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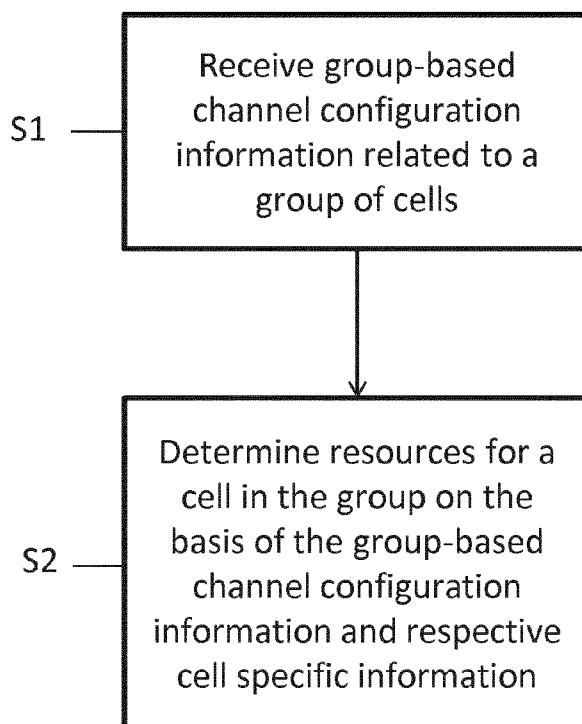
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(54) **Title:** APPARATUS AND METHOD OF DETERMINING RESOURCES FOR A CELL

Figure 10



(57) **Abstract:** A method comprising: receiving at a user device group-based channel configuration information related to a group of cells; and determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

DESCRIPTION**TITLE**

APPARATUS AND METHOD OF DETERMINING RESOURCES FOR A CELL

5 Some embodiments relate to a method and apparatus and in particular but not exclusively to a method and apparatus for use in scenarios where a user device or equipment is in communication with two or more nodes or base stations.

 A communication system can be seen as a facility that enables communication sessions between two or more nodes such as fixed or mobile communication devices, access points such as nodes, base stations, servers, hosts, machine type servers, routers, and so on. A communication system and compatible communicating devices typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved. For example, the standards, specifications and related protocols can define the manner how communication devices shall communicate with the access points, how various aspects of the communications shall be implemented and how the devices and functionalities thereof shall be configured.

 It should be understood that conveying, broadcasting, signalling, transmitting and/or receiving may herein mean preparing a data conveyance, broadcast, transmission and/or reception, preparing a message to be conveyed, broadcasted, signalled, transmitted and/or received, or physical transmission and/or reception itself, etc. on a case by case basis. The same principle may be applied to the terms transmission and reception as well.

 A user can access the communication system by means of an appropriate communication device. A communication device of a user is often referred to as user equipment (UE), user device or terminal.

 Signals can be carried on wired or wireless carriers. Examples of wireless systems include public land mobile networks (PLMN), satellite based communication systems and different wireless local networks, for example wireless local area networks (WLAN). Wireless systems can be divided into coverage areas referred to as cells, such systems being often referred to as cellular systems. A cell can be provided by a base station, there being various different types of base stations. Different types of cells can provide different

features. For example, cells can have different shapes, sizes, functionalities and other characteristics. A cell is typically controlled by a control node.

A communication device is provided with an appropriate signal receiving and transmitting arrangement for enabling communications with other parties. In wireless systems a communication device typically provides a transceiver station that can communicate with another communication device such as e.g. a base station and/or another user equipment. A communication device such as a user equipment (UE) may access a carrier provided by a base station, and transmit and/or receive on the carrier.

An example of cellular communication systems is an architecture that is being standardized by the 3rd Generation Partnership Project (3GPP). A recent development in this field is often referred to as the long-term evolution (LTE) or long-term evolution advanced (LTE advanced) of the Universal Mobile Telecommunications System (UMTS) radio-access technology. In LTE base stations providing the cells are commonly referred to as enhanced NodeBs (eNB). An eNB can provide coverage for an entire cell or similar radio service area.

Cells can provide different service areas. For example, some cells may provide wide coverage areas while some other cells provide smaller coverage areas. The smaller radio coverage areas can be located wholly or partially within a larger radio coverage area. For example, in LTE a node providing a relatively wide coverage area is referred to as a macro eNode B. Examples of nodes providing smaller cells, or local radio service areas, include femto nodes such as Home eNBs (HeNB), pico nodes such as pico eNodeBs (pico-eNB) and remote radio heads.

A device may communicate with more than one cell. Communications with more than one cell may be provided e.g. to increase performance. A way of providing this could be, for example, based on carrier aggregation (CA). In carrier aggregation a plurality of carriers are aggregated to increase bandwidth. Carrier aggregation comprises aggregating a plurality of component carriers.

LTE-Advanced is an example of a system capable of providing carrier aggregation. In LTE-A two or more component carriers (CCs) can be aggregated in order to support wider transmission bandwidths and/or for spectrum aggregation. Currently it is envisaged that the bandwidths can extend up to 100MHz. Depending on its capabilities, it is possible to configure a user equipment (UE) to aggregate a different number of component carriers either from the same frequency band or different ones. A primary component carrier can

be provided by a primary cell (PCell) whereas further carriers can be provided by at least one secondary cell (SCell). SCells form together with the PCell a set of serving cells. To enable reasonable battery consumption by the user equipment when aggregating carriers, an activation/deactivation mechanism of SCells is supported. When operated to provide CA a user equipment (UE) is configured with a primary cell (PCell). The PCell is used for taking care of security, Non-Access-Stratum (NAS) protocol mobility, and transmission of physical uplink control channel (PUCCH). All other configured CCs are called secondary cells (SCells).

Inter-site carrier aggregation has also been proposed. For example, it has been proposed that smaller cells could be used in conjunction with macro cells. In dual connectivity, a UE is connected to a macro cell and a small cell simultaneously. An aim of dual connectivity is to benefit from user throughput gains by the inter-site carrier aggregation for increased transmission bandwidth and scheduling flexibility as well as to potentially decrease mobility related signalling load towards the core network. In some aspects dual connectivity is rather similar to CA with the macro cell serving as PCell and the small cells being SCells. However, in dual connectivity different eNBs provide the PCell and the SCell(s) as opposed to only one eNB according to e.g. 3GPP LTE Releases 10 and 11.

In a first aspect there is provided a method comprising: receiving at a user device group-based channel configuration information related to a group of cells; and determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

Preferably said channel configuration information is received in a single information element.

Preferably said channel configuration information comprises at least one of: information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

Preferably said information relating to an index of available resources comprises information relating to at least one of available frames and subframes.

- 5 Preferably said information relating to available frequency resources comprises information defining a first physical resource block of the available frequency resources.

Preferably said information defining a first physical resource block of the available frequency resources comprises frequency offset information.

- 10 Preferably said respective cell information comprises at least one of secondary cell index and physical cell identity.

Preferably said determining comprises changing said frequency offset.

- 15 Preferably said determining comprises changing said frequency offset until one of all possible values of the frequency offset are used and all cell information has been used.

Preferably said changing said frequency offset comprises changing according to an agreed scheme.

20

Preferably said agreed scheme comprises one of incrementally and decrementally changing said frequency offset.

- 25 Preferably said determining comprises changing said information relating to an index of available resources.

Preferably said determining comprises changing said information relating to an index of available resources until one of all of the available locations are used and all cell information has been used.

- 5 Preferably said determining comprises determining a preamble for each cell as a function of the preamble information and said respective cell information.

Preferably said method comprises receiving information which indicates how said resources are to be determined.

10

Preferably said group of cells comprises a group of secondary cells.

- 15 Preferably said channel configuration information comprises at least one of PRACH channel configuration information, PUCCH channel configuration information and SRS channel configuration information.

Preferably said resources comprise at least one of PRACH resources, PUCCH resources and SRS resources.

- 20 Preferably said resources comprise physical resources.

In a second aspect there is provided a computer program comprising computer executable instructions which when run on one or more processors perform the method of the first aspect.

25

In a third aspect there is provided an apparatus comprising: at least one processor;

and at least one memory including computer program code; the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to: receive group-based channel configuration information related to a group of cells; and determine resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to receive said channel configuration information in a single information element.

10

Preferably said channel configuration information comprises at least one of: information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

15 Preferably said information relating to an index of available resources comprises information relating to at least one of available frames and subframes.

Preferably said information relating to available frequency resources comprises information defining a first physical resource block of the available frequency resources.

20

Preferably said information defining a first physical resource block of the available frequency resources comprises frequency offset information.

25 Preferably said respective cell information comprises at least one of secondary cell index and physical cell identity.

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to change said frequency offset as part of said determining.

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to change said frequency offset until one of all possible values of the frequency offset are used and all cell information has been used as part of said determining.

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to change said frequency offset according to an agreed scheme.

10 Preferably said agreed scheme comprises one of incrementally and decrementally changing said frequency offset.

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to change said information relating to an index of available resources as part of said determining

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to change said information relating to an index of available resources until one of all of the available locations are used and all cell information has been used as part of said determining.

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to determine a preamble for each cell as a function of the preamble information and said respective cell information as part of said determining.

25

Preferably the at least one processor and the at least one memory are configured to cause the apparatus to receive information which indicates how said resources are to be determined.

Preferably said group of cells comprises a group of secondary cells.

5 Preferably said channel configuration information comprises at least one of PRACH channel configuration information, PUCCH channel configuration information and SRS channel configuration information.

Preferably said resources comprise at least one of PRACH resources, PUCCH resources and SRS resources.

10

Preferably said resources comprise physical resources.

15 In a fourth aspect there is provided an apparatus comprising: means for receiving group-based channel configuration information related to a group of cells; and means for determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

Preferably said channel configuration information is received in a single information element.

20

Preferably said channel configuration information comprises at least one of: information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

25 Preferably said information relating to an index of available resources comprises information relating to at least one of available frames and subframes.

Preferably said information relating to available frequency resources comprises information defining a first physical resource block of the available frequency resources.

5 Preferably said information defining a first physical resource block of the available frequency resources comprises frequency offset information.

Preferably said respective cell information comprises at least one of secondary cell index and physical cell identity.

10 Preferably said apparatus comprises means for changing said frequency offset as part of said determining.

15 Preferably said apparatus comprises means for changing said frequency offset until one of all possible values of the frequency offset are used and all cell information has been used as part of said determining.

Preferably said apparatus comprises means for changing said frequency offset according to an agreed scheme.

20 Preferably said agreed scheme comprises one of incrementally and decrementally changing said frequency offset.

Preferably said apparatus comprises means for changing said information relating to an index of available resources as part of said determining.

25

Preferably said apparatus comprises means for changing said information relating to an index of available resources until one of all of the available locations are used and all cell information has been used as part of said determining.

- 5 Preferably said apparatus comprises means for determining a preamble for each cell as a function of the preamble information and said respective cell information as part of said determining.

10 Preferably said apparatus comprises means for receiving information which indicates how said resources are to be determined.

