer 520 may be operated according to the TDD scheme or the FDD scheme or both.

[57] Several physical control channels are used in the physical layer 520. A Physical Downlink Control Channel (PDCCH) through which physical control information is transmitted informs UE of the resource allocation of a Paging Channel (PCH) and a downlink shared channel (DL-SCH) and Hybrid Automatic Repeat Request (HARQ) information related to the DL-SCH. The PDCCH may carry an uplink grant, informing the UE of the allocation of resources for uplink transmission.

[58] A Physical Control Format Indicator Channel (PCFICH) is used to inform UE of the number of OFDM symbols used in PDCCHs and is transmitted for every frame. A Physical Hybrid ARQ Indicator Channel (PHICH) carries an HARQ ACK/NAK signal in response to uplink transmission. A Physical Uplink Control Channel (PUCCH) carries HARQ ACK/NAK for downlink transmission, a scheduling request, and uplink control information, such as a Channel Quality Indicator (CQI). A Physical Uplink Shared Channel (PUSCH) carries an Uplink Shared CHannel (UL-SCH).

[59] FIG. 6 shows an example of a frame structure for a multiple carrier operation.

[60] Referring to FIG. 6, a radio frame consists of 10 subframes. Each of the subframes includes a plurality of OFDM symbols. Each of Component Carriers (CCs) may have its own control channel (e.g., a PDCCH). The CCs may be contiguous to each other or may not be contiguous to each other. UE can support one or more CCs according to its capability.

[61] FIG. 7 shows linkage between a downlink CC and an uplink CC in a multiple carrier system.

[62] Referring to FIG. 7, in downlink, downlink CCs (hereinafter referred to as DL CCs) D1, D2, and D3 are aggregated. In uplink, uplink CCs (hereinafter referred to as UL CCs) U1, U2, and U3 are aggregated. Here, D_i is the index of the DL CC, and U_i is the index of the UL CC (where $i=1, 2, 3$).

[63] In an FDD system, a DL CC and an UL CC are linked to each other in a one-to-one manner. Each of D1 and U1, D2 and U2, and D3 and U3 is linked to each other in a one-to-one manner. UE sets up linkage between the DL CCs and the UL CCs based on system information transmitted on a logical channel BCCH or UE-dedicated Radio

Resource Control (RRC) message transmitted on a DCCH. Each linkage may be set up in a cell-specific way or UE-specific way.

[64] Examples of an UL CC linked to a DL CC are as follows.

[65] 1) A UL CC on which UE will transmit ACK/NACK information in response to data transmitted by a BS through a DL CC.

[66] 2) A DL CC on which a BS will transmit ACK/NACK information in response to data transmitted by UE through an UL CC.

[67] 3) A DL CC on which a BS will transmit a response to a Random Access Preamble (RAP), transmitted by UE starting a random access procedure through an UL CC, when the BS receives the RAP.

[68] 4) A UL CC to which uplink control information is applied when a BS transmits the uplink control information through a DL CC.

[69] FIG. 7 illustrates only the 1:1 linkage between the DL CC and the UL CC, but linkage, such as 1:n or n:1, may be set up. Furthermore, the index of a CC does not coincide with the order of the CC or the location of a frequency band of the CC.

[70] FIG. 8 is an explanatory diagram illustrating a concept of a serving cell and a neighbor cell.

[71] Referring to FIG. 8, a system frequency band is classified into a plurality of carrier frequencies. Here, the carrier frequency refers to the center frequency of a cell. The cell may mean downlink frequency resources and uplink frequency resources. In an alternative embodiment, the cell may mean a combination of downlink frequency resources and optional uplink frequency resources. When a carrier aggregation is not taken into consideration, one cell always includes a pair of uplink and downlink frequency resources.

[72] A serving cell 805 refers to a cell in which service is now being provided to UE. A neighbor cell refers to a cell adjacent to the serving cell 805 geographically or one frequency band. Neighbor cells using the same carrier frequency on the basis of the serving cell 805 are called intra-frequency neighbor cells 800 and 810. Furthermore, neighbor cells using a different carrier frequency on the basis of the serving cell 805 are called inter-frequency neighbor cells 815, 820, and 825. That is, a serving cell and neighbor cells (i.e., not only cells using the same frequency as the serving cell, but also cells using a different frequency from the serving cell) may be called neighbor cells.

[73] What UE performs handover from the serving cell 805 to the intra-frequency neighbor cell 800 or 810 is called intra-frequency handover. Meanwhile, what UE performs handover from the serving cell 805 to the inter-frequency neighbor cell 815, 820, or 825 is called inter-frequency handover.

[74] In order for packet data to be transmitted and received through a specific cell, UE first has to complete the configuration of a specific cell or CC. The configuration of a

cell or CC means a state in which the reception of system information necessary for data transmission and reception for a relevant cell or CC has been completed.

[75] For example, the configuration may include an overall process of receiving common physical layer parameters necessary for the data transmission and reception, MAC layer parameters, or parameters necessary for a specific operation in an RRC layer. A configured cell or CC is in a state in which packets can be instantly transmitted and received when only signaling information, indicating that packet data can be transmitted, is received.

[76] Meanwhile, a cell whose configuration has been completed may exist in an activation state or a deactivation state. The reason why the state of the cell whose configuration has been completed is divided into the activation state and the deactivation states is to allow UE to monitor or receive a control channel (PDCCH) and a data channel (PDSCH) only in the activation state so that the battery consumption of the UE can be minimized. Here, an initial state related to the activation state right after the cell is configured is a deactivation state.

[77] Activation means that traffic data is being transmitted or received or is in a ready state. In order to check resources (e.g., frequency and time resources) allocated to UE, the UE may monitor or receive the control channel (PDCCH) and the data channel (PDSCH) of an activated cell.

[78] Deactivation means that traffic data cannot be transmitted or received, but measurement or the transmission or reception of minimum information is possible. UE may receive System Information (SI) necessary to receive packets from a deactivated cell. However, the UE does not monitor or receive the control channel (PDCCH) and the data channel (PDSCH) of the deactivated cell in order to check resources (e.g., frequency and time resources) allocated thereto.

[79] FIG. 9 is an explanatory diagram illustrating a concept of a primary serving cell (Pcell) and a secondary serving cell (Scell).

[80] Referring to FIG. 9, a primary serving cell (PCell) 905 refers to one serving cell which provides security input and Non-Access Stratum (NAS) mobility information in an RRC establishment or re-establishment state. At least one cell, together with the primary serving cell 905, may be configured to form a set of serving cells according to UE capabilities. Here, the at least one cell is called a secondary serving cell (SCell) 920.

[81] Accordingly, the set of serving cells configured for one UE may include only the one primary serving cell 905 or may include the one primary serving cell 905 and the at least one secondary serving cell 920.

[82] The intra-frequency neighbor cells 900 and 910 of the primary serving cell 905 or the intra-frequency neighbor cells 915 and 925 of the secondary serving cell 920 or both

belong to the same carrier frequency. Furthermore, the inter-frequency neighbor cells 930, 935, and 940 of the primary serving cell 905 and the secondary serving cell 920 belong to a different carrier frequency.

- [83] A DL CC corresponding to the primary serving cell 905 is called a downlink Primary Component Carrier (DL PCC), and an UL CC corresponding to the primary serving cell 905 is called an uplink Primary Component Carrier (UL PCC). Furthermore, in downlink, a CC corresponding to the secondary serving cell 920 is called a downlink Secondary Component Carrier (DL SCC). In uplink, a CC corresponding to the secondary serving cell 920 is called an uplink Secondary Component Carrier (UL SCC).
- [84] The PCC is a CC to which UE is connected or RRC-connected at the early stage, from among several CCs. The PCC is a special CC that is responsible for connection or RRC connection for signaling regarding a number of CCs and for the management of UE context information (i.e., connection information related to the UE). Furthermore, the PCC is always in the activation state, when it is connected to UE and is in an RRC connected mode.
- [85] The SCC is a CC allocated to UE in addition to the PCC. The SCC is a carrier extended for the additional allocation of resources to UE in addition to the PCC. The state of the SCC may be divided into the activation state and the deactivation state. The primary serving cell 905 and the secondary serving cell 920 have the following characteristics.
- [86] First, the primary serving cell 905 is used to transmit a PUCCH.
- [87] Second, the primary serving cell 905 is always activated, whereas the secondary serving cell 920 is a carrier that is activated or deactivated according to specific conditions.
- [88] Third, when the primary serving cell 905 experiences a Radio Link Failure (RLF), RRC re-establishment is triggered. When the secondary serving cell 920 experiences an RLF, RRC re-establishment is not triggered.
- [89] Fourth, the primary serving cell 905 may be changed by a change of a security key or a handover procedure accompanied by a Random Access Channel (RACH) procedure. In case of MSG4 contention resolution, only a PDCCH indicating MSG4 must be transmitted through the primary serving cell 905, and MSG4 information may be transmitted through the primary serving cell 905 or the secondary serving cell 920.
- [90] Fifth, NAS information is received through the primary serving cell 905.
- [91] Sixth, the primary serving cell 905 always includes a pair of a DL PCC and a UL PCC.
- [92] Seventh, a different CC may be configured as the primary serving cell 905 for every UE.

