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(54) **Title**: METHODS AND ARRANGEMENTS FOR PROVIDING PROPER SYSTEM INFORMATION AT CARRIER AGGREGATION IN A WIRELESS COMMUNICATION SYSTEM

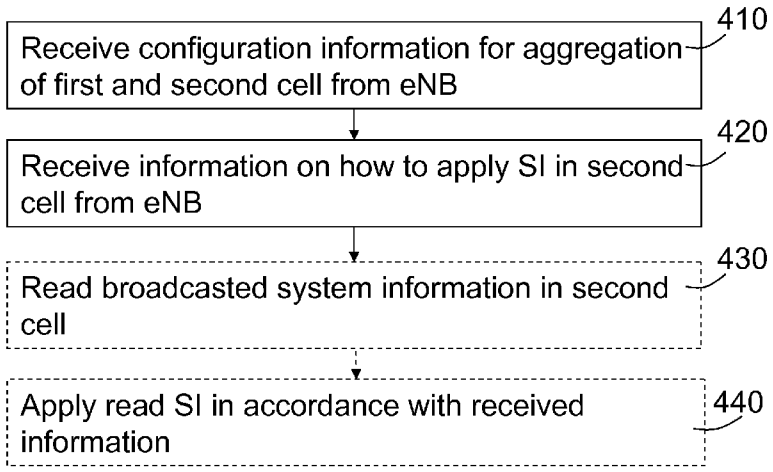

Fig. 4

(57) **Abstract**: The present invention relates to methods,a user equipment and a radio base station in a wireless communication system supporting carrier aggregation. The user equipment is configured to receive data from the radio base station in a first cell, and the radio base station is configured to broadcast system information comprising configuration parameters in the first and in a second cell. The method for the user equipment comprises receiving (410, 420) configuration information for an aggregation of the first and the second cell, and information on how to apply the system information broadcasted in the second cell from the radio base station. The method further comprises reading (430) the system information broadcasted in the second cell, and applying (440) the read system information in accordance with the received instruction.

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METHODS AND ARRANGEMENTS FOR PROVIDING PROPER SYSTEM INFORMATION AT CARRIER AGGREGATION IN A WIRELESS COMMUNICATION SYSTEM

TECHNICAL FIELD

The present invention generally relates to methods and arrangements in a wireless communication system supporting carrier aggregation. In particular it relates to methods and arrangements for transmitting and applying system information broadcasted in multiple aggregated cells.

BACKGROUND

The Universal Mobile Telecommunication System (UMTS) is one of the 3G mobile communication technologies designed to succeed GSM. 3GPP Long Term Evolution (LTE) is a project within the 3rd Generation Partnership Project (3GPP) to improve the UMTS standard to cope with future requirements in terms of improved services such as higher data rates, improved efficiency, and lowered costs. The Universal Terrestrial Radio Access Network (UTRAN) is the radio access network of a UMTS system and evolved UTRAN (E-UTRAN) is the radio access network of an LTE system. As illustrated in **Figure 1**, a radio access network typically comprises user equipment (UE) 150 wirelessly connected to radio base stations (RBS) 110a-c, commonly referred to as NodeB (NB) in UTRAN and eNodeB (eNB) in E-UTRAN.

E-UTRA according to Release 8 (Rel-8) of the 3GPP specifications supports bandwidths up to 20 MHz. However, one of the requirements of future releases of this standard is expected to be the support of bandwidths larger than 20 MHz. A further important requirement on such releases is to assure backward compatibility with Rel-8. This should also include spectrum compatibility. That would imply that a future-release carrier, wider than 20 MHz, should appear as a number of Rel-8 carriers to a Rel-8 UE. Each such carrier is sometimes referred to as a Component Carrier (CC). In particular for early deployments of future releases, it can be expected that there will be a smaller number of future-release UEs compared to many legacy Rel-8 UEs. Therefore, it is necessary to assure an efficient use of a wide carrier also for legacy UEs, i.e. that it is possible to implement carriers where legacy UEs can be scheduled in all parts of the wideband future-release carrier.

The straightforward way to obtain this would be by means of carrier aggregation. Carrier aggregation implies that a future-release UE can receive and send on multiple CCs,

where the CCs have, or at least have the possibility of having, the same structure as a Rel-8 carrier. Carrier aggregation is illustrated in **Figure 2a** where five CCs 210, each of 20 MHz bandwidth, have been aggregated together to form an aggregated bandwidth 220 of 100 MHz. Carrier aggregation is planned for Release 10 (Rel-10) of the 3GPP LTE specifications.

Carriers can be aggregated contiguously, as illustrated in **Figure 2a**, or they may be aggregated from discontinuous portions in the frequency domain (sometimes also called spectrum aggregation). **Figure 2b** illustrates schematically an example with non-contiguous carriers.

With the carrier aggregation concept, it may be possible to support, among other things:

- Higher bit-rates;
- Farming of non-contiguous spectrum – i.e. to provide high bit-rates and better capacity also in cases when an operator lacks contiguous spectrum;
- Fast and efficient load balancing between carriers.

The LTE carrier or spectrum aggregation has some similarities with concepts such as Dual or Multi Carrier (DC or MC) HSPA, where one or multiple carriers in UTRAN are combined.

It should be noted that carrier aggregation can be viewed as a UE-centric concept, in that one UE may be configured to use e.g. the two left-most CCs (230) in **Figure 2b**, another UE may be configured to use only a single CC such as the right-most CC (250) in **Figure 2b**, and a third UE may be configured to use all of the CC (230, 240, 250) depicted in **Figure 2b**. Thus, a UE may be configured with component carriers (CCs), on a carrier of a specific frequency within the same frequency band or within different frequency bands. Multiple uplink (UL) and downlink (DL) CCs are configured independently of each other, meaning that they are not necessarily configured as UL/DL pairs as in Rel-8/9 of the 3GPP LTE specifications. Asymmetric configurations are possible, where the number of configured UL CCs differ from the number of configured DL CCs.

Initially, the UE will be configured with one UL/DL CC pair on which it makes the initial random access. These CCs are called Primary Component Carriers (PCC). In addition to the UL/DL PCC pair, the eNB may configure the UE with additional CCs, so called

Secondary Component Carriers (SCC) as needed.

Conventionally, a carrier is a portion of the frequency spectrum that can be used for transmission in UL and/or DL. The notion of cell is normally used to denote the radio network object that can be uniquely identified by a UE. In UTRAN e.g. a cell is identified thanks to a cell identification that is broadcasted over a geographical area from one UTRAN access point. Typically, a cell is associated with a single pair of UL and DL carriers in FDD, and a single carrier that provides both UL and DL resources, if the mode is TDD. There may be multiple cells associated with one carrier, as long as the cells are physically separated from each other. This is the case e.g. when neighboring eNBs implement one cell each on the same carrier.

As already mentioned above, future releases of e-UTRAN introduces the support of a larger bandwidth or frequency spectrum, and for compatibility reasons the extra bandwidth may be seen as additional carriers of e.g. 20 MHz, so called component carriers (CC), that are aggregated together. However, by applying the notion of cell being the radio network object associated with a certain CC - a cell that may be identified by the UE - a UE using carrier aggregation in connected mode may also be referred to as being connected to multiple aggregated cells: one primary cell (referred to as PCC above, and for which notations such as PCell, primary serving cell and serving cell are also used), and additional configured CCs that are part of another set of secondary cells (referred to as SCC above, and for which notations such as SCell, secondary serving cell, and secondary cell are also used).

In LTE, many different scenarios and carrier types are being discussed, including the aggregation of Rel-8 backwards compatible carriers. Also non-backwards compatible and extension carriers are being discussed. Such carriers may not be available for Rel-8 terminals. A particular and relevant example of a plausible carrier aggregation scenario includes the case when two or more Rel-8 downlink carriers/cells, are aggregated for a UE. It should be noted that carrier aggregation is typically and mainly relevant for a connected UE, which is a UE that is actively involved in transmission to and from the eNB, and thus has a connection with the eNB controlling the aggregated carriers/cells.

The aggregated carriers/cells may thus also be available for Rel-8 UEs, meaning that each of the carriers/cells may be independently available for single-cell operation. Such a single-cell operation includes idle mode camping when the UE is typically inactive, and connected mode operation in single-cell mode. Therefore, these Rel-8 compatible

carriers/cells will have to provide System Information (SI) that is broadcasted in the cell, such that UEs may perform e.g. idle mode camping and cell selection according to the rules set by the parameters broadcasted in SI. Other sets of particular relevance that also must be broadcast in each of the Rel-8 carriers/cells are parameters related but not limited to:

- Random Access (RA), and RA channel (RACH) parameters, i.e. common parameters that define how a UE should access a cell;

- UL parameters, i.e. common parameters e.g. related to UL bandwidth, frequency, PUCCH (Physical Uplink Control Channel), and PUSCH (Physical Uplink Shared Channel);

- DL parameters, i.e. common parameters e.g. related to PFICH (Physical Control Format Indicator Channel), PDSCH (Physical Downlink Shared Channel), paging information, and DL frequency and bandwidth.