Preferably said group of cells comprises a group of secondary cells.

15 Preferably said channel configuration information comprises at least one of PRACH channel configuration information, PUCCH channel configuration information and SRS channel configuration information.

Preferably said resources comprise at least one of PRACH resources, PUCCH resources and SRS resources.

20

Preferably said resources comprise physical resources.

25 In a fifth aspect there is provided a method comprising: sending to at least one user device group-based channel configuration information related to a group of cells; said group-based channel configuration information configured to be usable for determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

Preferably said channel configuration information is sent in a single information element.

5 Preferably said channel configuration information comprises at least one of: information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

Preferably said information relating to an index of available resources comprises information relating to at least one of available frames and subframes.

10 Preferably said information relating to available frequency resources comprises information defining a first physical resource block of the available frequency resources.

Preferably said information defining a first physical resource block of the available frequency resources comprises frequency offset information.

15

Preferably said respective cell information comprises at least one of secondary cell index and physical cell identity.

20 Preferably the method comprises sending information which indicates how said resources are to be determined

Preferably said group of cells comprises a group of secondary cells.

25 Preferably said channel configuration information comprises at least one of PRACH channel configuration information, PUCCH channel configuration information and SRS channel configuration information.

Preferably said resources comprise at least one of PRACH resources, PUCCH resources and SRS resources.

Preferably said resources comprise physical resources.

5

In a sixth aspect there is provided a computer program comprising computer executable instructions which when run on one or more processors perform the method of the fifth aspect.

10 In a seventh aspect there is provided an apparatus comprising: at least one processor; and at least one memory including computer program code; the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to: send to at least one user device group-based channel configuration information related to a group of cells; said group-based channel configuration
15 information configured by said apparatus to be usable for determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

Preferably said at least one processor and said at least one memory are configured to
20 cause said apparatus to send said channel configuration information in a single information element.

Preferably said channel configuration information comprises at least one of: information relating to an index of available resources; information relating to available frequency
25 resources; and information relating to preamble sequences.

Preferably said information relating to an index of available resources comprises information relating to at least one of available frames and subframes.

Preferably said information relating to available frequency resources comprises information defining a first physical resource block of the available frequency resources.

5 Preferably said information defining a first physical resource block of the available frequency resources comprises frequency offset information.

Preferably said respective cell information comprises at least one of secondary cell index and physical cell identity.

10 Preferably said at least one processor and said at least one memory are configured to cause said apparatus to send information which indicates how said resources are to be determined

Preferably said group of cells comprises a group of secondary cells.

15

Preferably said channel configuration information comprises at least one of PRACH channel configuration information, PUCCH channel configuration information and SRS channel configuration information.

20 Preferably said resources comprise at least one of PRACH resources, PUCCH resources and SRS resources.

Preferably said resources comprise physical resources.

25 In an eighth aspect there is provided an apparatus comprising: means for sending to at least one user device group-based channel configuration information related to a group of cells; said group-based channel configuration information configured by configuring

means of said apparatus to be usable for determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

- 5 Preferably said apparatus comprises means for sending said channel configuration information in a single information element.

10 Preferably said channel configuration information comprises at least one of: information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

Preferably said information relating to an index of available resources comprises information relating to at least one of available frames and subframes.

- 15 Preferably said information relating to available frequency resources comprises information defining a first physical resource block of the available frequency resources.

Preferably said information defining a first physical resource block of the available frequency resources comprises frequency offset information.

20

Preferably said respective cell information comprises at least one of secondary cell index and physical cell identity.

- 25 Preferably said apparatus comprises means for sending information which indicates how said resources are to be determined

Preferably said group of cells comprises a group of secondary cells.

Preferably said channel configuration information comprises at least one of PRACH channel configuration information, PUCCH channel configuration information and SRS channel configuration information.

5

Preferably said resources comprise at least one of PRACH resources, PUCCH resources and SRS resources.

Preferably said resources comprise physical resources.

10

A computer program comprising program code means adapted to perform the method(s) may also be provided. The computer program may be stored and/or otherwise embodied by means of a carrier medium.

15 In the above, many different embodiments have been described. It should be appreciated that further embodiments may be provided by the combination of any two or more of the embodiments described above.

Various other aspects and further embodiments are also described in the following detailed description and in the attached claims.

20 Some embodiments will now be described, by way of example only, with respect to the following Figures in which:

Figure 1 shows a schematic diagram of a network according to some embodiments;

Figures 2 and 3 are simplified examples illustrating the principle of dual connectivity;

Figure 4 shows a schematic diagram of a mobile communication device according to some embodiments;

25 Figure 5 shows a schematic diagram of a control apparatus according to some embodiments;

Figure 6 is a flow diagram according to an embodiment;

Figures 7A to 7C are respective embodiments showing bearer-splitting;

Figures 8A to 8E show protocol stacks according to some example embodiments;

30 Figure 9 is a signalling diagram according to an embodiment;

Figure 10 is a flow chart showing steps according to an embodiment;

Figure 11 is a flow chart showing steps according to an embodiment.

5 In the following certain exemplifying embodiments are explained with reference to a wireless or mobile communication system serving mobile communication devices. Before explaining in detail the exemplifying embodiments, certain general principles of a wireless communication system and nodes thereof and mobile communication devices are briefly explained with reference to Figures 1 to 5 to assist in understanding the context of the
10 described examples.

A non-limiting example of the recent developments in communication system architectures is the long-term evolution (LTE) of the Universal Mobile Telecommunications System (UMTS) that is being standardized by the 3rd Generation Partnership Project (3GPP). The LTE employs a mobile architecture known as the Evolved Universal
15 Terrestrial Radio Access Network (E-UTRAN). Base stations of such systems are known as evolved or enhanced Node Bs (eNBs) and may provide E-UTRAN features such as user plane Radio Link Control/Medium Access Control/Physical layer protocol (RLC/MAC/PHY) and control plane Radio Resource Control (RRC) protocol terminations towards the communication devices. Other examples of radio access system include
20 those provided by base stations of systems that are based on technologies such as wireless local area network (WLAN) and/or WiMax (Worldwide Interoperability for Microwave Access). WLANs are sometimes referred to by WiFi™, a trademark that is owned by the Wi-Fi Alliance, a trade association promoting Wireless LAN technology and certifying products conforming to certain standards of interoperability.

25 Different types of communication devices 101, 102, 103 can be provided wireless access via base stations or similar wireless transmitter and/or receiver nodes providing radio service areas or cells. In Figure 1 different neighbouring and/or overlapping radio service areas or cells 100, 110, 117 and 119 are shown being provided by base stations 106, 107, 118 and 120. It is noted that the cell borders are schematically shown for
30 illustration purposes only in Figure 1. It shall be understood that the sizes and shapes of the cells or other radio service areas may vary considerably from the omni-directional shapes of Figure 1. A base station site can provide one or more cells or sectors, each sector providing a cell or a subarea of a cell. Each communication device and base station may have one or more radio channels open at the same time and may send signals to
35 and/or receive signals from more than one source.

Base stations are typically controlled by at least one appropriate controller apparatus so as to enable operation thereof and management of mobile communication devices in communication with the base stations. The control apparatus can be interconnected with other control entities. The control apparatus can typically be provided with memory capacity and at least one data processor. The processor may be in the form of a circuit board. The control apparatus and functions may be distributed between a plurality of control units. In some embodiments, each base station can comprise a control apparatus. In alternative embodiments, two or more base stations may share a control apparatus. In some embodiments the control apparatus may be respectively provided in each base station. The memory capacity may be implemented as a memory unit within the processor or externally to the processor. In the latter case it may be communicatively coupled to the processor via various means, as is known in the art. The control apparatus may also use cloud services.

Different types of possible cells include those known as macro cells, pico cells and femto cells. For example, transmission/reception points or base stations can comprise wide area network nodes such as a macro eNode B (eNB) which may, for example, provide coverage for an entire cell or similar radio service area. A base station can also be provided by small or local radio service area network node, for example Home eNBs (HeNB), pico eNodeBs (pico-eNB), or femto nodes. Some applications utilise radio remote heads (RRH) that are connected to for example an eNB. As cells can overlap a communication device in an area can listen and transmit to more than one base station. Smaller radio service areas can be located entirely or at least partially within a larger radio service area. A communication device may thus communicate with more than one cell.

In a particular example, Figure 1 depicts a primary cell (PCell) 100. In this example the primary cell 100 can be provided by a wide area base station 106 provided by a macro-eNB. The macro-eNB 106 transmits and receives data over the entire coverage of the cell 100. A secondary cell (SCell) 110 in this example is a pico-cell. A secondary cell can also be provided by another suitable small area network node 118 such as Home eNBs (HeNB) (femto cell) or another pico eNodeBs (pico-eNB). A yet further cell 119 is shown to be provided by a remote radio head (RRH) 120 connected to the base station apparatus of cell 100. These smaller cells are referred to as small cells in the document.

Base stations may communicate via each other via fixed line connection and/or air interface. The logical connection between the base station nodes can be provided for

example by an X2 or Xn interface. In Figure 1 this interface is shown by the dashed line denoted by 105.

Figure 2 shows an example for dual connectivity where a UE 20 is connected to a macro cell 10 and a small cell 12 simultaneously. The macro cell 10 is in communication with the core network. The small cell 12 is in communication with the core network via the macro cell 10. The macro cell and the small cell may communicate via the Xn interface.

Reference is made to exemplifying Figure 3. For inter-site CA the receiving RLC entity may be located in the MeNB, in some embodiments. The SeNB may not have a corresponding RLC entity. UL RLC PDUs (packet data units) delivered in UL to the SeNB are simply forwarded to the MeNB via the Xn interface. However in some embodiments the SeNB might also host the RLC entity, or at least some of the RLC functionalities. This may be dependent upon the U-plane option.

A Common Packet Data Convergence Protocol (PDCP) with separated Radio Link Control (RLC) and Medium Access Control (MAC) can be used for user plane communications. The macro eNB 10 can host the Packet Data Convergence Protocol (PDCP) layer and a RLC layer while both the macro cell and the small cell host one MAC each. The arrangement of the layers is shown in figure 3. The cells also host one physical layer each beneath these layers. In some embodiments at least RLC (re-) segmentation may need to be located in the SeNB, assuming non-ideal backhaul between MeNB and SeNB.

In the downlink, each bearer may be first split in the macro to component carriers 33 and 34 in order to go through both the macro eNB 10 and the small cell 12.

In the uplink, the UE may split the bearer below PDCP to component carriers 35 and 36 and feeds them to the macro cell and the small cell. The bearer to be split can comprise a radio bearer but this is not the only option.

Some embodiments may also apply to U-plane alternatives not supporting bearer split.

In Figure 1 nodes or stations 106 and 107 are shown as coupled to a core network 113 via gateway 112. A further gateway function may be provided to connect the core network to another network. The smaller nodes or stations 118 and 120 can also be connected to the network 113, for example by a separate gateway function and/or via the

macro level cells. In the example, station 118 is connected via a gateway 111 whilst station 120 connects via the controller apparatus 108.