- [93] Eighth, procedures, such as the reconfiguration, addition, and removal of the secondary serving cell 920, may be performed by the RRC layer. In newly adding the secondary serving cell 920, RRC signaling may be used in order to transmit system information about a dedicated secondary serving cell.
- [94] The technical spirit of the present invention regarding the characteristics of the primary serving cell 905 and the secondary serving cell 920 is not necessarily limited to the above description, and it may include more examples.
- [95] A DL CC may configure one serving cell, or a DL CC and a UL CC may be linked to each other, thus forming one serving cell. However, only one UL CC does not form a serving cell. For example, a DL CC1 and a UL CC1 may be linked to each other to form the primary serving cell 905. Furthermore, a DL CC2 and a UL CC2 may be linked to each other to form one secondary serving cell 920, and a DL CC3 and a UL CC3 may be linked to each other to form another secondary serving cell 920. Accordingly, in a carrier system, a concept in which communication between UE and a BS is performed through a DL CC or a UL CC is the same as a concept in which communication between UE and a BS is performed through a serving cell. For example, when UE performs measurement accompanied by handover, a measurement report for a CC may be considered as the same concept as a measurement report for the primary serving cell 905 or the secondary serving cell 920. Hereinafter, in order to aim at unity, it is assumed that the measurement report of UE is for a serving cell.
- [96] In handover in which a carrier aggregation is taken into consideration, both the primary serving cell 905 and the secondary serving cell 920 must be taken into consideration. For example, when the primary serving cell 902 is changed into the secondary serving cell 920 in the same BS, it corresponds to intra BS (or intra eNB) handover. When the primary serving cell 905 is changed into a specific cell 920 in a different BS, it corresponds to inter BS (or inter eNB) handover.
- [97] If the service state of UE is sought to remain intact even after handover to a target BS in a multiple component carrier system, a source BS and the target BS must first check the state of a serving cell (particularly, a secondary serving cell) configured in the UE. The state of the secondary serving cell may be checked by the measurement of the UE for the secondary serving cell. Criteria of the measurement for the secondary serving cell may include, for example, Reference Signal Received Power (RSRP) and Reference Signal Received Quality (RSRQ).
- [98] In order to check the state of the secondary serving cell, the source BS or the target BS may select a secondary serving cell that is suitable for being configured in the UE. For example, it is assumed that the UE is linked to the source BS and first and second secondary serving cells are configured in the UE. If the channel state of the second secondary serving cell is greatly deteriorated when the UE is connected to the target

BS through handover, the target BS may select only the first secondary serving cell and configure the first secondary serving cell in the UE.

[99] In order for the target BS to select the secondary serving cell valid for the UE as described above, there is need for data (i.e., information elements) that are bases for selection. The target BS may directly obtain the information elements or may obtain the information elements from the source BS via an X2 interface. The information elements are pieces of information that are bases when the target BS selects the secondary serving cell for the UE in a handover procedure. A set of the information elements is also called service state information.

[100] For example, the information element may include a candidate cell list. The candidate cell list is a list that may be configured by the source BS. The candidate cell list indicates a serving cell that may be configured for the UE which has completed handover to the target BS. The candidate cell list lists secondary serving cells according to a specific order. For example, the secondary serving cells may be listed in order of better measurement results, or the secondary serving cells may be listed in order of worse measurement results. The candidate cell list may simply list only serving cells and may include measurement results for the respective listed serving cells.

[101] For another example, the information element includes the number of serving cells used in the source BS.

[102] For yet another example, the information element includes UE capabilities.

[103] For yet another example, the information element includes a maximum term average throughput.

[104] Table 1 is an example of the information elements.

[105] Table 1

[Table 1]

ElementS	Description
Candidate Cell List	Information for candidate cells or measurement results for candidate cells or both
Number of CCs for SeNB	The number of CCs are used by SeNB
UE Capability	Available CCs (e.g., the number of CCs and frequency for CC)

[106] Referring to Table 1, service state information may include a candidate cell list, the number of CCs used for a source BS, UE capabilities, information about CCs included in the candidate cell list, and an RSRP or RSRQ for cells that have performed mea-

surement reports.

- [107] A source BS transfers some or all of the information elements, such as the candidate cell list, the number of serving cells used, UE capability, and a maximum term average throughput, to a target BS. In response thereto, the target BS may determine a serving cell that may be validly configured in UE, from among serving cells included in the candidate cell list, by comprehensively taking the information elements into consideration, or RSRP or RSRQ value for cells that performed measurement reports. The determined at least one serving cell is called available cell.
- [108] It is not guaranteed that the channel state of a serving cell is regularly maintained because a radio channel is sensitive to noise and fading. For this reason, an accurate channel state may be no longer incorporated into a candidate cell list because the channel state is already changed when the candidate cell list is transferred. In this case, an order of the serving cells or measurement results included in the candidate cell list are no longer valid. If a target BS determines a valid cell on the basis of an invalid candidate cell list there is a problem in that an inappropriate serving cell is configured in UE. Accordingly, there is a need for a method of improving reliability of a candidate cell list.
- [109] In other words, a target BS has determined a valid cell and has selected the valid cell as a serving cell for UE, but a problem may occur when the valid cell is actually used as the serving cell. This is because measurement results (i.e., criteria for determining quality for a candidate cell list or cell) do not always maintain a new state. A method of maintaining measurement results for a candidate cell list or cell in new values or of obtaining new values by taking a situation into consideration needs to be taken into account.
- [110] FIG. 10a is a flowchart schematically illustrating a method of performing handover in a multiple component carrier system according to an example of the present invention. In FIG. 10a, it is assumed that serving cells A, B, C, D, and E have been configured in UE. Any one of the serving cells A, B, C, D, and E may be a primary serving cell, and the remainder may be secondary serving cells. Here, the UE may support more serving cells in addition to the serving cells A to E, but only the five serving cells are described as an example.
- [111] Referring to FIG. 10a, the UE performs measurement for the serving cells in accordance with a method defined by a BS at step S1000. When the measurement is performed in the measurement unit 1000 of the UE, the measurement unit is constructed as shown in FIG. 10b.
- [112] FIG. 10b is a block diagram showing the measurement unit 1000 of UE according to the present invention. Referring to FIG. 10b, the measurement unit 1000 includes a Layer 1 filter unit 1005, a Layer 3 filter unit 1010, and a report evaluation unit 1015.

- [113] The Layer 1 filter unit 1005 obtains a plurality of measurement samples through filtering in a physical layer level and reports the plurality of measurement samples to the Layer 3 filter unit 1010. The Layer 3 filter unit 1010 performs filtering in the high layer level based on RRC configuration parameters for the reported measurement samples. Thus, a first measurement result for each of the serving cells is deduced.
- [114] For example, the first measurement result may be an RSRP or RSRQ. The RSRP and the RSRQ may be defined as follows. The RSRP is calculated as a linear average for the power contribution of resource elements. The resource elements carry a cell-specific reference signal within a measurement frequency bandwidth that is taken into consideration. The reference point of the RSRP is the antenna connector of the UE. Meanwhile, the RSRQ is defined as a ratio between the RSRP and a received Signal Strength Indicator (RSSI) as in Equation 1.
- [115] [Equation 1]
- [116]
- $$RSRQ = N \times \frac{RSRP}{RSSI}$$
- [117] In Equation 1, N is the number of resource elements of the carrier RSSI measurement bandwidth of a wireless access network. In Equation 1, measurement for a numerator and a denominator is performed on a set of the same resource blocks.
- [118] The RSSI includes a linear average of all reception powers. All the reception powers are measured only within an OFDM symbol including reference symbols within a measurement bandwidth and are values obtained over N resource blocks.
- [119] The report evaluation unit 1015 evaluates whether an actual measurement report is necessary. The report evaluation unit 1015 performs the evaluation on the basis of one or more flows of the first measurement results provided by the Layer 3 filter unit 1010. The report evaluation unit 1015 evaluates reporting criteria whenever at least new measurement result is reported by the Layer 3 filter unit 1010. The evaluation criteria may be given by RRC signaling.
- [120] Referring back to FIG. 10a, when a specific event is triggered, the UE transmits the first measurement result for the serving cell to a source BS at step S1005. This is called a measurement report. The first measurement result may include an RSRP or RSRQ for the serving cell. The measurement report may be periodically performed or may be aperiodically performed at the request of the source BS.
- [121] Thus, the source BS continues to detect a measurement result for a secondary serving cell which has been performed by the UE. Accordingly, if the UE is in a situation in which the UE has to perform handover, the source BS may know that the handover of the UE is close at hand from the measurement result.
- [122] The source BS configures a candidate cell list on the basis of the first measurement

results. Here, the first measurement results are result values determined to be valid by the source BS. The source BS transmits candidate cell lists, consisting of the first measurement results, to a target BS. Here, the validity may be determined, for example, by a reference time or by using a set reference value.