- Cell-specific timers and constants.

SI also includes e.g. sets of parameters related to cell and radio access technology (RAT) selection. "Common parameters" is used to denote parameters that many or all UEs in a cell are required to acquire according to specific rules in specifications. Such common parameters will typically be read and used by many UEs. Deviations from this general rule may be specified.

In Rel-8, the SI of relevance for a connected mode UE is distributed in the Master Information Block (MIB), and the first two System Information Blocks (SIB1 and SIB2). It may be specified that the UE should maintain updated information of this required SI, as specified in the 3GPP standard. When the SI changes the UEs are notified by different means, in order for them to re-acquire the required SI.

It is possible that also non-backwards compatible carriers/cells may be available for idle mode camping and single-cell operation. In this case these carriers/cells will also have to broadcast SI with sets of cell-specific parameters similar to the ones described above.

The DL of a cell will typically include broadcast of SI parameters that are relevant for this cell, including parameters of relevance both for the DL and the UL. Technically, it would be possible to, in addition to the aforementioned parameters, broadcast parameters

associated with a second cell on the DL of a first cell. However, such a solution may not be preferable, since the parameters associated with the second cell should then often also be broadcast on the DL of the second cell. This duplication is not desirable, and 3GPP has therefore agreed to, in Rel-10, not broadcast information related to a second cell on a first cell.

In a typical use-case, illustrated by the signaling diagram of **Figure 3a**, a UE 310 will first be connected to a single cell, also called the primary cell, following an RRC connection setup procedure 301 similar to those known from Rel-8. Only then, the eNB 320 may, based on different criteria, decide to configure the UE 310 for reception (DL) and transmission (UL) on multiple aggregated carriers/cells. This means that the eNB 320 may send a configuration message, typically an RRCConnectionReconfiguration message 302, including information about the additional UL and DL CCs that the UE is supposed to take into use. The UE replies to the configuration message, typically with an RRCConnection ReconfigurationComplete message 303.

Such a connected mode UE will now have knowledge of multiple UL and DL CCs, which may aggregate up to a very large bandwidth, and the UE is now ready to be scheduled on all of the CCs – sometimes on individual CC, and sometimes on all CC at the same time. Said in another way, the UE is now ready to be scheduled on the DL and/or the UL in all of the cells. There is now thus SI available on multiple DL CC or cells that the UE has been configured with. However, as described above, this required SI is of relevance also for UEs operating in single-cell mode, such as for Rel-8 UEs that lack the capability for carrier aggregation. It may happen that some of the SI that is of relevance for such single-cell operation is not valid, not useful, and possibly even harmful as it may result in unwanted restrictions to the flexibility of carrier aggregation operation, as will be further described below. There problem is thus that SI of relevance for single-cell operation is broadcasted in all cells in order to e.g. provide backwards compatibility, but when a cell should be used for carrier aggregation this single-cell SI is not optimal.

Assuming now the example above, where a UE has first been connected to one cell – the primary cell – that includes both a configuration of a DL and an UL, and that the UE is configured to aggregate one additional DL carrier of a secondary cell. Assuming further that SI of relevance to the DL carriers is broadcasted in both the primary and the secondary cell. However, as noted above, the SI broadcasted on each of the cells will provide SI of relevance also for single-carrier operation. Thus, the SI broadcasted in the

secondary cell will include information about a corresponding UL configuration, including e.g. UL bandwidth and frequency, RACH, PUCCH and PUSCH parameters. Thus, if the UE operating with multiple aggregated carriers is required to read and follow the SI broadcasted in both the primary and the secondary cell, it will result in a situation where the UE by necessity also configures all the corresponding parameters for single-cell operation.

In the following example, an RBS is in control of three UL and DL carriers in three cells, here denoted UL1/DL1/cell1, UL2/DL2/cell2, and UL3/DL3/cell3. When operated in single-cell mode, the carriers are coupled such that UL1 is operated together with DL1, UL2 with DL2, and UL3 with DL3, respectively. Thus, any SI of relevance for ULx/DLx is broadcasted on cellx, as illustrated in **Figure 2c**. Note that the example does not rule out that ULx is on the same frequency as DLx, which is the case for a TDD mode.

It is assumed that a UE is connected to the cell2 defined by DL2, i.e. the UE 310 follows known Rel-8 procedures, reads required SI on DL2, and uses UL2 for UL transmissions (state 304 in signaling diagram of **Figure 3b**). Furthermore, the eNB 320 now wants to configure the UE 310 with two additional DL carriers, since the eNB concludes that the UE needs a larger DL bandwidth. The eNB sends a configuration message in 305 including information that the UE may additionally use DL1 in cell1 and DL3 in cell3, in addition to the already existing DL2. However, if the UE now reads the required SI broadcasted in cell1 and cell3 as well, following existing art, the UE will take also the corresponding UL configurations into use, i.e. UL1 and UL3. This was clearly not desirable, as the eNB only found reasons to aggregate DL carriers in this case, and not to configure the UE with additional UL bandwidth that greatly exceeds the needs of the UE. Thus, existing art provides inflexibility, in that SI of relevance for single-cell operation may be too restrictive for carrier aggregation operation.

Another example concerns e.g. the Random Access (RA) configuration. Assume now that the UE has been configured with two aggregated cells in both UL and DL, say UL1/DL1 in cell1 and, UL2/DL2 in cell2. The SI parameters concerning carrier frequency and bandwidth broadcasted on both the cells are in this case of relevance. However, both cell's SI include RA parameters, offering the UE a possibility to perform RA on both of the UL carriers. It may be that the eNB wants to constrain the UE to perform RA only on one particular of the available ULs. With present art, this is not possible, since the UE will read SI comprising RA parameters on both cells and thus perform RA on both ULs.

A further example concerns e.g. PUCCH control. It has recently been agreed that it shall be possible to provide all PUCCH control information on one single UL carrier, regardless of how many UL and DL carriers that are configured for a UE. In the examples illustrated above, each cell will provide independent PUCCH parameters. However, the UE should only follow PUCCH parameters broadcasted on one of the cells.

Yet another example concerns timers and constants. Each of the aggregated cells may provide independent timer and constant values that might be different in value. However, the timers and constants may not be relevant per cell, but rather per UE. A UE may e.g. maintain only a single timer t1 that expires when the value T1 is reached, but SI on all the cells is offering different values for this T1, and it is unclear which one of the values that the UE should apply.

SUMMARY

It is therefore an object of the embodiments of the present invention to address the above mentioned problems, and to provide a flexible solution for how to apply system information broadcasted on multiple aggregated cells in a wireless communication system supporting carrier aggregation. This object and others are achieved by the methods and devices according to the independent claims, and by the embodiments according to the dependent claims.

In accordance with a first aspect of embodiments of the present invention, a method for a user equipment in a wireless communication system supporting carrier aggregation is provided. The user equipment is configured to receive data from a radio base station in a first cell, and the radio base station is configured to broadcast system information comprising configuration parameters in the first and a second cell. The method comprises receiving configuration information for an aggregation of the first and the second cell from the radio base station, as well as information on how to apply the system information broadcasted in the second cell from the radio base station.

In accordance with a second aspect of embodiments of the present invention, a method for a radio base station in a wireless communication system supporting carrier aggregation is provided. The radio base station is configured to transmit data to a user equipment in a first cell. The method comprises broadcasting system information comprising configuration parameters in the first and in a second cell, and transmitting configuration information for an aggregation of the first and second cells to the user

equipment. It also comprises transmitting information on how to apply the system information broadcasted in the second cell to the user equipment.

In accordance with a third aspect of embodiments of the present invention, a user equipment configured to be used in a wireless communication system supporting carrier aggregation is provided. The user equipment is also configured to receive data from a radio base station in a first cell, and system information comprising configuration parameters is broadcasted in the first and a second cell by the radio base station. The user equipment comprises a receiving unit adapted to receive configuration information for an aggregation of the first and the second cell, and information on how to apply the system information broadcasted in the second cell from the radio base station.

In accordance with a fourth aspect of embodiments of the present invention, a radio base station configured to be used in a wireless communication system supporting carrier aggregation, and to transmit data to a user equipment in a first cell is provided. The radio base station comprises a broadcasting unit adapted to broadcast system information comprising configuration parameters in the first and in a second cell. It also comprises a transmitting unit adapted to transmit configuration information for an aggregation of the first and second cells, and information on how to apply the system information broadcasted in the second cell to the user equipment.

An advantage of embodiments of the present invention is that they allow carrier aggregation in a flexible way, such that configuration information that is common to both single-cell operation and carrier aggregation operation is read and obeyed by all UEs, but where additional parameters and rules are provided for UEs operating in carrier aggregation mode.

Another advantage of embodiments of the present invention is that they provide a lean way of signaling, such that the overhead in signaling can be minimized.