A possible user device, such as a mobile communication device for transmitting to and receiving from a plurality of nodes or base stations will now be described in more detail with reference to Figure 4 showing a schematic, partially sectioned exemplifying view of a mobile communication device 200. Such a device is often referred to as user equipment (UE) or terminal. An appropriate mobile communication device may be provided by any device capable of sending radio signals to and/or receiving radio signals from multiple cells. Non-limiting examples include a mobile station (MS) such as a mobile phone or what is known as a 'smart phone', a tablet or a portable computer provided with a wireless interface card, and USB stick or 'dongle' with radio, or other wireless interface facility, personal data assistant (PDA) provided with wireless communication capabilities, or any combinations of these or the like. A mobile communication device may provide, for example, communication of data for carrying communications such as voice, electronic mail (email), text message, multimedia and so on.

The mobile device may receive and transmit signals over an air interface 207 with multiple base stations via an appropriate transceiver apparatus. In Figure 4 transceiver apparatus is designated schematically by block 206. The transceiver apparatus 206 may be provided for example by means of a radio part and associated antenna arrangement. The radio part is arranged to communicate simultaneously with different stations. The radio part may also be arranged to communicate via different radio technologies. For example, the radio part can provide a plurality of different radios. The antenna arrangement may be arranged internally or externally to the mobile device.

A mobile communication device is also provided with at least one data processing entity 201, such as a processor, at least one memory 202 and other possible components 203 for use in software and hardware aided execution of tasks it is designed to perform, including control of access to and communications with access systems and other communication devices. The data processing, storage and other relevant control apparatus can be provided on an appropriate circuit board and/or in chipsets. This feature is denoted by reference 204. The at least one memory may be implemented as at least one memory unit within the processor or externally to the processor. In the latter case it may be communicatively coupled to the processor via various means, as is known in the art. The mobile communication device may also use cloud services.

The user may control the operation of the mobile device by means of a suitable user interface such as key pad 205, voice commands, touch sensitive screen or pad, combinations thereof or the like. A display 208, a speaker and a microphone can also be provided. Furthermore, a mobile communication device may comprise appropriate
5 connectors (either wired or wireless) to other devices and/or for connecting external accessories, for example hands-free equipment, thereto.

Figure 5 shows an example of a control apparatus for a communication system.. The control apparatus may be located in a network control entity, such as in a (e)NodeB, or elsewhere in the system being operably coupled to the entity to be controlled. The
10 control apparatus 300 can be arranged to provide control on communications in the service area of a cell to provide the functions described below. The control apparatus 300 can be configured to provide control functions in association with configurations for dual connectivity arrangements by means of the data processing facility in accordance with certain embodiments described below. For this purpose the control apparatus comprises
15 at least one memory 301, at least one data processing unit 302, 303 and an input/output interface 304. Via the interface the control apparatus can be coupled to a receiver and/or a transmitter. The receiver and/or transmitter may also be implemented as a remote radio head. The control apparatus can be configured to execute an appropriate software code to provide the control functions. It shall be appreciated that similar component can be
20 provided in a control apparatus provided elsewhere in the system for controlling configurations of secondary nodes / cells.

A wireless communication device, such as a mobile or base station, can be provided with a Multiple Input / Multiple Output (MIMO) antenna system for enabling multi-flow communications. MIMO arrangements as such are known. MIMO systems use multiple
25 antennas at the transmitter and receiver along with advanced digital signal processing to improve link quality and capacity. More data can be received and/or sent where there are more antennae elements.

Small cell enhancements are being studied for Rel-12 in 3GPP. In order to benefit from flexible resource usage across eNBs as well as decrease signalling load towards the
30 core network, dual connectivity is being considered. As discussed above, in dual connectivity, a UE is simultaneously connected to both a Master eNB (MeNB) and a Secondary eNB (SeNB). MeNB and SeNB are assumed to be connected via a backhaul link, the Xn interface. The Xn interface may be an extension to the current X2 interface or

a newly defined inter-eNB interface. Dual connectivity may be used where MeNB and SeNB operate on different frequency bands.

User plane and control planes alternatives to support dual connectivity can be divided into options which allow bearer split and those which do not. Bearer split refers to the ability to split data from one radio bearer over two or more eNBs, and is sometimes referred to as inter-eNB carrier aggregation (CA).

Some embodiments may be used with autonomous SCell management for cases with inter-eNB carrier aggregation. Alternatively or additionally, some embodiments can also apply to autonomous SCell management with other types of dual connectivity between MeNB and SeNB. For example some embodiments may be used where there is no bearer split. There may be some CA capability at the UE, for example in the DL.

Autonomous SCell management is where a set of small cells can be prepared to operate as SCells for a specific UE. A set can comprise one or more cells, such as at least two cells. The UE is then allowed to directly access the prepared SCells with no need for signalling exchange with the network. For example, there is no need for RRM (radio resource management) measurements reports from the UE to the network and/or HO (handover) commands from the network to the UE. It may be possible to reduce frequent RRC (radio resource control) signalling for small cell mobility management by delegating such management actions from the network to the UEs.

Autonomous SCell management may give an advantage in terms of reduced RRC signalling only if combined with group-based SCell configuration, i.e. two or more SCells (e.g. corresponding to different small cells in one small cell cluster) can be prepared/configured at the same time for one UE using one RRC configuration message, or at least with significantly reduced RRC signalling as compared to configuring each SCell independently using a similar RRC reconfiguration procedure as for SCell configuration in for example Rel-10/Rel-11.

One option may be to use group-based configuration for at least some of the configurations.

It may be reasonable to assume that small cells in the same small cell cluster would share some similar configurations in values of some of the parameters in a configuration message such *RadioResourceConfigCommonSCell-r10*. Examples of one or more parameters which may have the same or similar values may be one or more of DL/UL bandwidth, antenna configuration, PHICH (physical Hybrid-ARQ (automatic repeat

request) indicator channel configuration, PDSCH (physical downlink shared channel) configuration, UL carrier frequency, etc. However, this may not be the case for one or more other parameters such as UL control channels and/or UL RACH (uplink random access channel) resources.

5 As an example, in order to minimize interference among small cells in one small cell cluster, PRACH (physical random access channel) resources in different small cells might need to be configured on different time and/or frequency resources, and/or using a different physical root sequence number. This may require each SCell to be configured with its own PRACH configuration. This may provide an increased signalling overhead
10 when using group-based configuration.

In some embodiments, a method may be used which uses implicit mapping from information in a PRACH configuration information element into different PRACH resources for the different SCells configured with a group-based SCell configuration message.

15 In some embodiments, a method is provided which allows using group-based SCell configuration for parts of the physical layer configuration that actually maps to different physical layer resources in different SCells.

Some embodiments relate to a method for signalling the PRACH configurations in a group of SCells.

20 Some embodiments signal only one PRACH configuration information element(s) to the UE for all SCells configured with group-based SCell configuration.

The information element may be called the *PRACH-Config* or *PRACH-SCellGroupConfig* information element in some embodiment or have any other suitable name.

The PRACH configuration information may comprise one or more of the following:

25 A PRACH configuration index (*prach-ConfigIndex*). This may be used to determine at least the system frame number (and the subframe numbers within one system frame) with available PRACH resources;

30 Frequency offset information (*prach-FreqOffset*). This may determine the first PRB (physical resource block) of the frequency resources available for PRACH transmission. In some embodiments, each PRACH resource may comprise 6 PRBs, so the offset would be indicated with steps of 6. The offset may be an index that is multiplied with the value 6 to indicate the offset; and

PRAH preamble sequence information (*rootSequenceIndex* and *ZeroCorrelationZoneConfig*). This is used to determine the PRACH preamble sequences to be used for the random access procedure. The random access procedure may be contention based. However, if enough resources are allocated for the PRACH in the SCell, the probability of collision may be low.

The UE may derive the physical PRACH resources for each SCell in the group of group-based configured SCells based on the received PRACH configuration information and optionally information specific to each SCell. Examples of information specific to a SCell could be the SCell index or SCell PCI (physical cell ID).

The method to derive the physical PRACH resources from the received PRACH configuration based on SCell index and/or SCell PCI may be one or more of standardized by specifications, explicitly signalled to the UE by the network using higher layer signalling, or a combination of both. For example a plurality of methods are standardized and the network signals which of the standardized methods is being used. If a method is standardised, then the UE would have knowledge of the method without requiring the details of the method to be signalled.

In some embodiments, a similar method as discussed for mapping one PRACH configuration signalled with group-based configuration into different physical layer resources in different SCells depending on the SCell index and/or SCell PCI could alternatively or additionally also be used for other SCell physical layer configurations, for example for physical layer configuration of PUCCH (physical uplink control channel) and SRS (sounding reference signal) resources.

In one embodiment the method used for mapping the PRACH configuration in the PRACH information to the PRACH physical layer resources to be used in different SCells configured with group-based configuration is based on incrementally increasing/decreasing (+/-y where y is the size of the PRB and in some embodiments is 6) the PRACH frequency offset signalled in the PRACH configuration information until either:

all possible values of the frequency offset (given the UL bandwidth and the frequency resources reserved for PUCCH transmission) are used, or

there are no more SCell indexes in SCell group-based configuration message

In another embodiment, the method used for mapping the PRACH configuration information to the PRACH physical layer resources to be used in different SCells

configured with group-based configuration is based on incrementally increasing/decreasing the PRACH configuration index signalled in PRACH-Config until either:

all possible values of the PRACH configuration indexes with same preamble format and equal number of subframes per radio frame with available PRACH transmission but different subframe numbers are used, or

there are no more SCell indexes in SCell group-based configuration message

In another embodiment, the method used for mapping the PRACH configuration information to the PRACH physical layer resources to be used in different SCells configured with group-based configuration is based on determining the logical root sequence number to be used in a SCell as a function of the root sequence index signalled in PRACH configuration information and of the corresponding SCell index.

Some embodiments may use a combination of two or more of the above methods.

In another embodiment, the PCI of the configured SCell is used together with the PRACH configuration in the PRACH configuration information and an appropriately designed mapping function $f()$ to determine the physical PRACH resources to be used in the corresponding SCell:

[PRACH configuration index, PRACH frequency offset, PRACH logical root sequence number] = $f(\text{PRACH-Configuration information, PCI})$

As an example, it can be noted that in cellular networks neighbor cells might need to be configured with a different root sequence index to avoid the reception of false preambles in adjacent eNBs (in case PRACH resources in neighbour cells are configured on same time and frequency resources). Such planning can be linked to the PCI planning.

Therefore, in one embodiment, the function used in the UE to determine the logical root sequence number to be used in a SCell only takes as input the PCI of the

corresponding cell.

In another embodiment, the function takes as input the SCell index and the logical root sequence number signalled in the PRACH configuration information.

It should be noted that in some embodiments, the configuration rule for assigning the corresponding SCell PRACH (or other UL control resources) could be designed to automatically exclude certain configurations in case one SCell knows the parameters for

the neighboring SCells (for instance obtained through the SCells communicating directly or the SCells using a network listen mode to discover configurations of neighboring cells).