- [123] More specifically, if the first measurement results included in the candidate cell lists are determined not to be valid according to a lapse of a specific time, the source BS may transmit a measurement update indicator, instructing the UE to perform a measurement report again, to the UE at step S1010.
- [124] The measurement update indicator may have a form of physical layer signaling, a MAC message, or an RRC message.
- [125] For example, RRC signaling may be transmitted through a measurement report request message, including at least one of the index of a serving cell, a PCI, and a measurement object ID.
- [126] Meanwhile, physical layer signaling may indicate a measurement report request by using a bit defined in a DCI within a Physical Downlink Control Channel (PDCCH). For example, the measurement report request may be indicated by 1 bit (e.g., 0 (there is no measurement report request) or 1 (there is a measurement report request)).
- [127] Furthermore, MAC signaling transmits a Logical Channel ID (LCID), including a subheader indicating the measurement report request and bit information set as the measurement report request of an index corresponding to a serving cell within a MAC Control Element (CE).
- [128] Meanwhile, the measurement update indicator may also be called measurement configuration information. The measurement configuration information may be included in an RRC connection reconfiguration message and then transmitted.
- [129] When the measurement update indicator is received, the UE performs a measurement report in which second measurement results for respective serving cells, newly deduced up to now after the measurement update indicator was received, when a specific event is triggered to the source BS at step S1015. There may be several types of events that trigger the measurement report. For example, when the measurement result value of a neighbor cell is greater than or smaller than the measurement result value of a primary serving cell by a specific offset or the measurement result value of the primary serving cell is greater than or smaller than the measurement result value of the neighbor cell by the specific offset, an event may be trigger. For another example, when the measurement result value of a neighbor cell is greater than or smaller than the measurement result value of a secondary serving cell by a specific offset or the measurement result value of the secondary serving cell is greater than or smaller than the measurement result value of the neighbor cell by the specific offset, an event may be trigger.

- [130] The measurement report for all the serving cells may be performed through a primary serving cell configured in the UE. For example, if a first secondary serving cell, a second secondary serving cell, a third secondary serving cell, and a fourth secondary serving cell are configured in UE, a measurement report for all the secondary serving cells may be performed through a primary serving cell.
- [131] In an alternative embodiment, the measurement report for each of the secondary serving cells may be performed through the relevant secondary serving cell. For example, a measurement report for the first secondary serving cell may be performed through the first secondary serving cell, and a measurement report for the second secondary serving cell may be performed through the second secondary serving cell.
- [132] Meanwhile, when performing the measurement report, the UE may set the following pieces of information related to the measurement report. That is, in relation to a measurement ID measID whose measurement report has been triggered, the UE sets measurement results (e.g., a measurement ID (measID), a primary serving cell measurement result (MeasResultPcell), a secondary serving cell measurement result (MeasResultScell), and a serving cell frequency list (measResultServFreqList)) which are included in the measurement report message. Here, the primary serving cell measurement result includes the quantity measurement result (e.g., an RSRQ and an RSRP) of the primary serving cell. Furthermore, the measurement ID is set as a measurement ID whose measurement report has been triggered. The serving cell frequency list is set as a list of secondary serving cells configured in the UE within the secondary serving cell measurement result.
- [133] Meanwhile, if at least one applicable neighbor cell to be reported exists, the UE is configured to include the best neighbor cells on the basis of measurement report neighbor cell information (measResultNeighCells) up to a maximum report cell (maxReportCells). The measurement report neighbor cell information may include a physical cell ID.
- [134] Thus, the source BS can obtain the latest measurement result for the secondary serving cells now configured in the UE.
- [135] The source BS configures a new candidate cell list on the basis of the second measurement results at step S1020. For example, the candidate cell list may indicate a serving cell that may become a primary serving cell or a secondary serving cell in the target BS. Here, the primary serving cell may be a serving cell having the best measurement result or may be a serving cell that has been previously set by a system for the UE. Furthermore, an order of the secondary serving cells listed in the candidate cell list may be determined according to priority of a measurement result.
- [136] For example, the candidate cell list may be configured so that cells are arranged in decreasing orders from a cell having a great measurement result to a cell having a

small measurement result in accordance with a top-down method or may be configured so that cells are arranged in increasing orders from a cell having a small measurement result to a cell having a great measurement result in accordance with a bottom-up method. The candidate cell list may further include a measurement result for each serving cell.

[137] It is assumed that the second measurement results for the serving cells A, B, C, D, and E are given as in Table 2. Here, the measurement results are quantities, such as an RSRP or an RSRQ, and may be dB values.

[138] Table 2

[Table 2]

cell	measurement results (dB)
A	10
B	12
C	5
D	8
E	2

[139] Referring to Table 2, if the serving cells are arranged in accordance with the top-down method, it leads to B>A>D>C>E. Accordingly, a new candidate cell list according to the top-down method is given as in Table 3.

[140] Table 3

[Table 3]

candidate cell list/measurement results (dB)
Candidate CarrierFreq(CC) B = 12 dB
Candidate CarrierFreq(CC) A = 10 dB
Candidate CarrierFreq(CC) D = 8 dB
Candidate CarrierFreq(CC) C = 5 dB
Candidate CarrierFreq(CC) E = 2 dB

[141] The new candidate cell list by the source BS may be configured in a handover preparation process.

[142] The source BS transmits the new candidate cell list to the target BS at step S1025. Here, the new candidate cell list may be included in a handover request message through an X2 interface or may be transmitted separately from the handover request message.

[143] The candidate cell list transmitted from the source BS to the target BS may include a

value of a downlink center frequency for a relevant serving cell that is defined through RRC signaling between the source BS and the UE, Physical Cell ID (PCI) information, and so on.

- [144] Next, the source BS transmits validity criteria information to the target BS at step S1030. The validity criteria information provides a criterion on which the target BS determines the validity of the measurement results of the serving cells indicated in the candidate cell list.
- [145] For example, the validity criteria information may include absolute elapsed time information from a reference time. The absolute elapsed time information may mean an absolute time elapsed from the time when a measurement result for a specific serving cell was obtained from the UE.
- [146] For example, the absolute elapsed time information may inform that the time elapsed from the time when the measurement result for the first secondary serving cell was obtained is 10 ms and that the time elapsed from the time when the measurement result for the second secondary serving cell was obtained is 5 ms. Accordingly, the source BS or the target BS can check that how much time has elapsed from the time when a measurement result for a serving cell was obtained from the UE or check an elapsed time of the measurement result for the serving cell from the time when the measurement result was obtained from the UE, on the basis of the absolute elapsed time information.
- [147] In an alternative embodiment, the absolute elapsed time information may simply include time information. The time information may be information about an accurate time when the measurement result for the serving cell was obtained from the UE. For example, the time information may include information about an hour, a minute, and a sec (i.e., the time when the measurement result for the serving cell was obtained from the UE). The source BS or the target BS may precisely determine the time when the measurement result for the serving cell was obtained from the UE through the time information. Furthermore, the source BS or the target BS may determine an elapsed time of a measurement result from the time when the measurement result was first obtained, as compared with the present time.
- [148] In FIG. 10a, an example in which the validity criteria information is transmitted separately from the candidate cell list has been described at step S1030. The validity criteria information may be transmitted along with the candidate cell list. In this case, the candidate cell list and the validity criteria information may be configured as in Table 4.
- [149] Table 4

[Table 4]

candidate cell list/measurement results (dB)	elapsed time information (ms)
Candidate CarrierFreq(CC) A = a dB	20
Candidate CarrierFreq(CC) B = b dB	10
Candidate CarrierFreq(CC) C = c dB	15
Candidate CarrierFreq(CC) D = d dB	25
Candidate CarrierFreq(CC) E = e dB	5

- [150] Referring to Table 4, the elapsed time of the serving cell A is 20 ms, and the elapsed time of the serving cell B is 10 ms. Here, the elapsed time is indicated by ms, but it is only illustrative. For example, the elapsed time may be indicated by sec or any absolute time. The validity criteria information may be included in a handover request message.
- [151] For another example, the validity criteria information may include a validity indicator indicating that what secondary serving cell is valid or invalid for being configured in UE after handover. For example, if the source BS has transmitted the candidate cell list to the target BS, but the source BS determines that a specific secondary serving cell is inappropriate for a secondary serving cell after handover as a result of the update of measurement reports, such as that at steps S1010 and S1015, the validity indicator may indicate that the relevant secondary serving cell is not valid. To this end, the validity indicator may be configured in the form of a bitmap. In case of Table 4, the validity indicator may consist of 5 bits because the 5 secondary serving cells are configured in the UE. Each of the 5 bits corresponds to one secondary serving cell. When the bit is 0, it may indicate that a relevant secondary serving cell is valid, and when the bit is 1, it may indicate that a relevant secondary serving cell is invalid.
- [152] Serving cell-related information used in the source BS may be transmitted to the target BS. The serving cell-related information includes serving cell-related frequency information being used by the UE in the source BS. The target BS that has received the information about the serving cells knows the order of the serving cells. For example, if the target BS has received information about serving cells of a center frequency, corresponding to A, B, C, D, and E, in order of A, B, C, D, and E, assuming that the information is transmitted in order of A, B, C, D, and E when a validity indicator for the serving cells is configured in the form of a bitmap and transmitted, the information may be used as a criteria for determining whether the serving cells are valid.
- [153] The target BS determines a valid cell on the basis of the validity criteria information at step S1035. For example, it is assumed that the validity criteria information is elapsed time information. If an elapsed time of a measurement result regarding a

secondary serving cell is greater than a valid time, the target BS determines that the secondary serving cell is invalid and thus does not determine the secondary serving cell as a valid cell. On the other hand, if the elapsed time of the measurement result regarding the secondary serving cell is equal to or smaller than the valid time, the target BS determines that the secondary serving cell is valid and thus determines the secondary serving cell as a valid cell.