A further advantage of embodiments of the present invention is that it is possible to configure a UE specific, asymmetric UL & DL configuration, where each UL and DL pair corresponds to Rel-8 backwards compatible cells.

Still another advantage of embodiments of the present invention is that it makes it possible to control e.g. the RACH selection and pooling in carrier aggregation mode, such that a UE can be assigned a particular RACH resource, even if SI in the multiple

aggregated cells provide different sets of RACH resources, primarily intended for single-cell use.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates schematically a conventional radio access network wherein the present invention may be implemented.

Figures 2a-b illustrate schematically carrier aggregation.

Figure 2c illustrates schematically example uplink and downlink carriers and the corresponding system information flow.

Figures 3a-b illustrate signaling diagrams for the RRC connection reconfiguration procedure.

Figure 4 is a flowchart of the method in the user equipment according to embodiments of the present invention.

Figure 5 is a flowchart of the method in the radio base station according to embodiments of the present invention.

Figures 6a-b illustrate schematically a block diagram of a UE and a UE control unit respectively, according to embodiments of the present invention.

Figures 7a-b illustrate schematically a block diagram of an eNB and a eNB control unit respectively, according to embodiments of the present invention.

Figure 8 illustrates schematically a block diagram of a UE and an eNB according to embodiments of the present invention.

DETAILED DESCRIPTION

In the following, the invention will be described in more detail with reference to certain embodiments and to accompanying drawings. For purposes of explanation and not limitation, specific details are set forth, such as particular scenarios, and techniques, in

order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details.

Moreover, those skilled in the art will appreciate that the functions and means explained herein below may be implemented using software functioning in conjunction with a programmed microprocessor or general purpose computer, and/or using an application specific integrated circuit (ASIC). It will also be appreciated that while the current invention is primarily described in the form of methods and devices, the invention may also be embodied in a computer program product as well as in a system comprising a computer processor and a memory coupled to the processor, wherein the memory is encoded with one or more programs that may perform the functions disclosed herein.

The embodiments of the present invention are described herein by way of reference to particular example scenarios. In particular embodiments of the invention are described in a non-limiting general context in relation to an E-UTRAN. It should though be noted that the invention and its embodiments may also be applied to other types of radio access networks configured to use carrier aggregation. It should be noted that the notation and terminology used in the description may change and does by no means restrict the applicability of embodiments of the present invention.

In embodiments of the present invention, the problem that system information (SI) broadcasted in the cells of a wireless communication system is not adapted for a UE that operates in a carrier aggregation mode, is addressed by a solution where a UE, when it is configured by the eNB to aggregate two cells, receives information from the eNB on how to apply the SI broadcasted in the second aggregated cell. The information may also include configuration parameters that override or replace SI parameters broadcasted in the second cell. Particular embodiments include:

- A solution based on a dedicated message that configures the UE to read system information in a UE specific way.

- A solution where system information parameters are provided with dedicated signaling, such that the parameters provided with dedicated signaling overrides the parameters read from broadcast system information.

- A solution where system information contains multiple set of parameters, where

one set is of relevance for single cell operation, and a second set is applicable for multi-carrier operation, where the second set overrides the first set of parameters, if the second set is present on the broadcast channel.

- A solution where a UE is requested to not follow any of the system information provided on a particular DL carrier, and where all the relevant information is provided with dedicated signaling.

- A solution where multiple downlink carriers carry the same system information parameters, but where the UE is instructed, or controlled to follow only one of the sets broadcasted on one special carrier.

According to embodiments of the present invention, the eNB is configured to broadcast SI that comprises a set of configuration parameters, and to transmit information, to a UE operating in carrier aggregation mode, which releases the UE of applying at least some of the parameters in the set of configuration parameters that are broadcasted. When a UE, that is configured to receive data and read SI in a first cell, is further configured by the eNB to aggregate the first cell with a second cell, the UE is informed by the eNB on how it should apply the broadcasted SI in the second cell. The eNB may in one embodiment instruct the UE to follow, i.e. read and apply, SI from only the first cell. Further embodiments of the eNB, may comprise the following embodiments implemented either each one by itself or in combination with other embodiments:

- The information transmitted to the UE operating in carrier aggregation mode is broadcasted or received as dedicated information;

- The information transmitted to the UE operating in carrier aggregation mode comprises configuration parameters that override or replace at least some of the SI configuration parameters;

A basic concept of embodiments of the present invention is thus to provide a method of reading, applying and overriding SI configuration parameters of relevance for single cell operation, such that an eNB can configure the UE to read and apply SI configuration parameters in a UE specific way, when it is operating in carrier aggregation mode.

Details of embodiments of the present invention are illustrated using the aforementioned example, where an eNB is in control of three UL and DL carriers in three cells, here denoted UL1/DL1/cell1, UL2/DL2/cell2, and UL3/DL3/cell3. The DL carriers provide SI of

relevance for each DL & UL pair, such that ULx is configured in the SI provided on DLx in cellx. A UE is establishing a connection to the cell defined by the SI on a first DL carrier (e.g. cell1 and DL1), i.e. after the establishment, the UE is prepared to send and receive (i.e. to be scheduled) on UL1 and DL1, respectively. The eNB now configures the UE to also use DL2 in cell2, typically by sending the dedicated RRCConnectionReconfiguration message, comprising configuration information for an aggregation of cell1 and cell2 and thus including information about the additional DL2 and cell2 that the UE is supposed to take into use.

There are two alternative embodiments of the present invention, denoted embodiment A and B, which are described hereinafter with reference to the example scenario described above. According to embodiment A of the present invention, the eNB may send a dedicated configuration message to the UE, which configures the UE to read and apply SI broadcasted in cell1 and cell2 in a UE specific way. The dedicated configuration message thus comprises information on how to apply SI broadcasted in cell2.

The dedicated configuration message may be the same message as the one used for transmitting configuration information for the aggregation of cell1 and cell2, and may e.g. be the RRC Connection Reconfiguration message. The message thus includes configuration parameters of relevance for DL2 and cell2, such that the UE, after receiving the configuration message, is prepared to receive data also on DL2, and information related to the relevance of SI broadcasted on cell2. The information related to the relevance of SI broadcasted on cell2, may in a first alternative embodiment comprise an instruction to obey (or apply) some of the parameters and related functionality read in the SI broadcasted on cell2, and to not obey others. In a second embodiment the information may comprise an instruction to the UE to apply or not apply SI broadcasted on cell2. In a third embodiment the information related to the relevance of SI broadcasted on cell2 may comprise configuration parameters that override or replace the configuration parameters read in the SI broadcasted on cell2. The third embodiment may be combined with either the first or the second embodiment.

In one embodiment, even if there is SI available on DL2 in cell2, the UE may be instructed not to read and apply the SI on DL2 in cell2. Alternatively, the UE may be instructed to apply only parts of the SI on DL2, e.g. to not apply the parameters that configures the UL2. An advantage of this embodiment is that it is possible to configure a UE specific, asymmetric UL & DL configuration, where each UL and DL pair corresponds to Rel-8

backwards compatible cells.

In another embodiment, the information related to the relevance of the SI broadcasted on cell2 comprises information related to the RACH configuration. In particular, the information may include an instruction to not apply the RACH configuration provided in SI on cell2. Alternatively, the information may include RACH parameters that override the configuration parameters provided in SI on cell2. This embodiment makes it possible to control the RACH selection and pooling, such that a UE can be assigned a particular RACH resource, even if SI in multiple cells provide different sets of RACH resources, where the RACH configuration provided in the SI is primarily intended for single-cell use.

According to embodiment B of the present invention, also explained with reference to the aforementioned example, the information on how to apply the SI broadcasted in cell2 is broadcasted together with the SI, instead of transmitted in a dedicated message as in embodiment A. The SI broadcasted in cell2 thus comprises configuration parameters of relevance for single cell operation, and in addition, the SI comprises at least one of:

- Information if all or parts of the SI is valid or not valid for a UE operating in carrier aggregation mode.
- A set of configuration parameters that are of relevance for a UE operating in carrier aggregation mode, where the set of parameters overrides the corresponding parameters being broadcast for single cell operation.
- Information if a UE operating in carrier aggregation mode shall obey or not obey all or parts of the SI parameters broadcasted in cell2.

Both embodiment A and B of the present invention may be used for adapting e.g. RACH, PUCCH and/or PUSCH parameters in SI to a carrier aggregation situation. Other parameters may also be considered such as timers and constants.

Figure 4 is a flowchart of the method of the UE in a wireless communication system supporting carrier aggregation, according to one embodiment of the present invention. The UE is configured to receive data from an RBS in a first cell, i.e. the primary cell. In this embodiment the RBS is an eNB. The eNB is configured to broadcast SI comprising configuration parameters in both the first primary cell and in a second cell. The method illustrated in the flowchart comprises the following steps:

- 410: Receive configuration information for an aggregation of the first and the second cell from the eNB. In this embodiment only two cells are aggregated (one primary and one secondary cell) but it is also possible that more than two cells are aggregated (one primary and several secondary cells). The configuration information is typically comprised in an RRCConnectionReconfiguration message, comprising information about the two cells that the UE may aggregate.