The function $f()$ could be standardized, signaled to the UE using higher layer signaling (e.g. as part of the group-based configuration), or a combination of both.

5

Figures 7A to 7C show three different options for splitting downlink U-plane data.

Referring first to Figure 7A, two bearers (EPS bearer #1 and EPS bearer #2) are received at S-GW 708, where they split. For ease of understanding EPS bearer #1 is shown with a solid line, and EPS bearer #2 is shown with a broken line. That is EPS
10 bearer #1 is sent to MeNB 710, and EPS bearer #2 is sent to SeNB 712. Both bearers are then subsequently respectively received at the UE 720 from the MeNB 710 and the SeNB 712. It may therefore be considered that the S1-U terminate in SeNB. This may be considered a relatively simple implementation, with backhaul offload possible. However it may not fully hide the SeNB mobility from the CN.

15 Figure 7B shows a second option for splitting the bearer. Again EPS bearer #1 and EPS bearer #2 are received at S-GW 708'. Both bearers are then sent to MeNB 710'. That is the S1-U terminates in MeNB, with no bearer split in the RAN. From MeNB 710' the bearer #1 is sent directly to UE 720', whereas bearer #2 is sent to the UE 720' via SeNB 712'. That is the bearer is split at the MeNB.

20 A third option is shown in Figure 7C. Initially both bearers #1 and #2 are received at S-GW 708''. Both bearers are sent to MeNB 710''. From there both bearers are sent directly to UE 720''. However bearer #2 is also sent to UE 720'' via SeNB 712''. This option may provide throughput gain also with a single bearer. This embodiment may require increased reordering buffers at the UE, and flow control between MeNB 710'' and
25 SeNB 712''.

Five different alternatives for the manner in which the bearers are received and sent from the MeNB and SeNB, and the architecture thereof, is shown in Figures 8A to 8E.

30 In Figure 8A a bearer #1 is received at MeNB 810 and bearer #2 is received at SeNB 812. Both the MeNB and SeNB comprise a PDCP block, an RLC block, a MAC

block and a PHY block. The bearers #1 and #2 are then subsequently forwarded to UE 820. It will therefore be appreciated that there are separate and independent protocol stacks in the UE 820 as well as the network elements 810 and 812. The use of independent PDCCPs for the different bearers enables separate security and different
5 ciphering keys. The UE may also be capable of handling multiple user plane security keys. This implementation may be relatively simple to specify and implement in both the user equipment 820 and the network elements. In the embodiment of Figure 8A the SeNB mobility may not be fully hidden from the core network.

In the embodiment of Figure 8B the architecture of the MeNB 810', SeNB 812',
10 and UE 820' are the same as shown in Figure 8A. However in Figure 8B the bearer #1 and bearer #2 are both initially received at MeNB 810'. Bearer #2 is split at this point and is sent separately on the Xn interface to the SeNB 812'. The embodiment of Figure 8B may enable the hiding of SeNB mobility from the core network. There may also be increased backhaul traffic on the Xn interface.

In the embodiment of Figure 8C the architecture of the UE 820'' is the same as in Figures 8A and 8B. However the architectures of MeNB 810'' and SeNB 812'' differ. That is the PDCP is located in the MeNB 810'', for both bearer #1 and bearer #2. That is the SeNB 812'' does not comprise a PDCP block. Since the PDCP is located in the MeNB then all data is routed via MeNB, and security is also carried out in MeNB. The PDCP in
20 the UE 820'' may be configured to cope with missing and/or out of order PDCP PDUs. This embodiment is simple to specify and implement in the UE 820'', although slightly more complex for the network elements since they require the processing of the bearer split, since there is a requirement for the PDCP to RLC connection over the Xn interface between the MeNB 810'' and the SeNB 812''.

A fourth alternative is shown in Figure 8D. Similarly to Figure 8C the PDCP is located in the MeNB 810'''. That is security is carried out in the MeNB, with all data being routed via the MeNB. There is a full protocol stack (i.e. PDCP, RLC, MAC and PHY) for both bearer #1 and bearer #2 in the MeNB. The SeNB 812''' which is connected to MeNB 810''' over the Xn interface comprises the RLC, MAC and PHY. The UE 820''' comprises
30 three protocol stacks as shown. The second and third protocol stacks share a PDCP block for the bearer #2. That is the UE 820''' combines two "RLC bearers". This may require reordering of PDCP PDUs. A timer may also be needed to recover from gaps due to the Xn interface, and the UE also may be configured to cover Xn, HARQ and RLC. The RLC retransmissions and status PDUs may be received via the same eNB as the initial

transmission.

A fifth embodiment is shown in Figure 8E. This is similar to the embodiment of Figure 8D although it comprises a bearer split with master-slave RLC. That is the master RLC is comprised in the MeNB 810''' and the slave RLC (shown by the dotted box) is comprised in the SeNB 812'''. In the UE there is a combined RLC and combined PD
5 for combining the two bearers from the MeNB and the SeNB. As with the embodiment of Figure 8D the PD is comprised in the MeNB 810''', and therefore all security is also carried out in the MeNB. In terms of the UE 820''' it may comprise a potentially longer RLC sequence number and RLC re-segmentation for unacknowledged mode (UM).

Figure 9 is a signalling diagram showing the signalling between an MeNB 910, UE 920, a first SeNB 912 and a second SeNB 914.

At step S1 MeNB 910 and UE 920 are communicating packet data. At step S2 a measurement report is sent from the UE to the MeNB 910. On the basis of this
15 measurement report at step S3 the MeNB 910 decides to prepare the first SeNB 912 and the second SeNB 914 as potential target S-cells. Accordingly at step S4 an S-cell reconfiguration request is sent from MeNB 910 to SeNB 912. At step S5 the SeNB 912 sends an S-cell configuration confirm message to the MeNB 910. At step S6 the MeNB 910 sends an S-cell configuration request to the SeNB 914. At step S7 the SeNB 914
20 sends an S-cell configuration confirm message to the MeNB 910. Following the configuration of SeNBs 912 and 914, an RRC reconfiguration request is sent from MeNB 910 to UE 920 at step S8. At step S9 a RRC reconfiguration complete message is sent from UE 920 to MeNB 910. Following this reconfiguration at step S10 it is shown that the UE undergoes a random access procedure with SeNB 912 using PRACH resources of the
25 SeNB 912.

At step S11 it is shown that the UE 920 undergoes a random access procedure with SeNB 914 using the PRACH resources of SeNB 914.

Some embodiments may have the advantage that it allows the network to plan using
30 different physical layer resources (e.g. for PRACH) in neighbor cells (e.g. small cells in one cluster of small cells) while at the same time the network can configure the UE with the same cells as SCells using a single information element.

Embodiments have been described where a UE is in communication with two cells. Some embodiments may be used where a UE is in communication with three or more cells.

Figure 10 is a flow chart showing steps according to some embodiments, viewed from a user device or equipment. At step S1 a user device or user equipment receives group-based channel configuration information related to a group of cells. At step S2 a determination is made of resources for a cell in the group on the basis of the group-based channel configuration information and respective cell-specific information.

Referring back to Figure 4 a mobile communication device 200 is shown. The device 200 includes components/facilities 203, such as processing entity 201, memory 202, suitable for carrying out the functions of the flow chart of Figure 10. The components/facilities may be software, hardware or combinations thereof. It will be understood that within the device 200 the modules and memory may be implemented in one or more physical or logical entities. The device 200 also comprises a transceiver 206 (or may have separate transmitter and receiver) for receiving the information.

Figure 11 is a flow chart showing steps according to some embodiments, viewed from a network apparatus such as a base station (for example an MeNB). At step S1 the apparatus configures group-based channel configuration information to be usable for determining resources for a cell in a group of cells in dependence on the group-based channel configuration information and cell-specific information. At step S2 the group-based channel configuration information is sent to at least one user equipment.

Referring back to Figure 5, the control apparatus 300 includes facilities/components, such as memory 301 and processing unit 302, 303 suitable for carrying out the functions of the flow chart of Figure 11. The components/facilities may be software, hardware or combinations thereof. It will be understood that within the apparatus 300 the modules and memory may be implemented in one or more physical or logical entities. The apparatus 300 also comprises input-output interface 304 for sending the information.

An appropriately adapted computer program code product or products may be used for implementing the embodiments, when loaded on an appropriate data processing apparatus, for example for determining geographical boundary based operations and/or other control operations. The program code product for providing the operation may be stored on, provided and embodied by means of an appropriate carrier medium. An appropriate computer program can be embodied on a computer readable record medium.

A possibility is to download the program code product via a data network. In general, the various embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Embodiments of the inventions may thus be practiced in various components such as integrated circuit modules. The design of
5 integrated circuits is by and large a highly automated process. Complex and powerful software tools are available for converting a logic level design into a semiconductor circuit design ready to be etched and formed on a semiconductor substrate.

It is also noted herein that while the above describes exemplifying embodiments of the invention, there are several variations and modifications which may be made to the
10 disclosed solution without departing from the scope of the present invention.

Claims

1. A method comprising

5 receiving at a user device group-based channel configuration information related to a group of cells; and

determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

10 2. A method as claimed in claim 1, wherein said channel configuration information is received in a single information element.

3. A method as claimed in any preceding claim, wherein said channel configuration information comprises at least one of:

15 information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

4. A method as claimed in any preceding claim, wherein said respective cell information comprises at least one of secondary cell index and physical cell identity.

20

5. A method as claimed in any preceding claim comprising receiving information which indicates how said resources are to be determined.

25 6. A method as claimed in any preceding claim, wherein said group of cells comprises a group of secondary cells.

7. A computer program comprising computer executable instructions which when run on one or more processors perform the method of any of claims 1 to 6.

8. An apparatus comprising:

5 at least one processor;

and at least one memory including computer program code;

the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

receive group-based channel configuration information related to a group of cells;

10 and

determine resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

9. An apparatus as claimed in claim 8, wherein the at least one processor and the at least one memory are configured to cause the apparatus to receive said channel configuration information in a single information element.

15

10. An apparatus as claimed in claim 8 or claim 9, wherein said channel configuration information comprises at least one of:

20 information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

11. An apparatus as claimed in any of claims 8 to 10, wherein said respective cell information comprises at least one of secondary cell index and physical cell identity.

25

12. An apparatus as claimed in any of claims 8 to 11, wherein the at least one processor and the at least one memory are configured to cause the apparatus to receive information which indicates how said resources are to be determined.

5 13. An apparatus as claimed in any of claims 8 to 12, wherein said group of cells comprises a group of secondary cells.

14. A method comprising:

10 sending to at least one user device group-based channel configuration information related to a group of cells;

said group-based channel configuration information configured to be usable for determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

15 15. A method as claimed in claim 14, wherein said channel configuration information is sent in a single information element.

16. A method as claimed in claim 14 or claim 15, wherein said channel configuration information comprises at least one of:

20 information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

17. A method as claimed in any of claims 14 to 16, wherein said respective cell information comprises at least one of secondary cell index and physical cell identity.