[154] For example, if a critical time is 18 ms in Table 4, elapsed times of measurement results for the secondary serving cells A and D are 20 ms and 25 ms. In this case, since each of 20 ms and 25 ms is greater than 18 ms, the secondary serving cells A and D are no longer valid. Accordingly, the target BS does not determine the secondary serving cells A and D as valid cells for the UE.

[155] Information about the critical time may be previously known to the source BS and the target BS, or the source BS may inform the target BS of the information about the critical time. In the latter case, the source BS may transmit the validity criteria information, including the information about the valid time, to the target BS. The elapsed time has been illustrated to be an absolute time, but may be a relative time. Accordingly, the target BS may optimally select the measurement result for the secondary serving cell in such a way as not to use information prior to a specific time.

[156] The procedure of the target BS determining the valid cell may be performed with it being included in a handover admission control procedure.

[157] Although not shown in FIG. 10a, a subsequent procedure may be performed as follows. The target BS may transmit a handover request ACK message to the source BS. The handover request ACK message may include a list of valid cells determined by the target BS. In this case, if handover resource allocation is not successful because the target BS does not have available resources, the target BS may transmit a handover preparation failure message to the source BS instead of the handover request ACK message. In response to the handover request ACK message, the source BS informs the UE of the start of handover by sending a handover command message.

[158] In response to the handover command message, the UE terminates access to the source BS to which the UE is now being accessed and then starts a process of accessing the target BS. The source BS transmits context, used by the UE in the source BS, to the target BS. In order to access the target BS, the UE performs an access operation related to a first layer and a second layer. The access operation related to the first layer and the second layer may include an operation, such as random access. The UE completes the access to the target BS and then switches to a state in which the UE can transmit and receive packet data.

[159] FIG. 11 is a flowchart illustrating a method of UE performing handover in a multiple component carrier system according to an example of the present invention.

- [160] Referring to FIG. 11, the UE transmits a first measurement result for each serving cell, deduced by obtaining a plurality of measurement samples through filtering in a physical layer level and performing filtering in a high layer level based on RRC configuration parameters for the plurality of measurement samples, to a source BS at step S1100. The first measurement result may include an RSRP or an RSRQ or the serving cell. The first measurement result may be periodically transmitted or may be aperiodically transmitted at the request of the source BS.
- [161] The UE receives a measurement update indicator, instructing to perform a measurement report again, from the source BS at step S1105. For example, if the source BS determines that a candidate cell list is invalid because the time when a measurement result included in the candidate cell list was obtained has elapsed, the source BS transmits the measurement update indicator, instructing to perform a measurement report again, to the UE. The measurement update indicator may have a form of physical layer signaling, a MAC message, or an RRC message.
- [162] For example, the RRC signaling may be transmitted through a measurement report request message, including at least one of the index of a serving cell, a PCI, and a measurement object ID.
- [163] Meanwhile, the physical layer signaling may indicate the measurement report request by using a bit defined in a DCI within a PDCCH. For example, the measurement report request may be indicated by 1 bit (e.g., 0 (there is no measurement report request) or 1 (there is a measurement report request)).
- [164] Furthermore, the MAC signaling transmits an LCID, including a subheader indicating the measurement report request and bit information set as the measurement report request of an index corresponding to a serving cell within an MAC CE.
- [165] In general, a measurement result regarding a secondary serving cell that is stored in the source BS may not be always new information. The measurement result may be no longer reliable owing to a reason, such as a lapse of a specific time. In this case, the measurement result related to the secondary serving cell may not help the target BS to determine a valid cell and, on the contrary, may hinder the target BS from determining an accurate valid cell. Accordingly, the source BS obtains the latest measurement result by using a measurement update indicator.
- [166] When the measurement update indicator is received, the UE transmits a second measurement result for each serving cell, newly deduced up to now since the measurement update indicator was received, to the source BS again at step S1110. Thus, the source BS can obtain the latest measurement result for the secondary serving cell now configured in the UE.
- [167] When handover preparation is completed, the UE receives a handover command message from the source BS at step S1115. Accordingly, the UE can terminate access

to the source BS and then perform access to a target BS at step S1120.

[168] FIG. 12 is a flowchart illustrating a method of a source BS performing handover in a multiple component carrier system according to an example of the present invention.

[169] Referring to FIG. 12, the source BS receives a first measurement result from UE at step S1200. If the first measurement result is determined to be no longer reliable owing to a reason, such as a lapse of a specific time, the source BS transmits a measurement update indicator, instructing to perform a measurement report again, to the UE at step S1205. The measurement update indicator may have a form of physical layer signaling, a MAC message, or an RRC message.

[170] Next, the source BS receives a second measurement result from the UE at step S1210. Each of the first and the second measurement results may include an RSRP or an RSRQ for a serving cell.

[171] The source BS configures a candidate cell list on the basis of the second measurement result at step S1215. The candidate cell list is a list providing a rank of the secondary serving cells each having a possibility that the secondary serving cell will be selected as a valid cell in a target BS. The rank of the secondary serving cells may be determined on the basis of the order of priority of measurement results. For example, the candidate cell list may be configured so that the secondary serving cells are arranged in order from a secondary serving cell having a great measurement result to a secondary serving cell having a small measurement result in accordance with a top-down method or may be configured so that the secondary serving cells are arranged in order from a secondary serving cell having a small measurement result to a secondary serving cell having a great measurement result in accordance with a bottom-up method. The candidate cell list may further include a measurement result for each secondary serving cell.

[172] For example, the configuration of a new candidate cell list by the source BS may be performed in a handover preparation process.

[173] The source BS transmits the candidate cell list to the target BS at step S1220. The candidate cell list may be transmitted through an interface (e.g., an X2 interface) between the source BS and the target BS. The candidate cell list may include a value of a downlink center frequency for a relevant serving cell that is defined through RRC signaling between the source BS and the UE, PCI information, and so on.

[174] The source BS configures validity criteria information and transmits the validity criteria information to the target BS at step S1225. The validity criteria information is information that provides criteria on which the target BS determines the measurement results for the secondary serving cells indicated in the candidate cell list are valid. For example, the validity criteria information may include information about an elapsed time from a reference time. For another example, the validity criteria information may

include a validity indicator indicating that what secondary serving cell is valid or invalid for being configured in the UE after handover.

- [175] Both the candidate cell list and the validity criteria information may be transmitted to the source BS as service state information. Here, the candidate cell list and the validity criteria information may be included in a handover request message transmitted from the source BS to the target BS.
- [176] Next, the source BS may receive a handover request ACK message (or a handover preparation failure message), including a list of valid cells determined by the target BS, from the target BS. The source BS may inform the UE of the start of handover by sending a handover command message to the UE and may perform the handover by sending context, used in the UE, to the target BS.
- [177] FIG. 13 is a flowchart illustrating a method of a target BS performing handover in a multiple component carrier system according to an example of the present invention.
- [178] Referring to FIG. 13, the target BS receives a candidate cell list from a source BS at step S1300. The candidate cell list has been configured by the source BS on the basis of a second measurement result received from UE, and the candidate cell list provides basic data that is necessary for the target BS to determine a valid cell to be configured in the UE. For example, the candidate cell list may indicate a serving cell that may become a primary serving cell or a secondary serving cell in the target BS. For example, the candidate cell list may be configured so that cells are arranged in order from a cell having a great measurement result to a cell having a small measurement result in accordance with a top-down method or may be configured so that cells are arranged in order from a cell having a small measurement result to a cell having a great measurement result in accordance with a bottom-up method. The candidate cell list may further include a measurement result for each serving cell.
- [179] Furthermore, the candidate cell list may be included in a handover request message through an X2 interface or may be transmitted separately from the handover request message.
- [180] Furthermore, the candidate cell list may include a value of a downlink center frequency for a relevant serving cell that is defined through RRC signaling between the source BS and the UE, PCI information, and so on.
- [181] The target BS receives validity criteria information from the source BS at step S1305. The validity criteria information is information providing criteria on which the target BS determines the validity of the measurement results for the serving cells indicated in the candidate cell list. The validity criteria information may include absolute elapsed time information from a reference time. The validity criteria information may include a validity indicator indicating that what secondary serving cell is valid or invalid for being configured in the UE after handover.