- 420: Receive information on how to apply the SI broadcasted in the second cell from the eNB. In the first alternative embodiment (also described above) the received information comprises an instruction to apply only a part of the configuration parameters in the SI broadcasted in the second cell, and the method further comprises step 430 and 440 below.

- 430: Read the SI broadcasted in the second cell.

- 440: Apply the read SI in accordance with the received instruction.

In the second alternative embodiment described above, the received information comprises an instruction to not apply SI broadcasted in the second cell, which means that the UE will not read and apply any SI in that secondary cell.

In any of these first and second embodiments, the received information may also comprise one or more configuration parameters that replace a corresponding configuration parameter in the SI broadcasted in the second cell, according to the third embodiment described above. It may e.g. be a configuration parameter that corresponds to a parameter in the SI from the second cell that the UE is instructed not to apply.

In one embodiment, denoted embodiment A above, the information on how to apply the SI broadcasted in the second cell is received in a dedicated message, e.g. in the RRCConnectionReconfiguration message which also comprises the configuration information as described in 410 above. In the alternative embodiment B, the information is received in a broadcast message together with the SI broadcasted in the first or the second cell.

Figure 5 is a flowchart of the method of the RBS, in a wireless communication system supporting carrier aggregation. The RBS is in this embodiment an eNB in an E-UTRAN. The eNB is configured to transmit data to a user equipment in a first cell. The method illustrated in the flowchart comprises the following:

- 510: Broadcast SI comprising configuration parameters in the first and in a second cell. The SI broadcasted in a cell comprises configuration parameters relevant for that cell.

- 520: Transmit configuration information for an aggregation of the first and second cells to the UE. The configuration information is typically comprised in an RRCConnectionReconfiguration message, comprising information about the two cells that the UE may aggregate.

- 530: Transmit information on how to apply the system information broadcasted in the second cell to the user equipment.

In analogy with the method of the eNB, the transmitted information comprises in the first alternative embodiment an instruction to apply only a part of the configuration parameters in the SI broadcasted in the second cell. In the second alternative embodiment, the transmitted information comprises an instruction to not apply SI broadcasted in the second cell, which means that the UE will not read and apply any SI in that cell.

Furthermore, in any of these embodiments, the transmitted information may also comprise one or more configuration parameters that replace a corresponding configuration parameter in the SI broadcasted in the second cell, according to the third embodiment. It may e.g. be a configuration parameter that corresponds to a parameter in the SI from the second cell that the UE is instructed not to apply.

In embodiment A, the information on how to apply the SI broadcasted in the second cell is transmitted in a dedicated message, e.g. in the RRCConnectionReconfiguration message which also comprises the configuration information as described in 520 above. In alternative embodiment B, the information is transmitted in a broadcast message in one or both of the cells together with the SI.

Figure 6a is a simplified block diagram of the UE 150 according to embodiments of the present invention, and discloses an antenna connected to a transceiver unit 61, that forwards control information received in the DL to a control unit 62. The control unit 62 comprises a SI Unit that controls the operation of the UE in accordance with the SI received. It also comprises a Further Information Unit that controls the operation of a UE in carrier aggregation operation in accordance with the received further information on how to apply the SI broadcasted in the second cell. The control unit 62, the Further

Information Unit and the SI Unit may be implemented as hardware, software or a combination of the two.

Figure 6b is a block diagram illustrating the control unit 62 as implemented in a combination of hardware and software according to embodiments of the present invention. It comprises a processor unit 620, and interface 624 to the transceiver units. Furthermore the control unit 62 comprises at least one computer program product 621 in the form of a non-volatile memory, e.g. an EEPROM, a flash memory and a disk drive. The computer program product 621 comprises a computer program, which comprises code means which when run on the processor unit 620 causes the processor unit 620 to perform the steps of the procedures or methods described earlier in conjunction with **Figure 4**.

Figure 7a is a simplified block diagram of the eNB according to embodiments of the present invention, and discloses a transceiver unit 71, connected to an antenna, and controlled by a control unit 72, that among other controls what control information that is transmitted from the transceiver 71. The control unit 72 comprises a SI Unit that controls the SI broadcasted. It also comprises a Further Information Unit that controls information sent to a UE in carrier aggregation operation. The control unit 72, the Further Information Unit and the SI Unit may be implemented as hardware, software or a combination of the two.

Figure 7b is a block diagram illustrating the control unit 72 as implemented in a combination of hardware and software according to embodiments of the present invention. It comprises a processor unit 720, and interface 724 to the transceiver units. Furthermore the control unit comprises at least one computer program product 721 in the form of a non-volatile memory, e.g. an EEPROM, a flash memory and a disk drive. The computer program product 721 comprises a computer program, which comprises code means which when run on the processor unit 720 causes the processor unit 720 to perform the steps of the procedures described earlier in conjunction with **Figure 5**.

The UE 150 and the eNB 110 are also schematically illustrated in **Figure 8,** according to embodiments of the present invention. The UE 150 is configured to be used in a wireless communication system supporting carrier aggregation, and to receive data from the eNB 110 in a first cell. The eNB 110 is configured to broadcast SI comprising configuration parameters in the first and a second cell. The UE comprises a receiving unit 151 adapted to receive configuration information for an aggregation of the first and the second cell from

the eNB. The receiving unit 151 is further adapted to receive information on how to apply the SI broadcasted in the second cell from the eNB. The eNB 110 correspondingly comprises a broadcasting unit 111 adapted to broadcast SI comprising configuration parameters in the first and in the second cell. It also comprises a transmitting unit 112 adapted to transmit configuration information for an aggregation of the first and second cells, and information on how to apply the system information broadcasted in the second cell to the user equipment.

In the first alternative embodiment the information on how to apply the SI broadcasted in the second cell comprises an instruction to apply only a part of the configuration parameters in the SI broadcasted in the second cell, and the UE further comprises a reading unit 152 adapted to read the SI broadcasted in the second cell, and an applying unit 153 adapted to apply the read SI in accordance with the received instruction.

In the second alternative embodiment, the information comprises an instruction to not apply SI broadcasted in the second cell, which means that no reading and applying unit is needed in the UE. In any of these first and second embodiments, the information may also comprise one or more configuration parameters that replace a corresponding configuration parameter in the SI broadcasted in the second cell, according to the third embodiment. It may e.g. be a configuration parameter that corresponds to a parameter in the SI from the second cell that the UE is instructed not to apply.

In embodiment A, the information on how to apply the SI broadcasted in the second cell is transmitted/received in a dedicated message. In alternative embodiment B, the information is transmitted/received in a broadcast message together with the SI broadcasted in the first or the second cells.

The units 152-153 may be circuits integrated in a processing logic including e.g. a processor, microprocessor, an ASIC, or the like or maybe separate units/circuits. It should be noted that the embodiments described herein are not limited to any specific combination of hardware circuitry and software.

The above mentioned and described embodiments are only given as examples and should not be limiting to the present invention. Although specific terms may be employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

CLAIMS

1. A method for a user equipment in a wireless communication system supporting carrier aggregation, wherein the user equipment is configured to receive data from a radio base station in a first cell, and the radio base station is configured to broadcast system information comprising configuration parameters in the first and a second cell, the method comprising:
   - receiving (410) configuration information for an aggregation of the first and the second cell from the radio base station,

   and **characterized in** that it comprises:
   - receiving (420) information on how to apply the system information broadcasted in the second cell from the radio base station.

2. The method according to claim 1, wherein the information on how to apply the system information comprises an instruction to not apply system information broadcasted in the second cell.

3. The method according to claim 1, wherein the information on how to apply the system information comprises an instruction to apply only a part of the configuration parameters in the system information broadcasted in the second cell, the method further comprising:
   - reading (430) the system information broadcasted in the second cell, and
   - applying (440) the read system information in accordance with the received instruction.

4. The method according to any of the preceding claims, wherein the information on how to apply the system information comprises a configuration parameter replacing a corresponding configuration parameter in the system information broadcasted in the second cell.

5. The method according to any of the preceding claims, wherein the information on how to apply the system information is received in a dedicated message.

6. The method according to any of claims 1-4, wherein the information on how to apply the system information is received in a broadcast message together with the system information broadcasted in the first or the second cell.

7. A method for a radio base station in a wireless communication system supporting carrier aggregation, wherein the radio base station is configured to transmit data to a user equipment in a first cell, the method comprising:
   - broadcasting (510) system information comprising configuration parameters in the first and in a second cell,
   - transmitting (520) configuration information for an aggregation of the first and second cells to the user equipment,

   and **characterized in** that it comprises:
   - transmitting (530) information on how to apply the system information broadcasted in the second cell to the user equipment.

8. The method according to claim 7, wherein the information on how to apply the system information comprises an instruction to not apply system information broadcasted in the second cell.

9. The method according to claim 7, wherein the information on how to apply the system information comprises an instruction to apply only a part of the configuration parameters in the system information broadcasted in the second cell.