25

18. A method as claimed in any of claims 14 to 17 comprising sending information which indicates how said resources are to be determined

19. A method as claimed in any of claims 14 to 18, wherein said group of cells comprises a group of secondary cells.

5 20. A computer program comprising computer executable instructions which when run on one or more processors perform the method of any of claims 14 to 19.

21. An apparatus comprising:

at least one processor;

10 and at least one memory including computer program code;

the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to:

send to at least one user device group-based channel configuration information related to a group of cells;

15 said group-based channel configuration information configured by said apparatus to be usable for determining resources for a cell in the group of cells on the basis of the group-based channel configuration information and respective cell-specific information.

22. An apparatus as claimed in claim 21, wherein said at least one processor and said at least one memory are configured to cause said apparatus to send said channel
20 configuration information in a single information element.

23. An apparatus as claimed in claim 21 or claim 22, wherein said channel configuration information comprises at least one of:

25 information relating to an index of available resources; information relating to available frequency resources; and information relating to preamble sequences.

24. An apparatus as claimed in any of claims 21 to 23, wherein said respective cell information comprises at least one of secondary cell index and physical cell identity.

25. An apparatus as claimed in any of claims 21 to 24, wherein said at least one processor and said at least one memory are configured to cause said apparatus to send information which indicates how said resources are to be determined

26. An apparatus as claimed in any of claims 21 to 25, wherein said group of cells comprises a group of secondary cells.

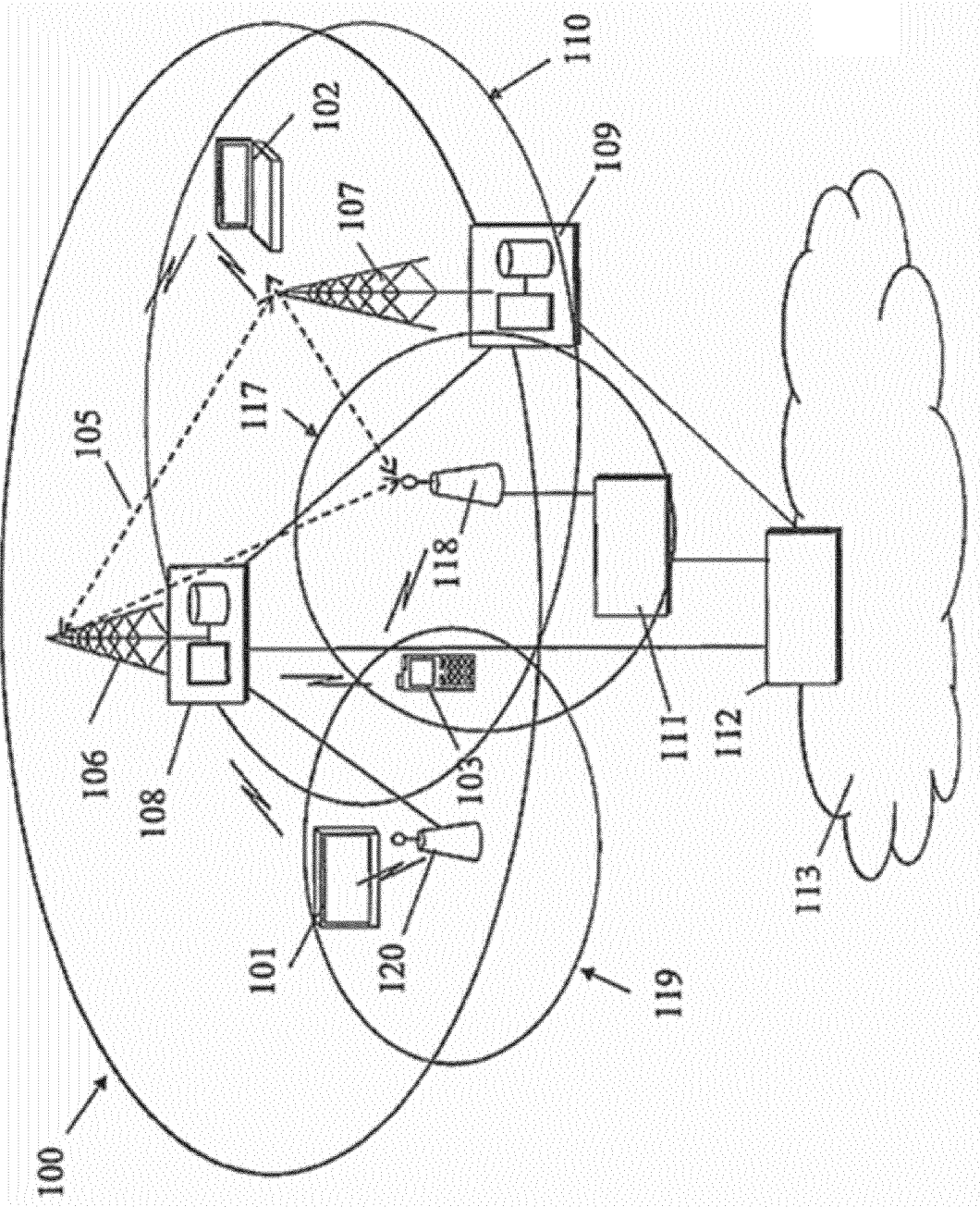


Figure 1

Figure 2

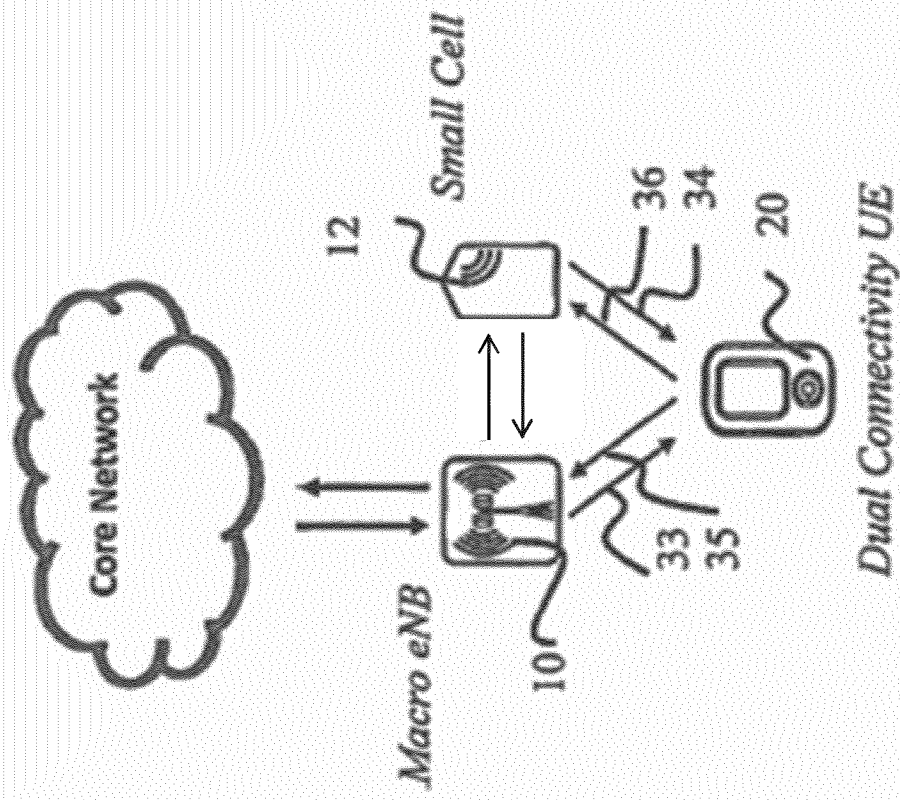
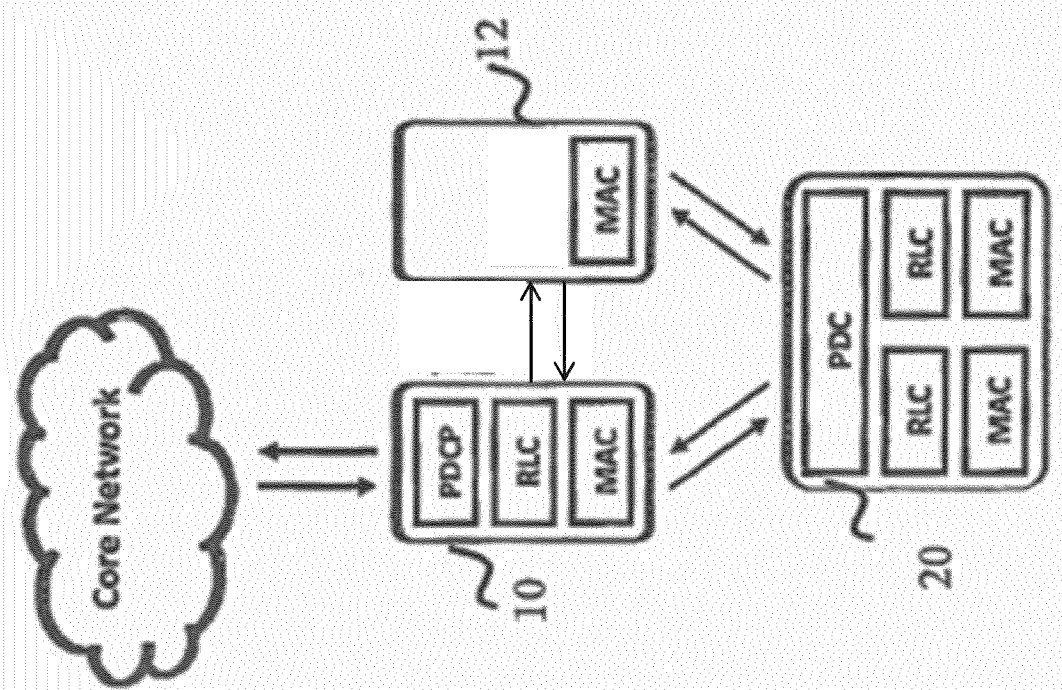