- [182] FIG. 13 shows that the candidate cell list and the validity criteria information are received at different time points, but this is only illustrative. The candidate cell list and the validity criteria information may be received with it included in one piece of service state information or may be received with it included in a handover request message.
- [183] The target BS determines a valid cell at step S1310. The valid cell may be determined according to the following method. For example, it is assumed that validity criteria information is elapsed time information. If an elapsed time of a measurement result for a secondary serving cell is greater than a valid time, the target BS determines that the secondary serving cell is not valid and thus determines the secondary serving cell as a valid cell. On the other hand, if the elapsed time of the measurement result for the secondary serving cell is equal to or smaller than the valid time, the target BS determines that the secondary serving cell is valid and thus determines the secondary serving cell as a valid cell. Information about the valid time may be previously known to the source BS and the target BS, or the source BS may inform the target BS of the information about the valid time. In the latter case, the source BS may transmit validity criteria information, including the information about the valid time, to the target BS. The elapsed time has been illustrated to be an absolute time, but may be a relative time. Accordingly, the target BS may optimally select the measurement result for the secondary serving cell in such a way as not to use information prior to a specific time.
- [184] When the valid cell is determined, the target BS transmits a handover request ACK message to the source BS at step S1315. The handover request ACK message may include a valid cell list indicating valid cells. If handover resource allocation is not successful because the target BS does not have available resources, the target BS may transmit a handover preparation failure message to the source BS instead of the handover request ACK message.
- [185] FIG. 14 is an explanatory diagram illustrating a scenario in which UE performs handover according to the present invention.
- [186] Referring to FIG. 14, at STEP 1, the UE 1410 is being accessed to an SeNB 1421, and CCs configured in the UE 1410 include CC1, CC2, and CC3. Here, the CC1 corresponds to a primary serving cell, and the CC2 and CC3 correspond to secondary serving cells. The UE 1410 performs measurement for the CC2 and CC3 and transmits the measurement results to the SeNB 1421 periodically or at the request of the SeNB 1421.
- [187] The SeNB 1421 may know that the UE 1410 requires handover on the basis of the measurement results. Accordingly, the SeNB 1421 configures a candidate cell list and validity criteria information at STEP 2. The CC2 and CC3 are arranged in order of CC3 and CC2 in the candidate cell list. The validity criteria information includes that

pieces of elapsed time information for the CC3 and CC2 are 10 ms and 20 ms.

- [188] When the candidate cell list and the validity criteria information are received, a TeNB 1422 determines a valid cell at STEP 3. If a valid time is 18 ms, the TeNB 1422 determines that the measurement result for the CC2 is not valid because the elapsed time of the CC2 is 20 ms which is greater than the valid time. In this case, the valid cell is only the CC3. The TeNB 1422 configures the CC1 corresponding to the primary serving cell and the CC3 corresponding to the secondary serving cell in the UE 1410. An example in which the primary serving cell is excluded from a validity criterion subject has been described in FIG. 14, but this is only illustrative. The primary serving cell, like the secondary serving cell, may become a validity criteria subject.
- [189] The TeNB 1422 may feed a valid cell list, indicating the valid cell CC3, back to the SeNB 1421. The UE 1410 may perform RRC reconfiguration for the CC3 according to the valid cell list determined by the TeNB 1422. In this state, when an activation indication is received from the TeNB 1422, the UE 1410 is finally changed into an activation state in which the UE 1410 can receive packets from the CC3.
- [190] FIG. 15 is a block diagram of UE 1530, a source BS 1500, and a target BS 1550 according to an example of the present invention.
- [191] Referring to FIG. 15, the source BS 1500 includes a source-side reception unit 1505, an update information generation unit 1510, a state information generation unit 1515, and a source-side transmission unit 1520.
- [192] The source-side reception unit 1505 receives a high layer message related to a handover procedure, such as a handover request ACK message, from the target BS 1550. Furthermore, the source-side reception unit 1505 receives a measurement result (e.g., a first measurement result or a second measurement result) from the UE 1530. The measurement result may include at least one of an RSRQ and an RSRP. Here, the UE 1530 may include the measurement unit 1000 of FIG. 10b, and the measurement and a report on the measurement result are performed by the measurement unit 1000.
- [193] The update information generation unit 1510 generates or configures a measurement update indicator. The measurement update indicator is information on which the source BS 1500 instructs the UE 1530 to perform a measurement report again in order to update a measurement result. The measurement update indicator may have a form of physical layer signaling, a MAC message, or an RRC message. The update information generation unit 1510 sends the measurement update indicator to the source-side transmission unit 1520.
- [194] For example, the update information generation unit 1510 may generate the measurement update indicator by adding the measurement update indicator to a measurement report request message of an RRC layer, including at least one of the index of a serving cell, a PCI, and a measurement object ID.

- [195] The update information generation unit 1510 may configure the measurement update indicator by using a bit defined in a DCI within a PDCCH.
- [196] Furthermore, the update information generation unit 1510 generates a subheader indicative of a measurement report request and bit information, set as the measurement report request of an index corresponding to a serving cell within a MAC CE, in an LCID.
- [197] The state information generation unit 1515 generates information elements (i.e., pieces of service state information, such as a candidate cell list providing a rank of secondary serving cells having possibilities that the secondary serving cells may be selected as valid cells in the target BS, the number of serving cells used in the source BS, UE capabilities, a maximum term average throughput, an validity criteria information). For example, the candidate cell list may be configured so that the secondary serving cells are arranged in order from a secondary serving cell having a great measurement result to a secondary serving cell having a small measurement result in accordance with a top-down method or may be configured so that the secondary serving cells are arranged in order from a secondary serving cell having a small measurement result to a secondary serving cell having a great measurement result in accordance with a bottom-up method. The candidate cell list may further include a measurement result for each secondary serving cell. For example, the validity criteria information may include elapsed time information from a reference time or may include a validity indicator indicating that a secondary serving cell is valid or invalid for being configured in UE after handover.
- [198] The state information generation unit 1515 may generate information of various forms, such as a physical layer signal, a MAC message, and an RRC message. In particular, the state information generation unit 1515 may generate a handover request message related to a handover procedure. The state information generation unit 1515 transmits the service state information to the source-side transmission unit 1520.
- [199] The source-side transmission unit 1520 transmits the measurement update indicator, received from the update information generation unit 1510, to the UE 1530 and transmits the service state information, such as the candidate cell list and the validity criteria information received from the state information generation unit 1515, to the target BS 1550.
- [200] The UE 1530 transmits a first measurement result for each serving cell, deduced by obtaining a plurality of measurement samples through filtering in a physical layer level by using the measurement unit 1000 of FIG. 10a and performing filtering in a high layer level based on RRC configuration parameters for the plurality of measurement samples, to the source BS 1500.
- [201] When the measurement update indicator is received from the source BS 1500, the UE

1530 transmits a second measurement result for each serving cell, newly deduced up to now since the measurement update indicator was received, to the source BS 1500 again.

[202] The target BS 1550 includes a target-side reception unit 1555, a valid cell criteria unit 1560, and a target-side transmission unit 1565.

[203] The target-side reception unit 1555 receives the service state information, such as the candidate cell list and the validity criteria information, from the source BS 1500 and transmits the service state information to the valid cell criteria unit 1560.

[204] The valid cell criteria unit 1560 determines a valid cell on the basis of a state of a secondary serving cell, indicated in the candidate cell list, and validity criteria information.

[205] For example, the validity criteria information includes elapsed time information about the measurement result of each secondary serving cell. For example, it is assumed that the validity criteria information is elapsed time information. If an elapsed time of a measurement result regarding a secondary serving cell is greater than a valid time, the valid cell criteria unit 1560 determines that the secondary serving cell is not valid and thus does not determine the secondary serving cell as a valid cell. On the other hand, if the elapsed time of the measurement result regarding the secondary serving cell is equal to or smaller than the valid time, the valid cell criteria unit 1560 determines that the secondary serving cell is valid and thus determines the secondary serving cell as a valid cell.

[206] For another example, the validity criteria information may include a validity indicator indicating whether what secondary serving cell is valid or invalid for being configured in the UE after handover. For example, if the source BS 1500 has transmitted the candidate cell list to the target BS 1550, but a specific secondary serving cell is determined to be invalid as a secondary serving cell after handover as a result of the update of a measurement report performed by the source BS, the validity indicator may indicate that the secondary serving cell is not valid. In this case, the valid cell criteria unit 1560 may determine only secondary serving cells that are indicated to be valid by the validity indicator as valid cells.

[207] The target-side transmission unit 1565 transmits a handover request ACK message, including a valid cell list indicating the valid cells determined by the valid cell criteria unit 1560, to the source BS 1500.

[208] If handover resource allocation is not successful because the target BS does not have available resources, the target-side transmission unit 1565 may transmit a handover preparation failure message to the source BS 1500 instead of the handover request ACK message.

[209] While the invention has been described in connection with what is presently

considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

- [Claim 1] User Equipment (UE) for performing a handover procedure in a multiple component carrier system, the UE comprising:
a measurement unit for obtaining measurement samples through filtering in a physical layer level and for deducing a first measurement result for each of serving cells by performing filtering in a high layer level based on Radio Resource Control (RRC) configuration parameters for the measurement samples;
wherein the UE transmits the first measurement results to a source Base Station (BS).
- [Claim 2] The UE of claim 1, wherein when a measurement update indicator is received from the source BS, the UE deduces a second measurement result for each of the serving cells and transmit the second measurement results to the source BS.
- [Claim 3] The UE of claim 2, wherein the measurement update indicator is received through one of physical layer signaling, a Media Access Control (MAC) message, and an RRC message.
- [Claim 4] The UE of claim 2, wherein each of the first measurement results and the second measurement results is Reference Signal Received Power (RSRP) or Reference Signal Received Quality (RSRQ).
- [Claim 5] A source BS for performing a handover procedure for UE in a multiple component carrier system, the source BS comprising:
a source-side reception unit for receiving a first measurement result for each of secondary serving cells, configured in the UE, from the UE;
a state information generation unit for generating a candidate cell list in which the secondary serving cells are arranged based on the first measurement results and for generating validity criteria information which is a criterion used to determine a validity of the first measurement results; and
a source-side transmission unit for transmitting the candidate cell list and the validity criteria information to a target BS.
- [Claim 6] The source BS of claim 5, further comprising an update information generation unit for generating a measurement update indicator to instruct the UE to perform a measurement report again,
wherein the source-side transmission unit transmits the measurement update indicator to the UE.
- [Claim 7] The source BS of claim 6, wherein the source-side reception unit

receives second measurement results from the UE in response to the measurement update indicator.