10. The method according to any of the preceding claims, wherein the information on how to apply the system information comprises a configuration parameter replacing a corresponding configuration parameter in the system information broadcasted in the second cell.

11. The method according to any of the preceding claims, wherein the information on how to apply the system information is transmitted in a dedicated message.

12. The method according to any of claims 7-10, wherein the information on how to apply the system information is broadcasted together with the system information broadcasted in one of the first and the second cell.

13. A user equipment (150) configured to be used in a wireless communication system supporting carrier aggregation, and to receive data from a radio base station in a first cell, wherein system information comprising configuration parameters is broadcasted in the first and a second cell by the radio base station, the user equipment being **characterized in** that it comprises:
    - a receiving unit (151) adapted to receive configuration information for an aggregation of the first and the second cell, and information on how to apply the system information broadcasted in the second cell from the radio base station.

14. The user equipment according to claim 13, wherein the information on how to apply the system information comprises an instruction to not apply system information broadcasted in the second cell.

15. The user equipment according to claim 13, wherein the information on how to apply the system information comprises an instruction to apply only a part of the configuration parameters in the system information broadcasted in the second cell, the user equipment further comprising:
    - a reading unit (152) adapted to read the system information broadcasted in the second cell, and
    - an applying unit (153) adapted to apply the read system information in accordance with the received instruction.

16. The user equipment according to any of claims 13-15, wherein the information on how to apply the system information comprises a configuration parameter replacing a corresponding configuration parameter in the system information broadcasted in the second cell.

17. The user equipment according to any of claims 13-16, wherein the information on how to apply the system information is received in a dedicated message.

18. The user equipment according to any of claims 13-16, wherein the information on how to apply the system information is received in a broadcast message together with the system information broadcasted in the first or the second cell.

19. A radio base station (110) configured to be used in a wireless communication system supporting carrier aggregation, and to transmit data to a user equipment in a first cell, the radio base station comprising:
    - a broadcasting unit (111) adapted to broadcast system information comprising configuration parameters in the first and in a second cell,

    and **characterized in** that it comprises:
    - a transmitting unit (112) adapted to transmit configuration information for an aggregation of the first and second cells, and information on how to apply the system information broadcasted in the second cell to the user equipment.

20. The radio base station according to claim 19, wherein the information on how to apply the system information comprises an instruction to not apply system information broadcasted in the second cell.

21. The radio base station according to claim 19, wherein the information on how to apply the system information comprises an instruction to apply only a part of the configuration parameters in the system information broadcasted in the second cell.

22. The radio base station according to any of claims 19-21, wherein the information on how to apply the system information comprises a configuration parameter replacing a corresponding configuration parameter in the system information broadcasted in the second cell.

23. The radio base station according to any of claims 19-22, wherein the information on how to apply the system information is transmitted in a dedicated message.

24. The radio base station according to any of claims 19-22, wherein the information on how to apply the system information is broadcasted together with the system information broadcasted in one of the first and the second cell.

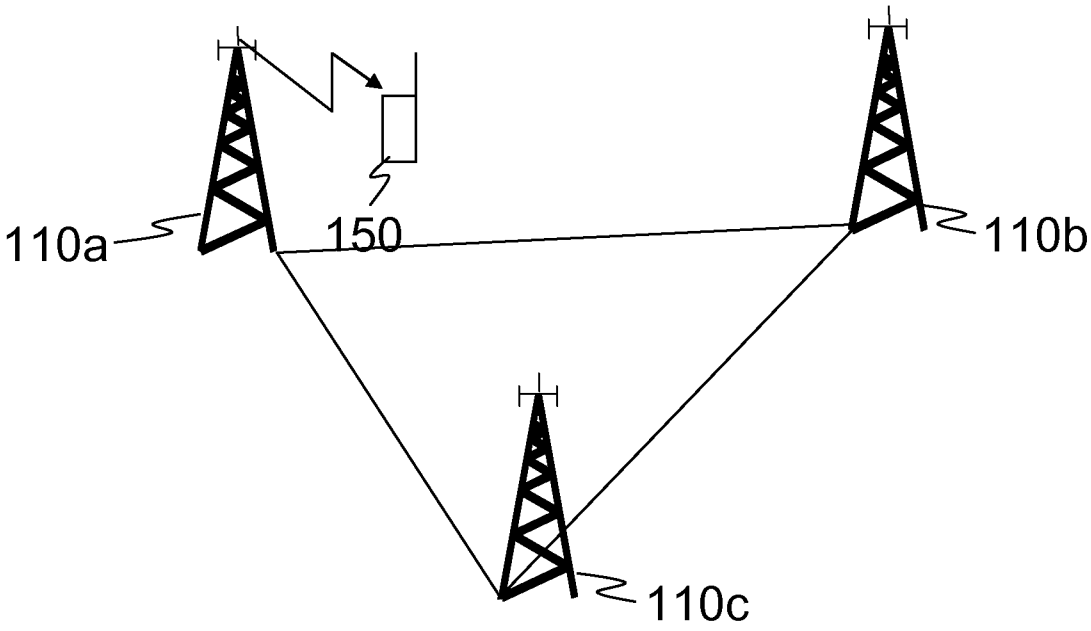

Fig. 1

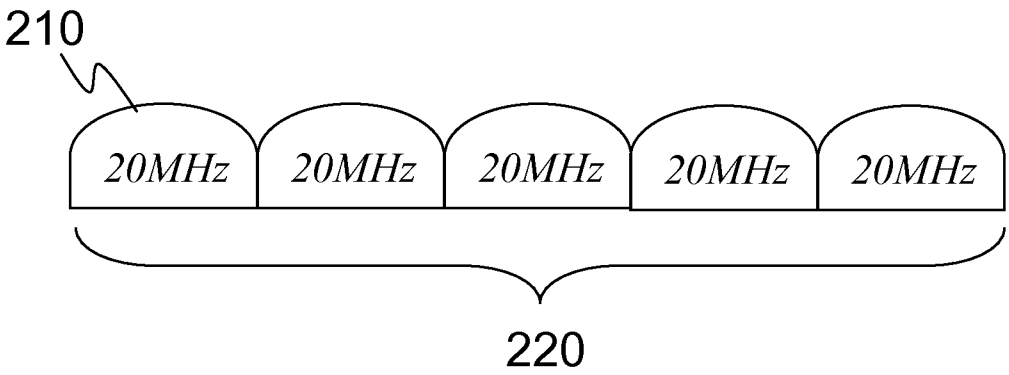

Fig. 2a

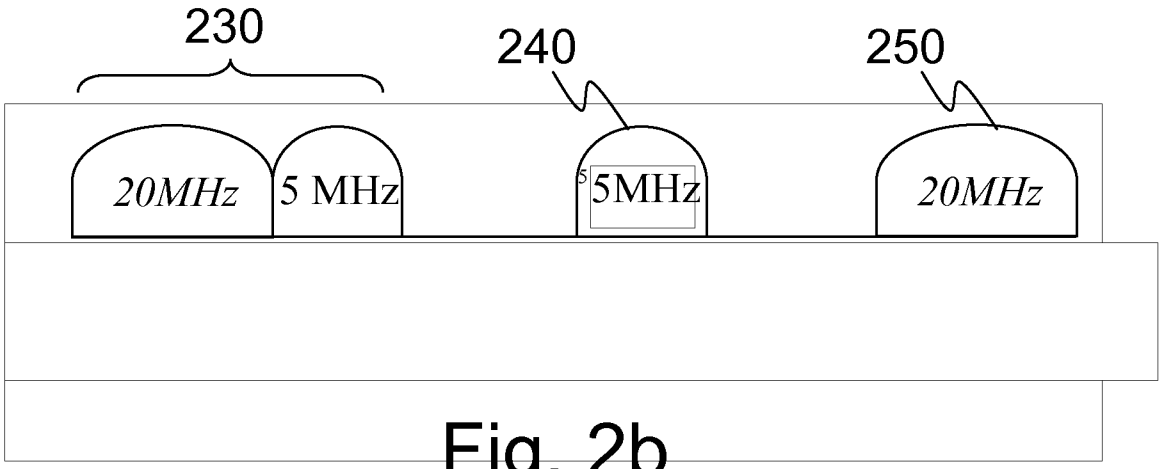
230
240
250
20MHz
5 MHz
5MHz
20MHz

Fig. 2b

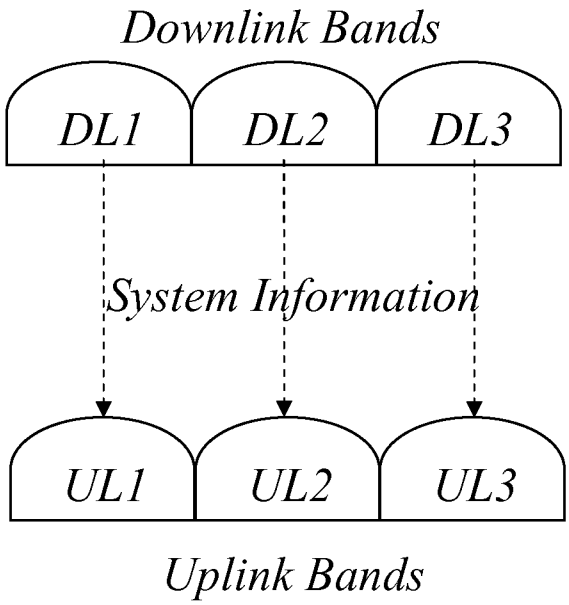
Downlink Bands
DL1
DL2
DL3
System Information
UL1
UL2
UL3
Uplink Bands