Figure 3



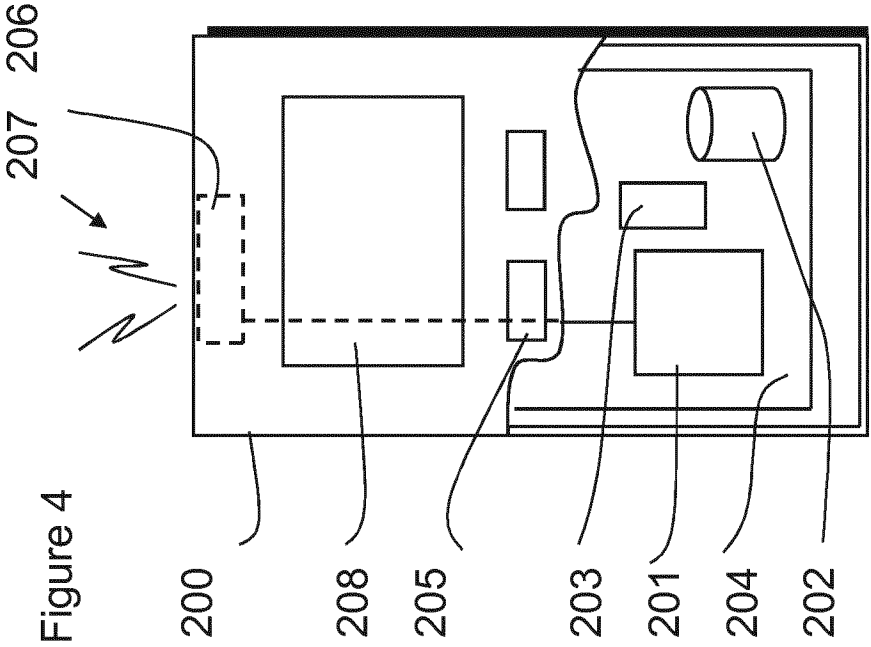
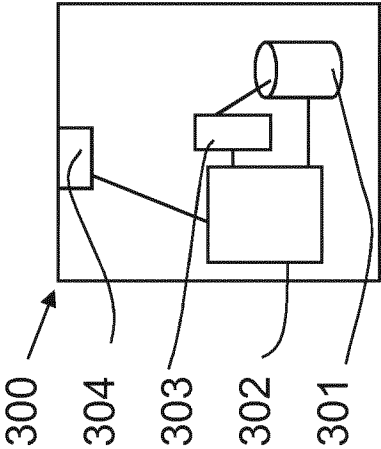


Figure 5



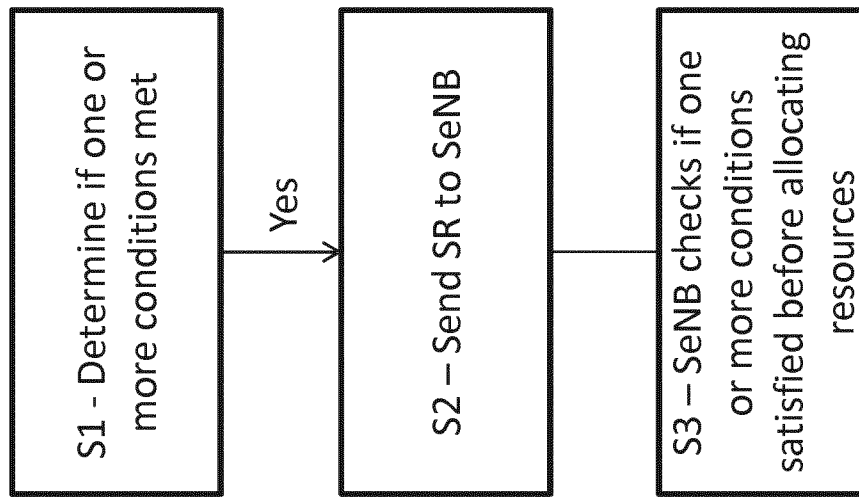


Figure 6

Figure 7A

Option 1

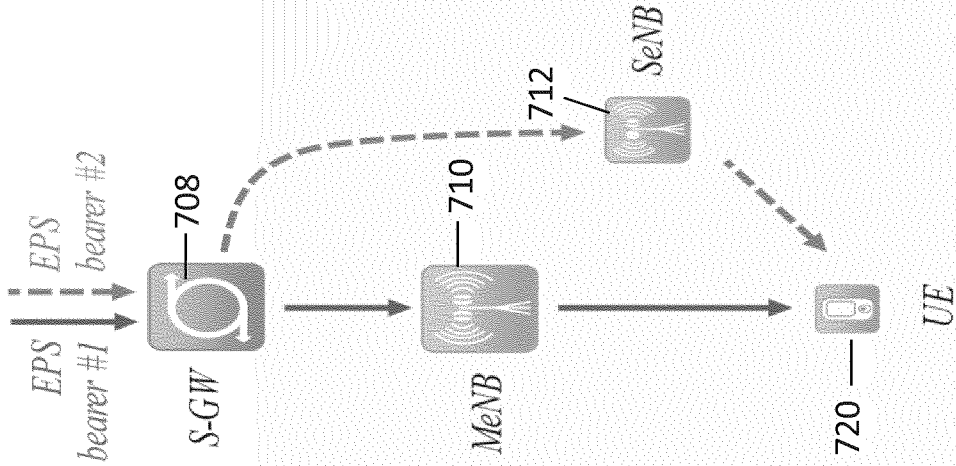


Figure 7B

Option 2

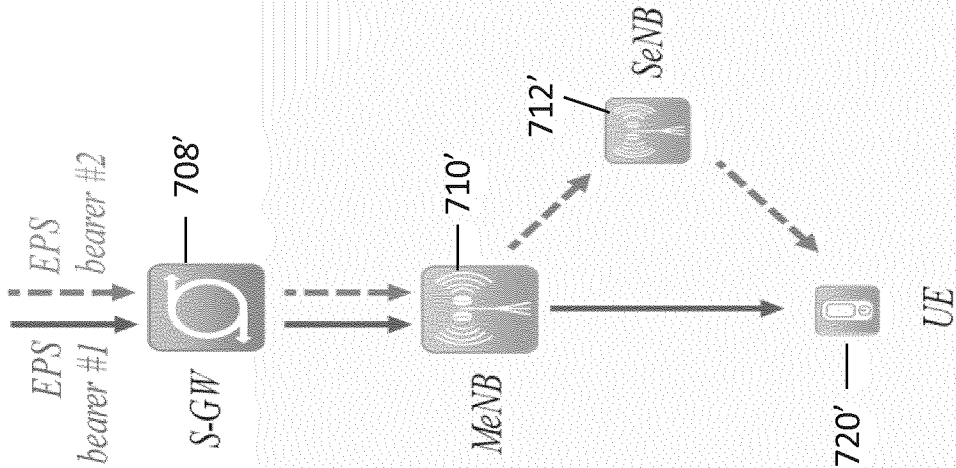


Figure 7C

Option 3

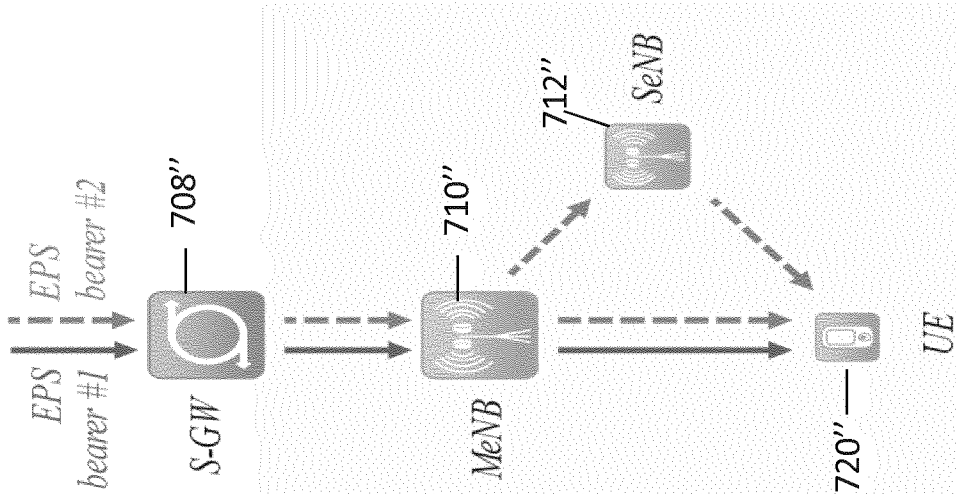


Figure 8B

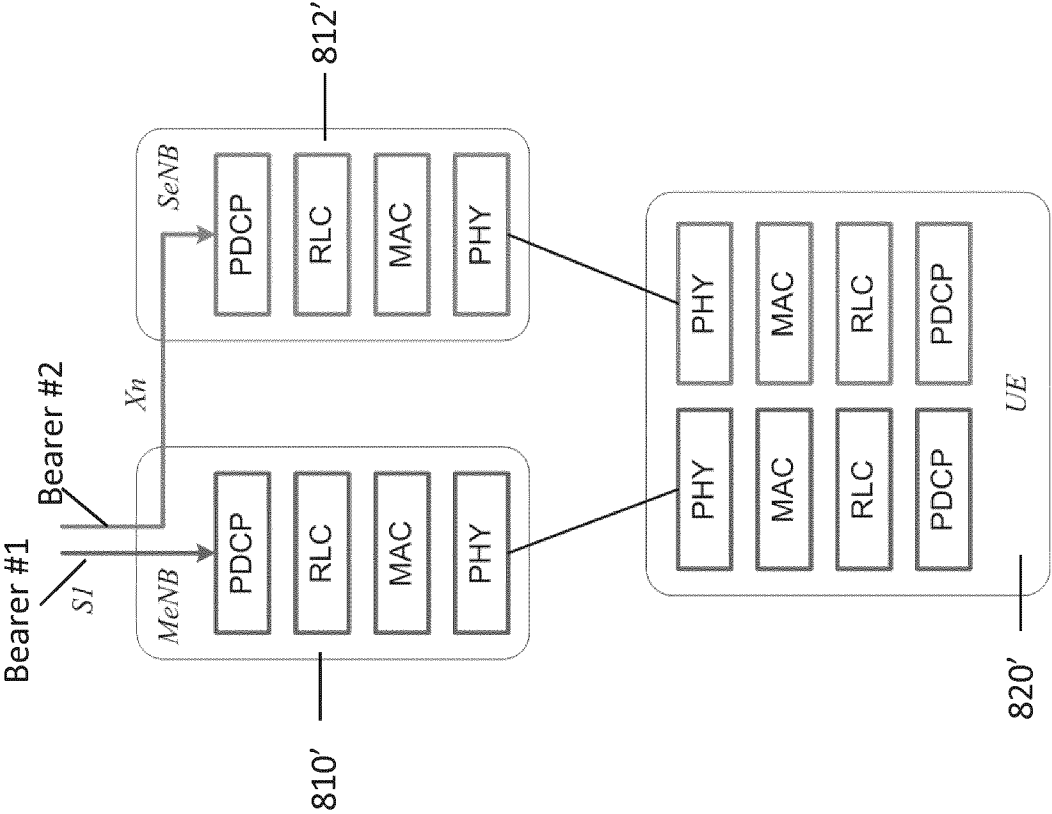
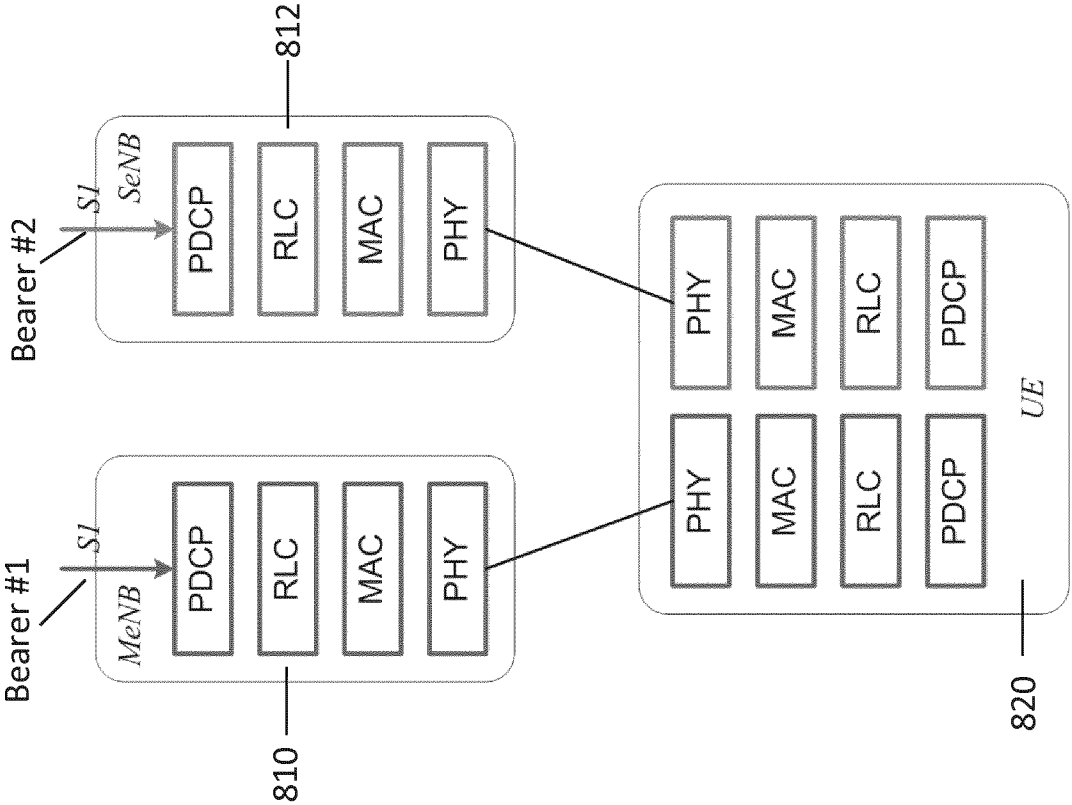