[Claim 8] The source BS of claim 5, wherein the validity criteria information indicates an elapsed time of each of the first measurement results from a reference time.

[Claim 9] The source BS of claim 5, wherein the validity criteria information comprises a validity indicator indicating whether each of the secondary serving cells is valid or invalid for being configured in the UE after handover.

[Claim 10] The source BS of claim 5, wherein the candidate cell list is configured so that the secondary serving cells are arranged in decreasing orders from a secondary serving cell having a great measurement result to a secondary serving cell having a small measurement result in accordance with a top-down method or is configured so that the secondary serving cells are arranged in increasing orders from a secondary serving cell having a small measurement result to a secondary serving cell having a great measurement result in accordance with a bottom-up method.

[Claim 11] The source BS of claim 5, wherein the candidate cell list comprises a value of a downlink center frequency for each of the secondary serving cells, defined through RRC signaling between the source BS and the UE, or physical cell ID information.

[Claim 12] A method of a source BS performing a handover procedure in a multiple component carrier system, the method comprising:
receiving a first measurement result for each of secondary serving cells, configured in UE, from the UE;
generating a candidate cell list in which the secondary serving cells are arranged based on the first measurement results;
generating validity criteria information which is a criterion used to determine a validity of the first measurement results; and
transmitting the candidate cell list and the validity criteria information to a target BS.

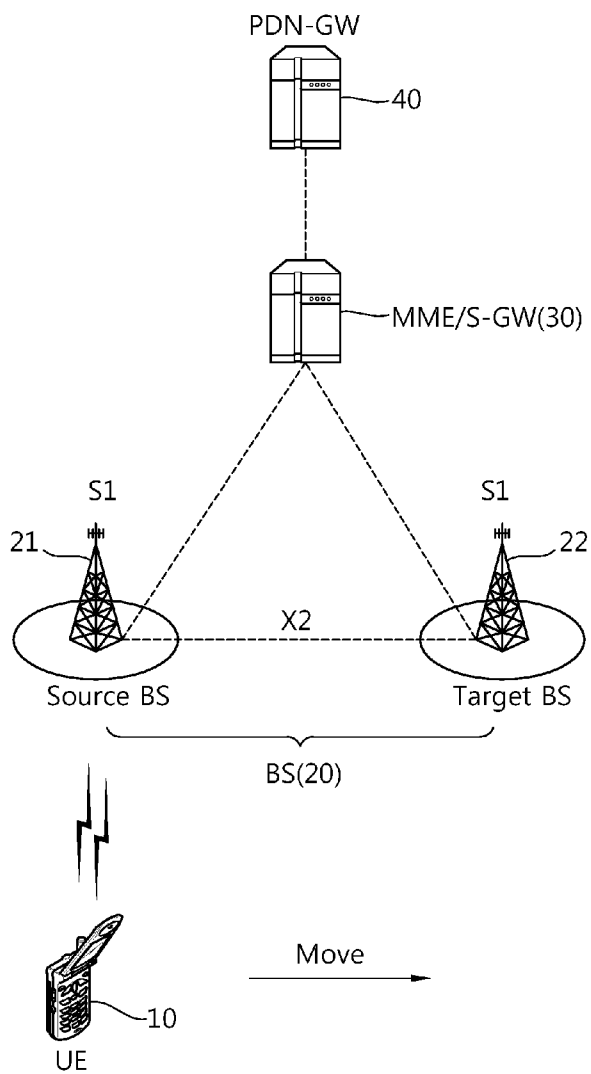
[Claim 13] The method of claim 12, further comprising:
generating a measurement update indicator instructing the UE to perform a measurement report again;
transmitting the measurement update indicator to the UE; and
receiving second measurement results from the UE in response to the measurement update indicator.

- [Claim 14] The method of claim 12, wherein the validity criteria information indicates an elapsed time of each of the first measurement results from a reference time.
- [Claim 15] A target BS for performing a handover procedure for UE in a multiple component carrier system, the target BS comprising:
a target-side reception unit for receiving, from a source BS, at least one of a candidate cell list in which secondary serving cells configured in the UE are arranged based on measurement results for the secondary serving cells and validity criteria information which is a criterion used to determine a validity of the measurement results;
a valid cell criteria unit for determining a valid cell based on the validity criteria information and states of the secondary serving cells indicated in the candidate cell list; and
a target-side transmission unit for transmitting a handover request ACK message, including the valid cell list indicating the determined valid cell, to the source BS.
- [Claim 16] The target BS of claim 15, wherein the validity criteria information indicates an elapsed time of each of the measurement results from a reference time.
- [Claim 17] The target BS of claim 16, wherein the valid cell criteria unit determines the secondary serving cell as the valid cell if the elapsed time is smaller than a valid time.
- [Claim 18] The target BS of claim 15, wherein the validity criteria information comprises a validity indicator indicating whether each of the measurement results is valid or invalid in determining the secondary serving cell regarding the UE after handover.
- [Claim 19] A method of a target BS performing a handover procedure in a multiple component carrier system, the method comprising:
receiving, from a source BS, a candidate cell list in which secondary serving cells configured in UE are arranged based on measurement results for the secondary serving cells;
receiving, from the source BS, validity criteria information which is a criterion used to determine a validity of the measurement results;
determining a valid cell based on the validity criteria information and states of the secondary serving cells indicated in the candidate cell list; and
transmitting a handover request ACK message, including a valid cell list indicating the determined valid cell, to the source BS.

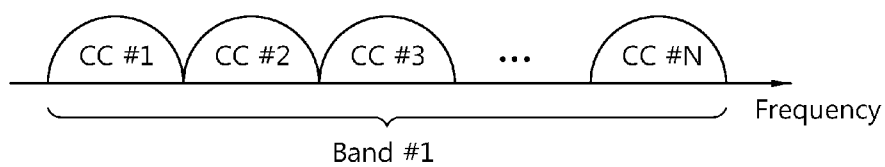
[Claim 20]

The method of claim 19, wherein the validity criteria information comprises a validity indicator indicating whether each of the measurement results is valid or invalid in determining the secondary serving cell regarding the UE after handover.

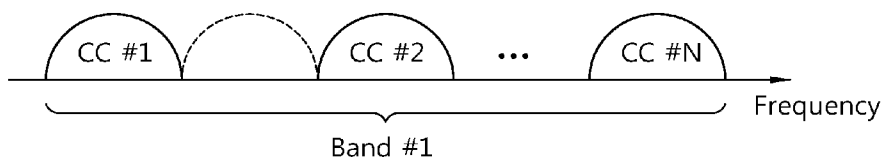
[Fig. 1]



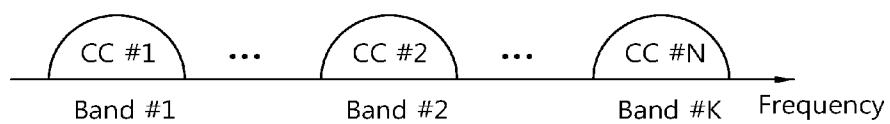
[Fig. 2]



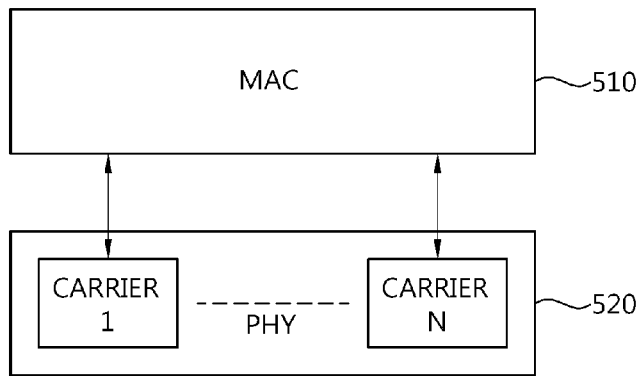
[Fig. 3]