Fig. 2c

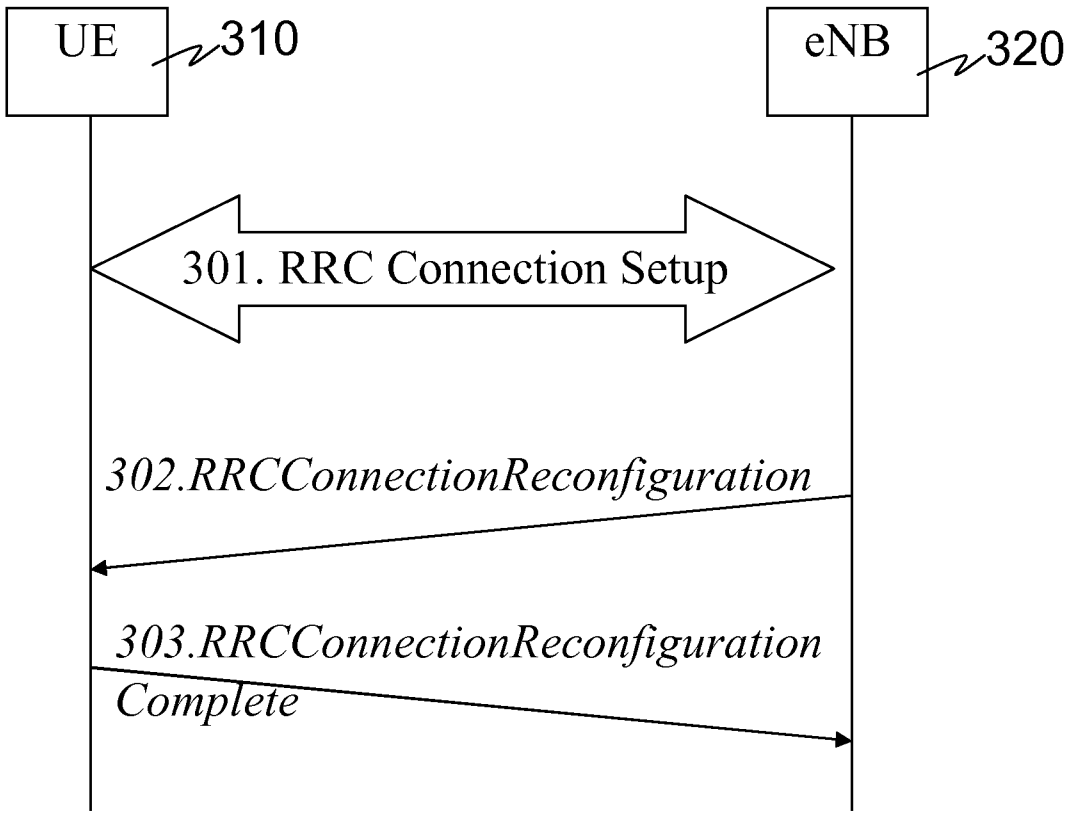
UE
310
eNB
320
301. RRC Connection Setup
302.RRCConnectionReconfiguration
303.RRCConnectionReconfiguration Complete

Fig. 3a

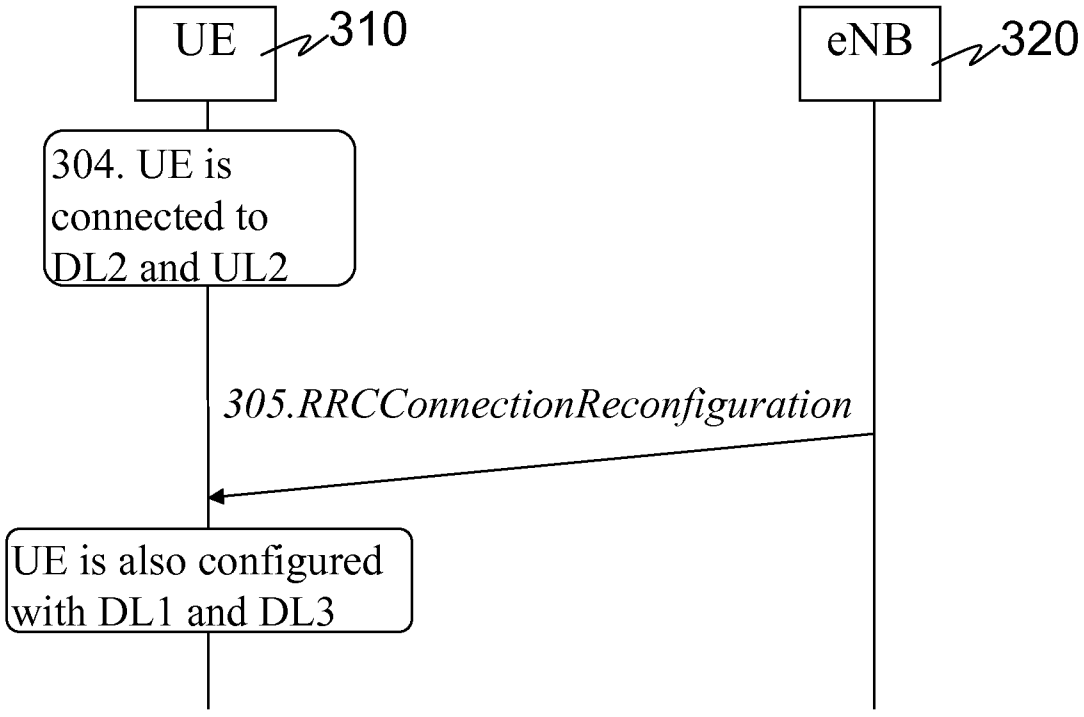
UE
310
eNB
320
304. UE is connected to DL2 and UL2
305.RRCConnectionReconfiguration
UE is also configured with DL1 and DL3

Fig. 3b

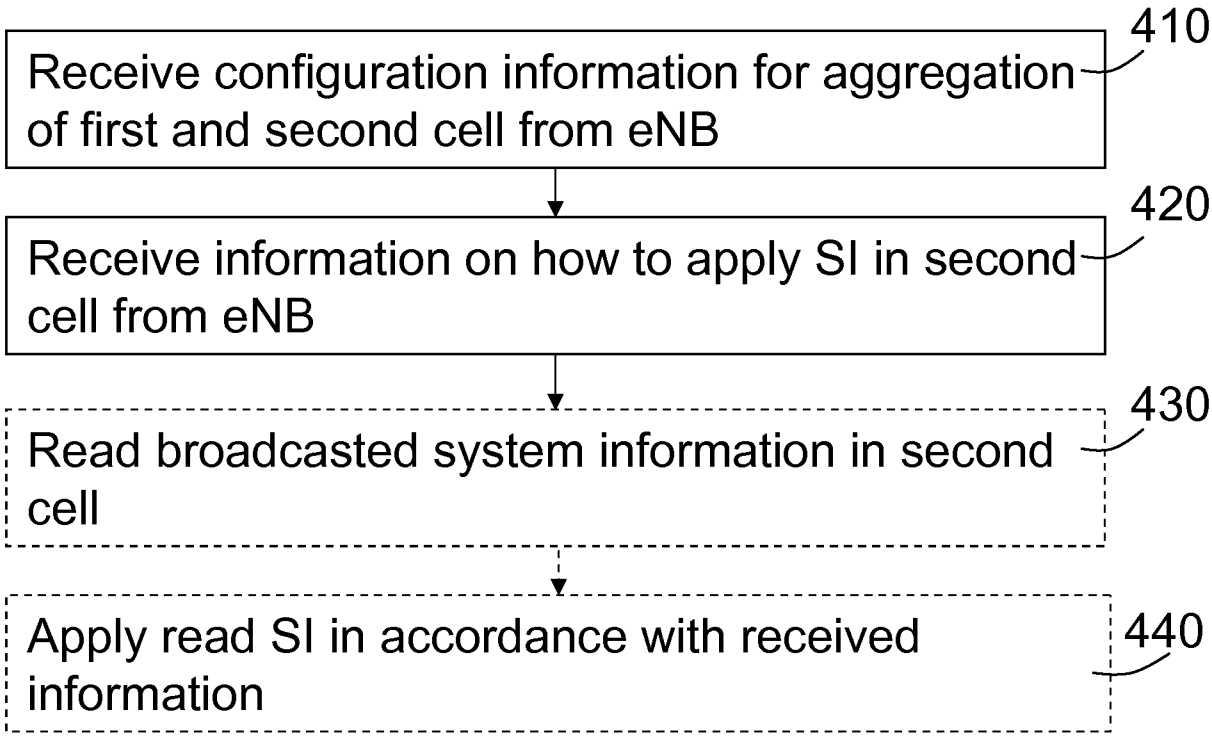
Receive configuration information for aggregation of first and second cell from eNB
410
Receive information on how to apply SI in second cell from eNB
420
Read broadcasted system information in second cell
430
Apply read SI in accordance with received information
440