Figure 8A



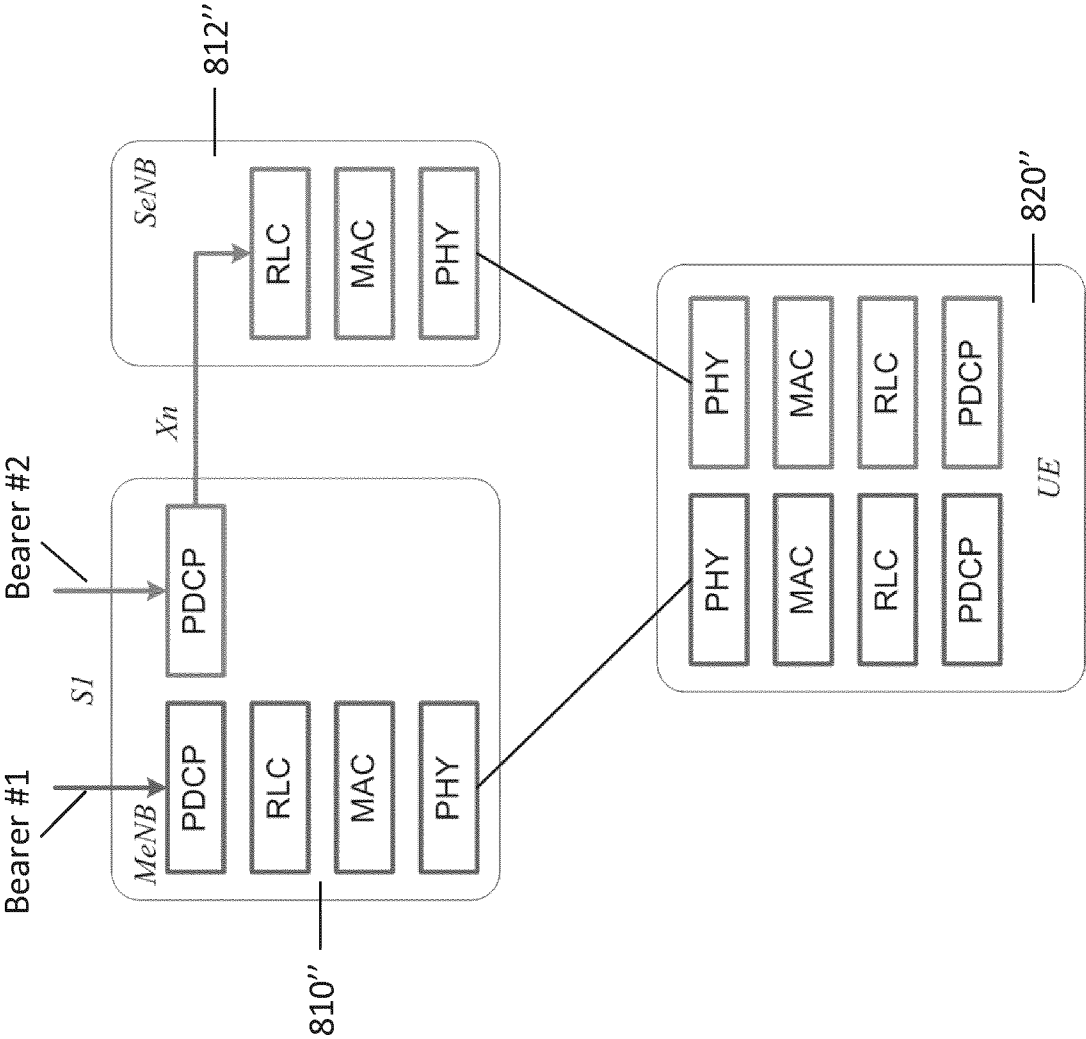


Figure 8C

Figure 8D

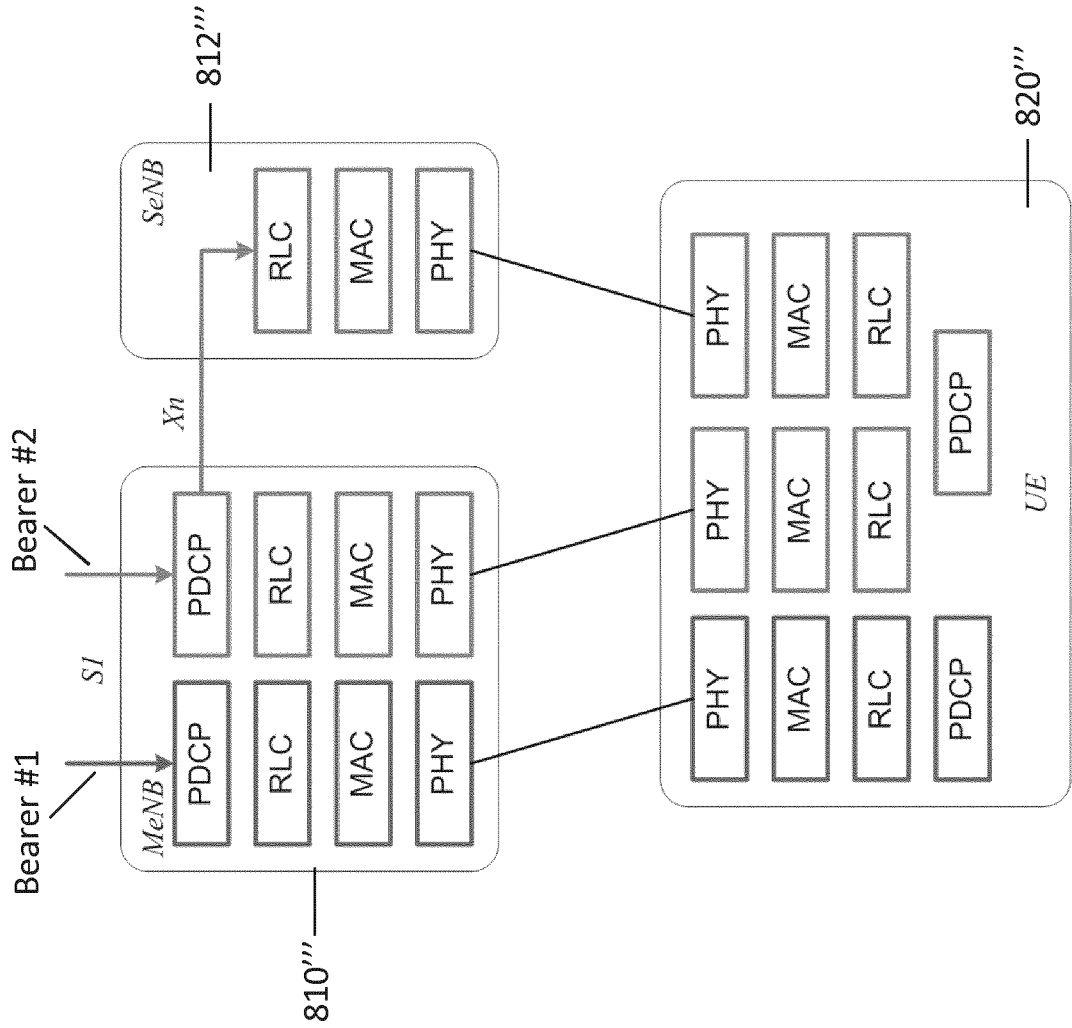


Figure 8E

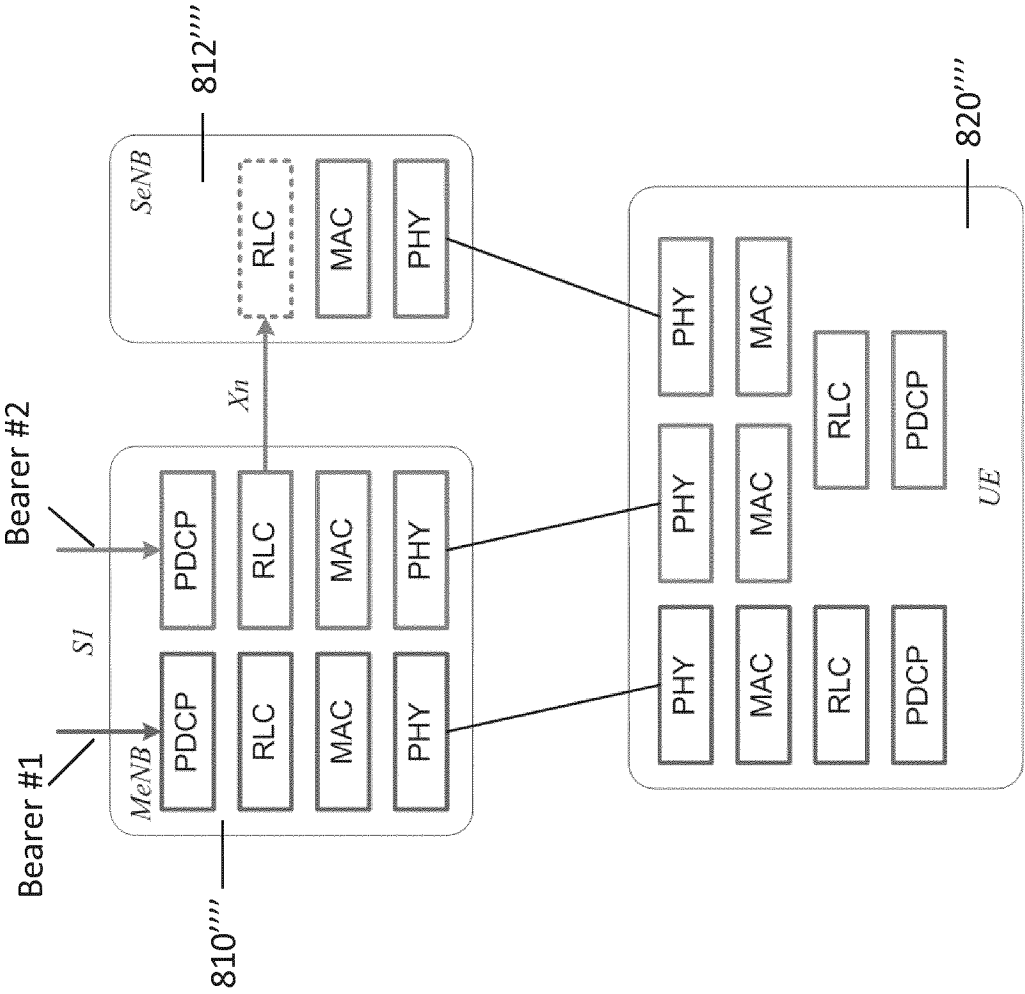
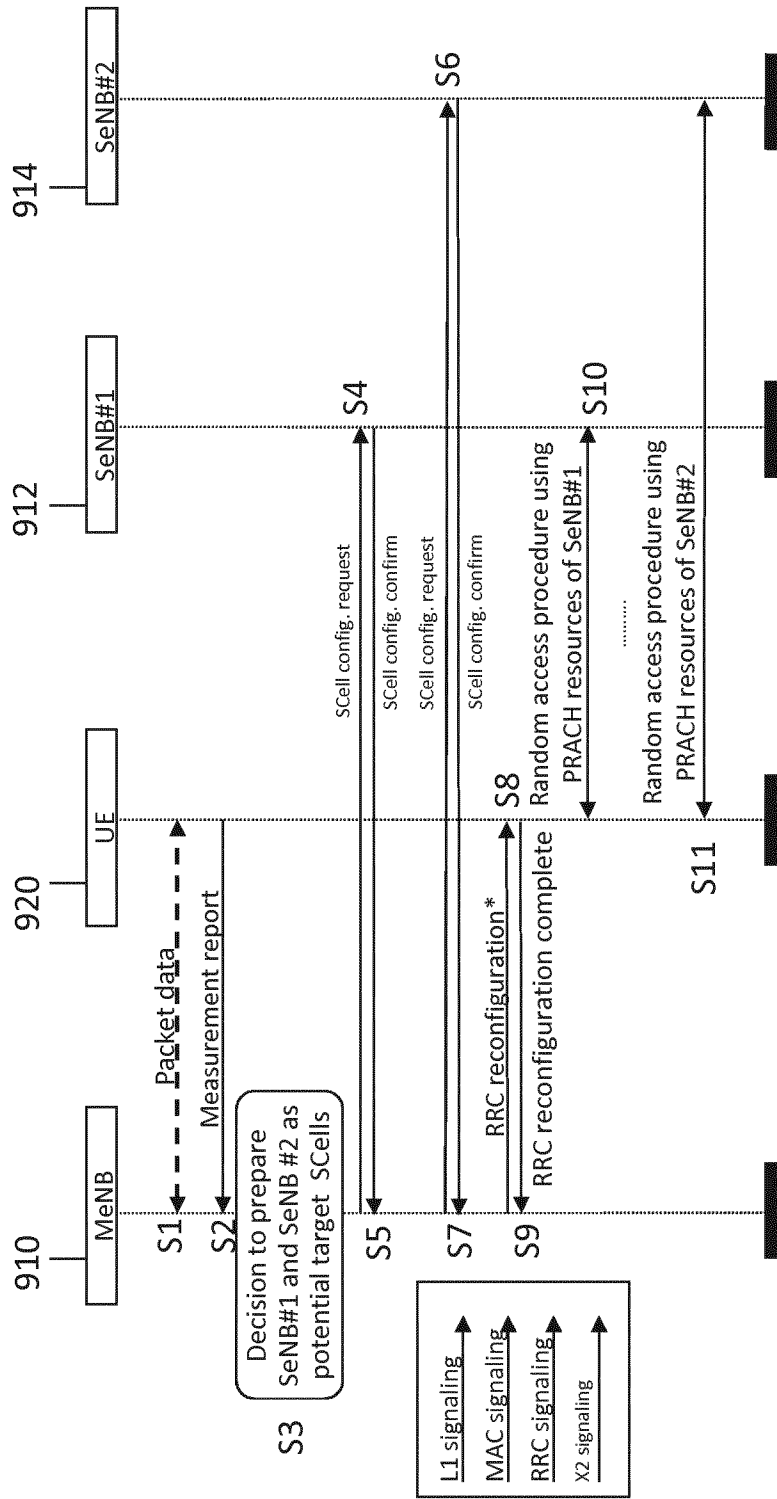


Figure 9



*In RRC reconfiguration message only one PRACH configuration is signaled to the UE, which is used by the UE to determine the PRACH resources to be used on both SeNB#1 and SeNB2

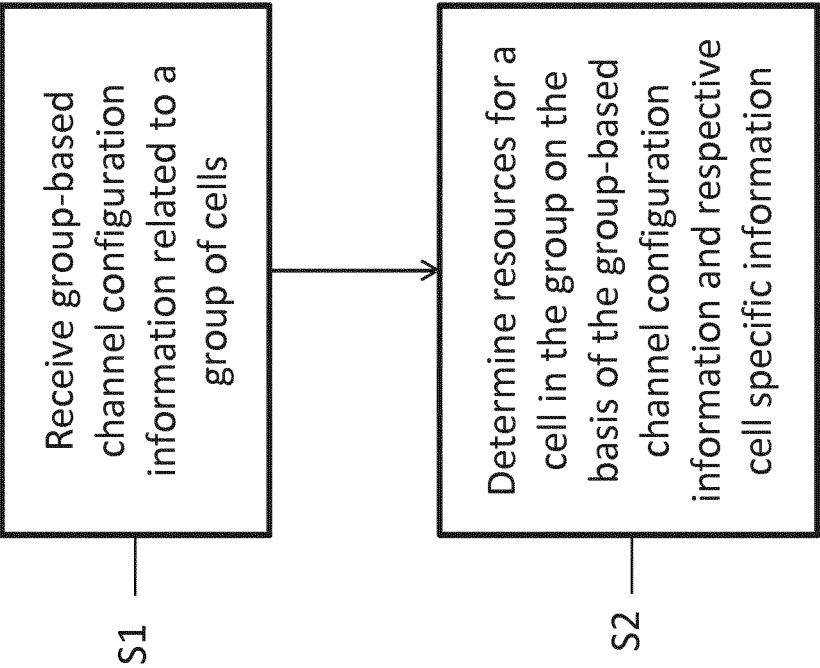
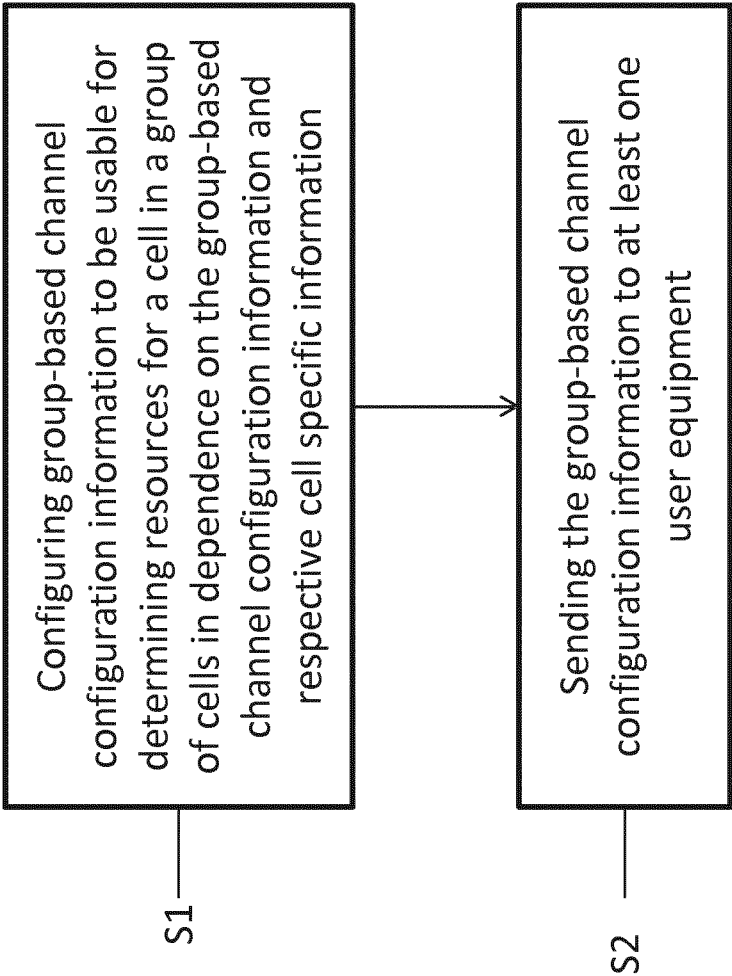


Figure 10

Figure 11



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/070225

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L5/00 H04W16/02
ADD.

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)
H04L H04W

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

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

EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2013/114574 A1 (NG BOON LOONG [US] ET AL) 9 May 2013 (2013-05-09) abstract figures 7-9 figures 12-14 paragraph [0004] - paragraph [0005] paragraph [0021] - paragraph [0101] paragraph [0129] - paragraph [0163] -----	1,7,8, 14,20,21 2-6, 9-13, 15-19, 22-26
X A	CN 102 932 797 A (ZTE CORP) 13 February 2013 (2013-02-13) abstract ----- -/-	1,7,8, 14,20,21 2-6, 9-13, 15-19, 22-26



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

16 May 2014

Date of mailing of the international search report

26/05/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Frantzeskakis, D

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/070225

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/281548 A1 (LIN SHIANG-JIUN [TW] ET AL) 8 November 2012 (2012-11-08) the whole document -----	1-26
A	US 2013/242730 A1 (PELLETIER GHYSLAIN [CA] ET AL) 19 September 2013 (2013-09-19) the whole document -----	1-26
A	US 2013/195066 A1 (LEE HYUNWOO [KR] ET AL) 1 August 2013 (2013-08-01) the whole document -----	1-26

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/070225

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