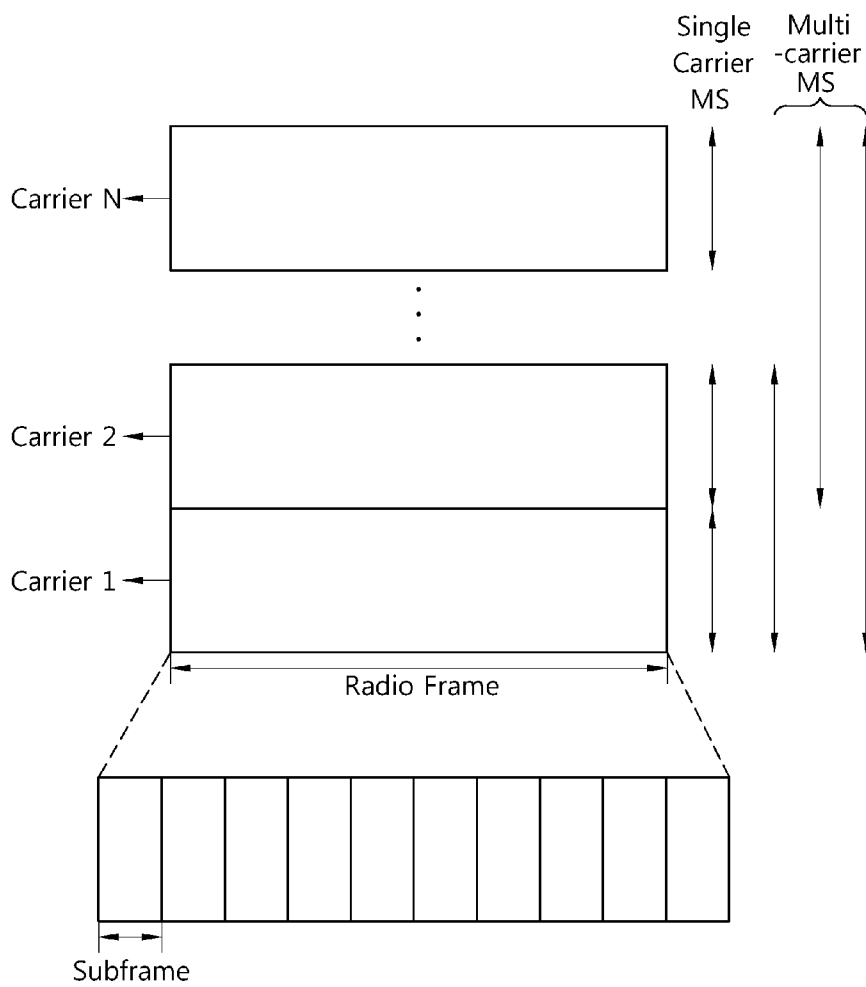
[Fig. 4]



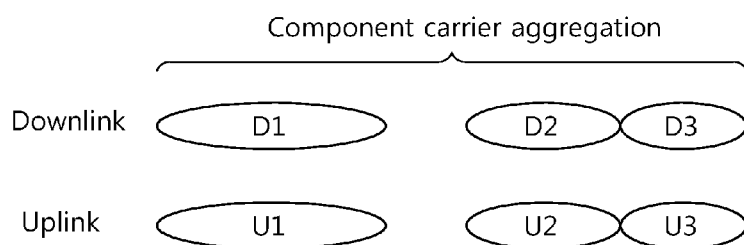
[Fig. 5]



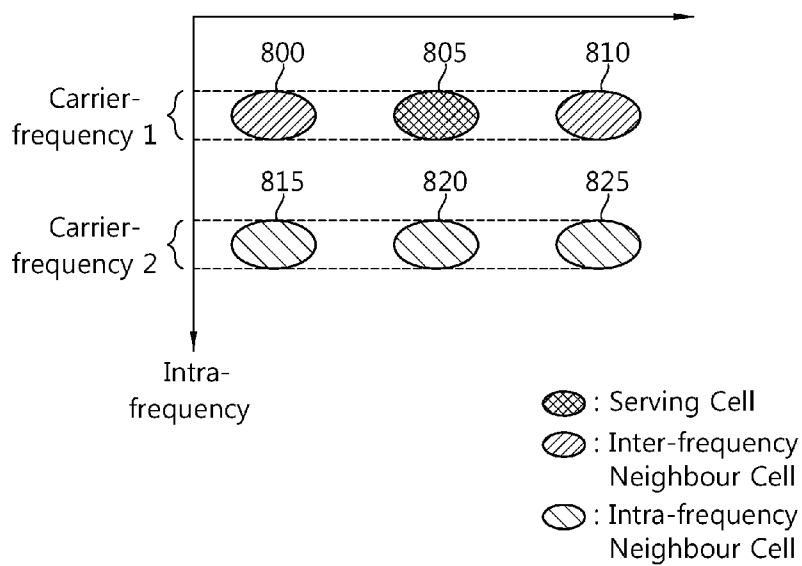
[Fig. 6]



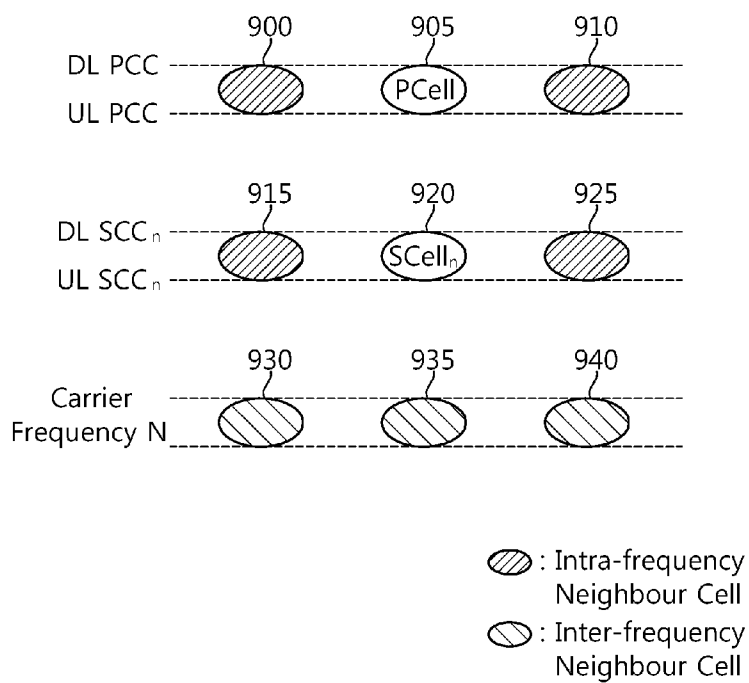
[Fig. 7]



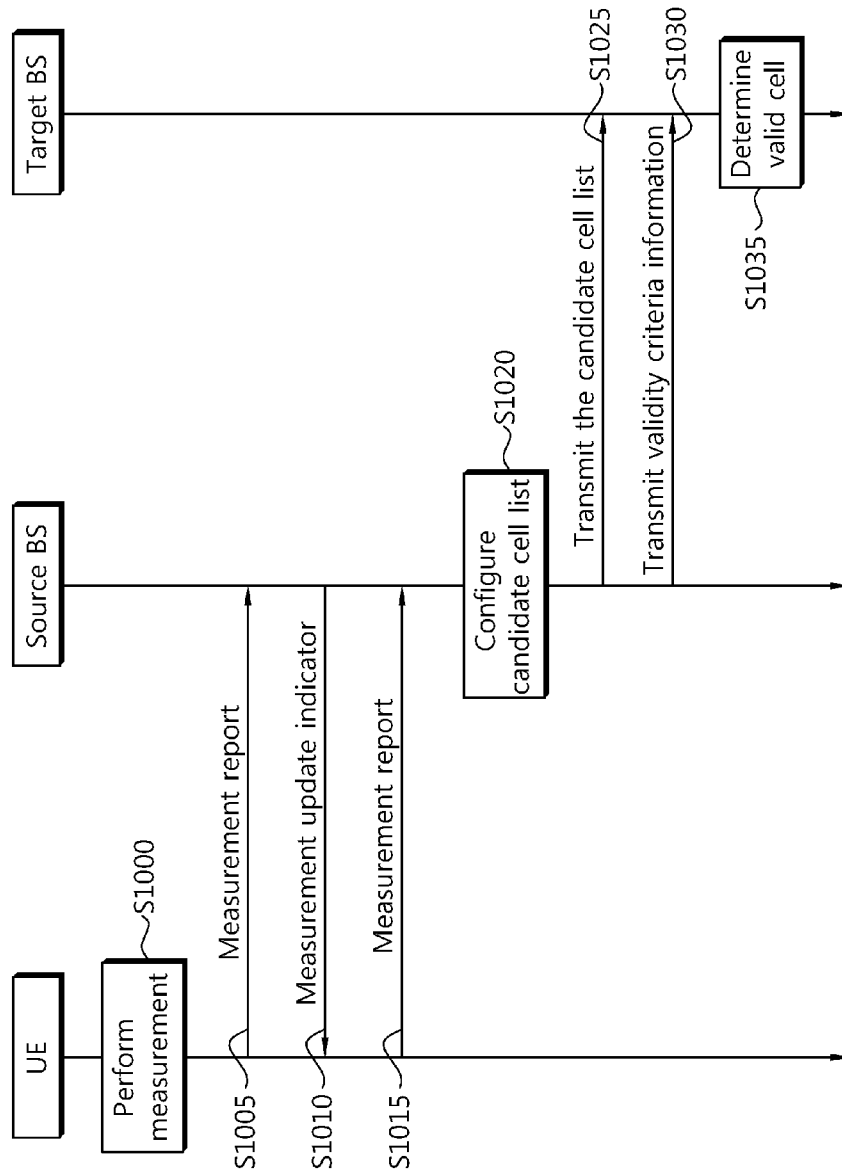
[Fig. 8]