Fig. 4

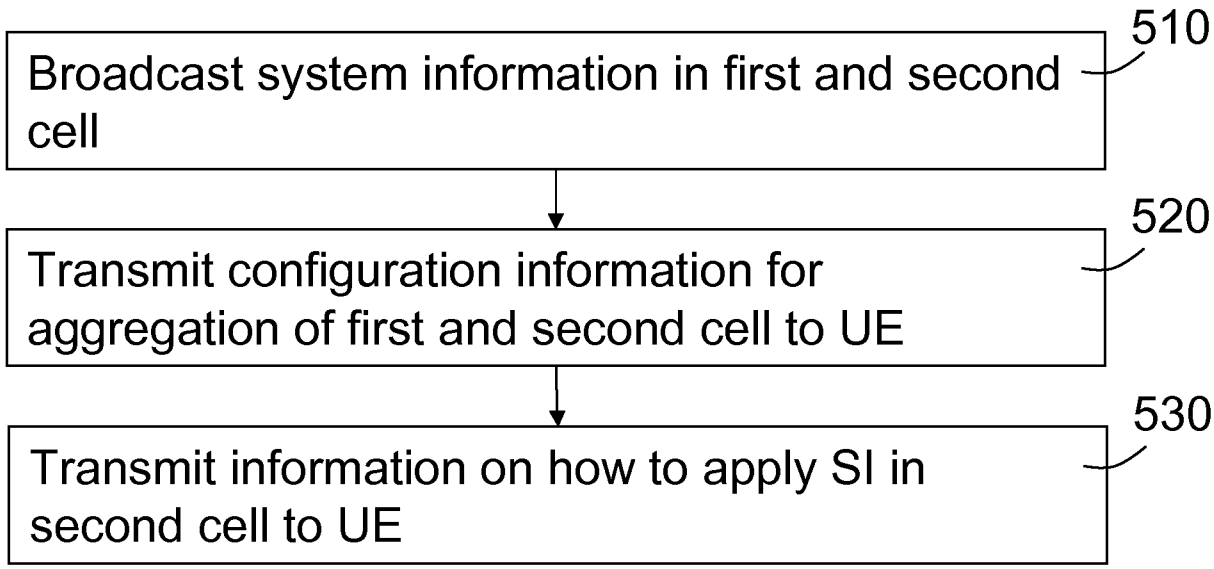
Broadcast system information in first and second cell
510
Transmit configuration information for aggregation of first and second cell to UE
520
Transmit information on how to apply SI in second cell to UE
530

Fig. 5

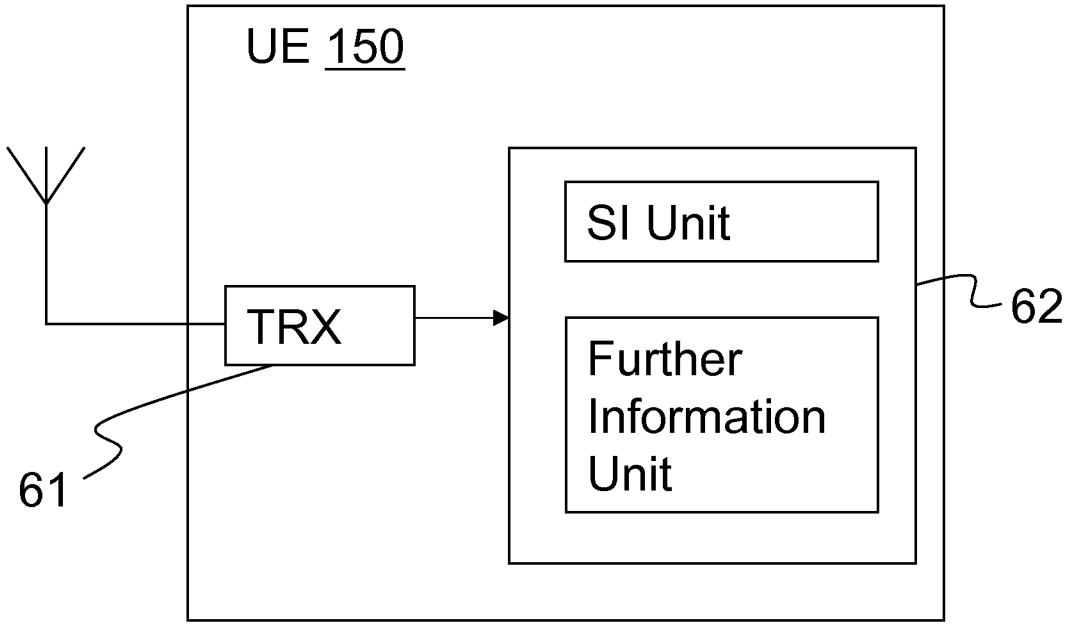
UE 150
SI Unit
TRX
Further Information Unit
62
61

Fig. 6a

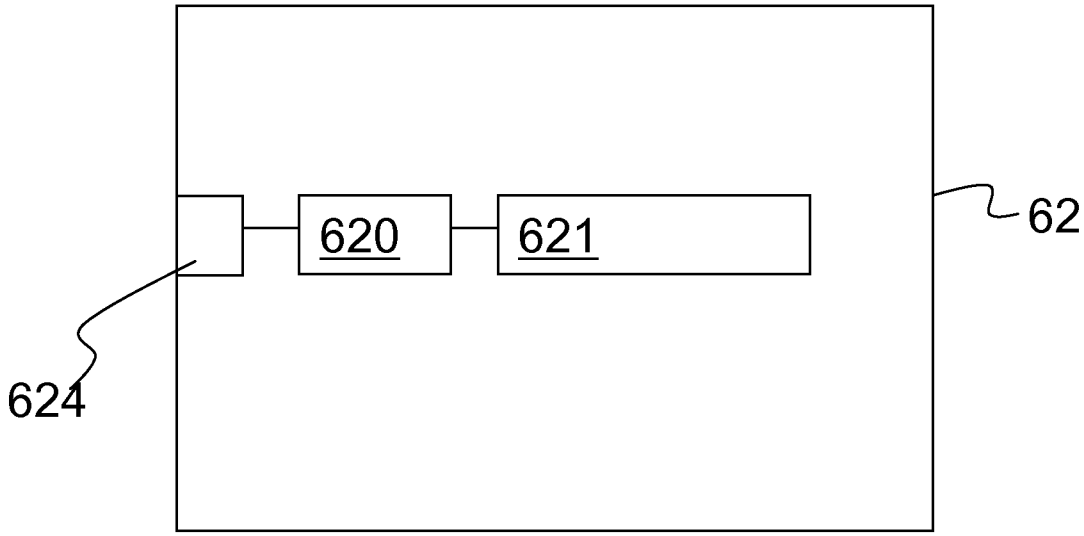
620
621
62
624

Fig. 6b

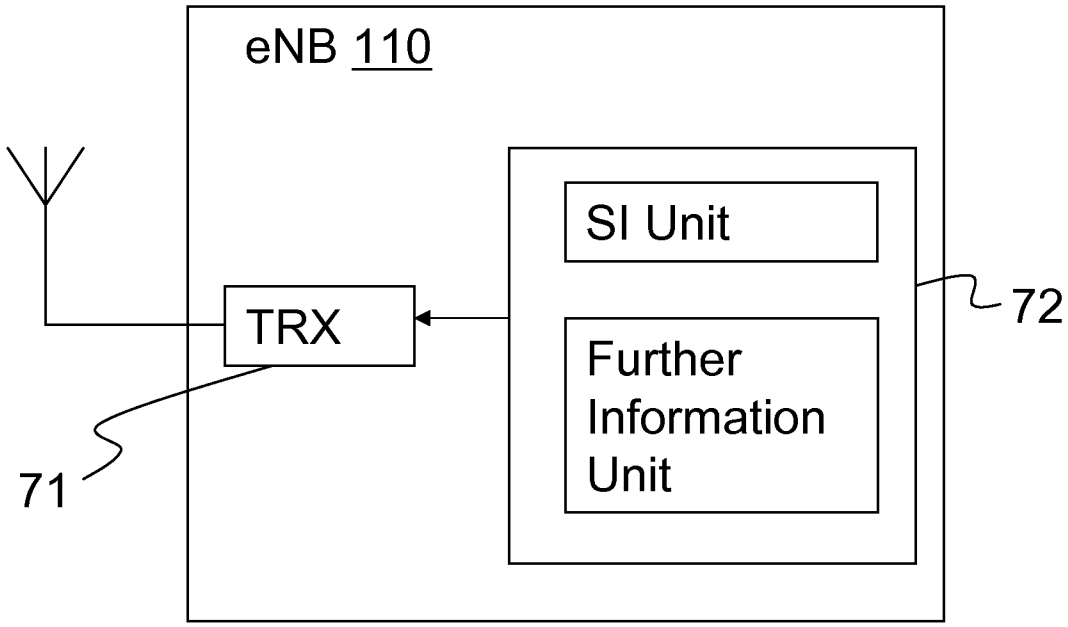
eNB 110
SI Unit
TRX
Further Information Unit
72
71

Fig. 7a

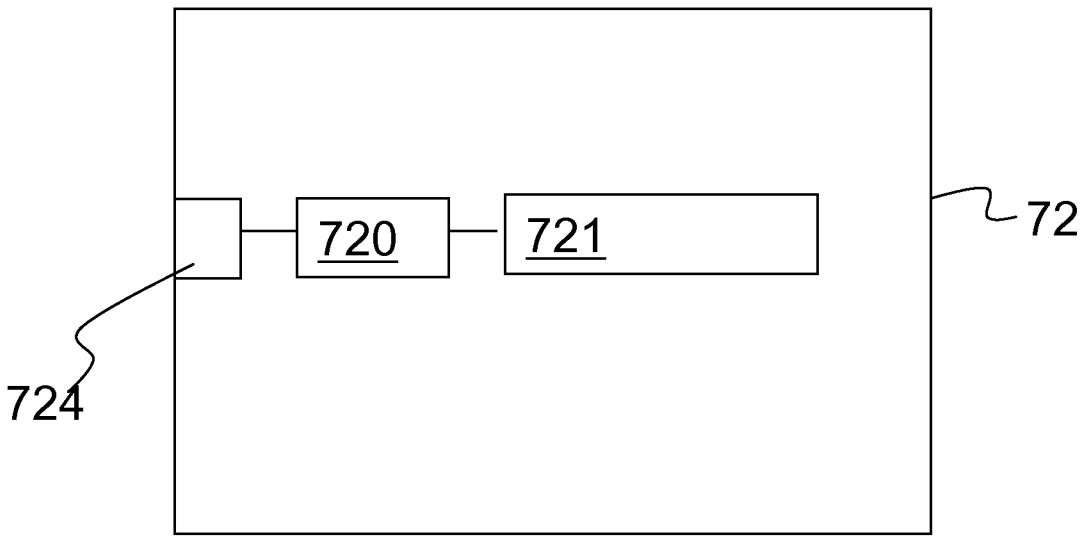
720
721
72
724

Fig. 7b

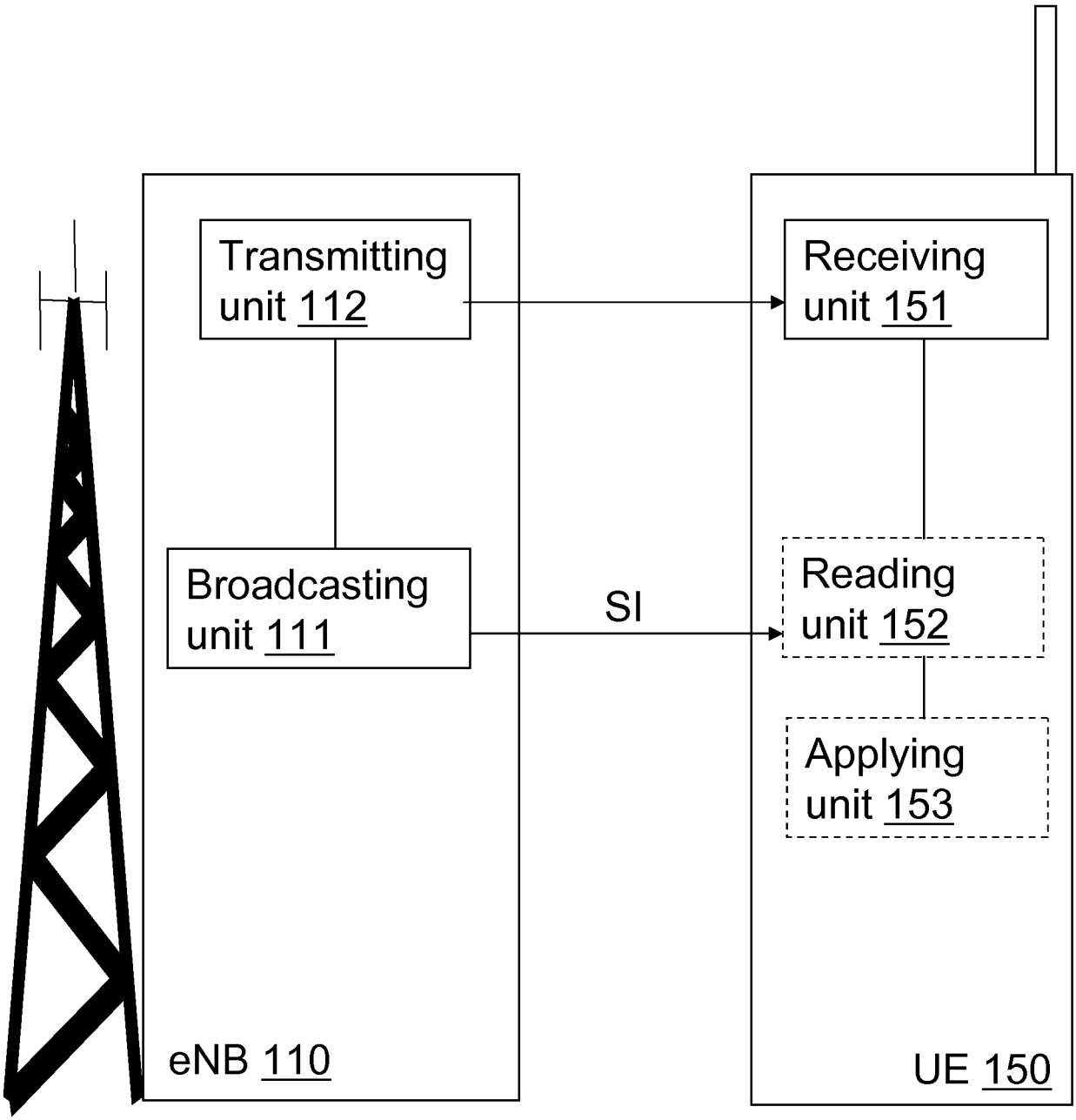
Transmitting unit 112
Receiving unit 151
Broadcasting unit 111
SI
Reading unit 152
Applying unit 153
eNB 110
UE 150

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2010/050837

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	3GPP TSG RAN WG2 Meeting #67bis; R2-095831; Miyazaki, Japan, October 12-16, 2009; "System Information Acquisition for Carrier Aggregation", Research In Motion UK Limited [retrieved from the internet 2011-01-24, URL: http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_67bis/Docs/R2-095831.zip]; See whole document. --	1-24
X	3GPP TSG RAN WG2#67; R2-094186; 24 - 28 August, Shenzhen, China, Panasonic; "System information acquisition at the start of carrier aggregation" [retrieved from the internet 2011-01-24, URL: http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_67/docs/R2-094186.zip]; See whole document. --	1-24

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28-01-2011	31-01-2011

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2010/050837

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	3GPP TSG RAN WG2 Meeting #66bis; R2-093720; Los Angeles, USA, 29 June - 03 July, 2009; Source: CATT; Title: "System Information Acquisition in CA"; [retrieved from the internet on 2010-01-24, URL: http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_66bis/docs/R2-093720.zip]; See whole document. --	1-24
A	3GPP TSG-RAN WG2 Meeting #67bis; R2-095633; Miyazaki, Japan, October 12 - 16 2009; Source: InterDigital; Title: System Information for Carrier Aggregation [retrieved from the internet 2011-01-25, URL: http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_67bis/Docs/R2-095633.zip]; See whole document. --	1-24
A	3GPP TSG-RAN WG1 #53bis; R1-082468; Warsaw, Poland, June 30 - July 4, 2008; Source: Ericsson; Title: "Carrier aggregation in LTE-Advanced"; [retrieved from the internet on 2010-01-24, URL: http://www.3gpp.org/ftp/tsg_ran/wg1_rl1/TSGR1_53b/Docs/R1-082468.zip]; See whole document. --	1-24
A	3GPP TSG-RAN2 Meeting #66bis; R2-093844; LA, USA, 29, June - 3, July, 2009; Source: LG Electronics Inc.; Title: "RACH for Carrier Aggregation"; [retrieved from the internet on 2010-01-24, URL: http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_66bis/docs/R2-093844.zip]; See whole document. -- --------	1-24

Continuation of: second sheet

International Patent Classification (IPC)

H04W 76/04 (2009.01)
H04W 48/10 (2009.01)
H04W 48/12 (2009.01)