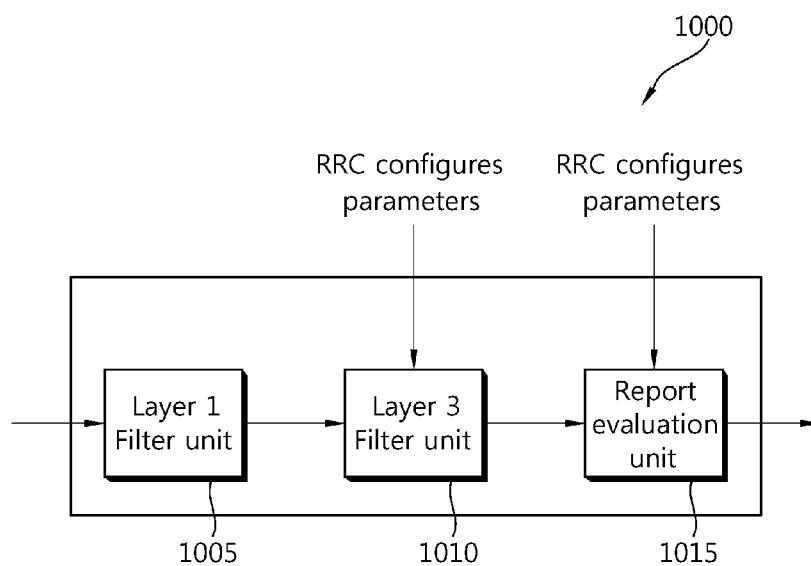
[Fig. 9]



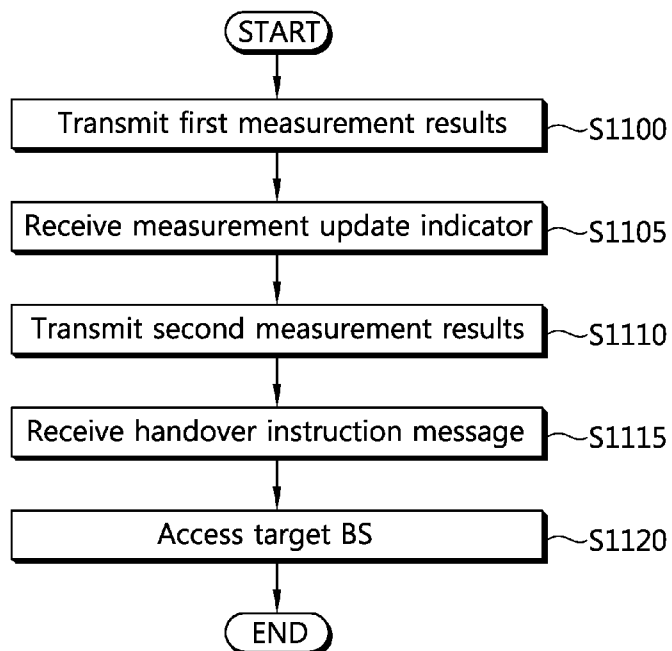
[Fig. 10a]



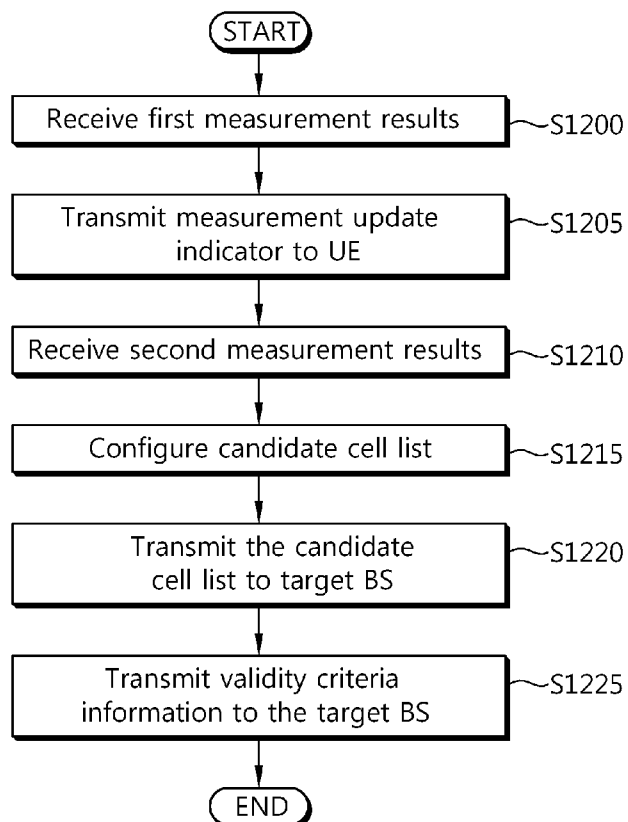
[Fig. 10b]



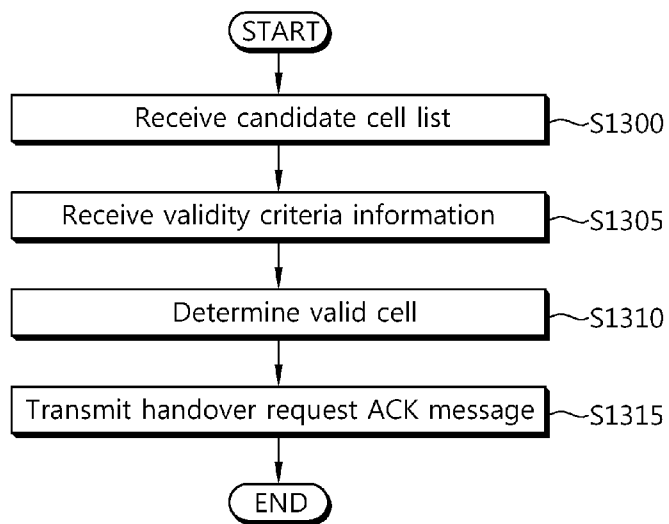
[Fig. 11]



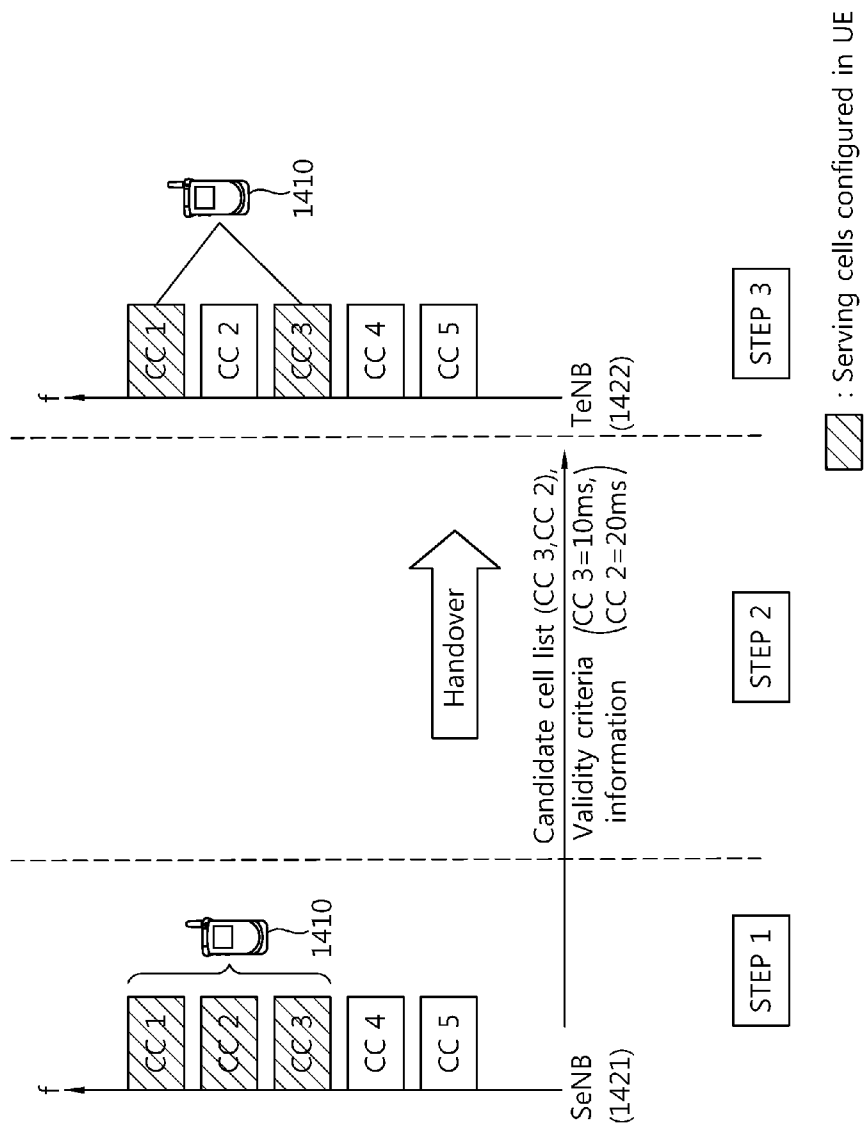
[Fig. 12]



[Fig. 13]



[Fig. 14]



[Fig. 15]

