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(54) Title: METHOD FOR SELECTING ANTENNAS TO BE INCLUDED IN A SET OF RECEIVING ANTENNAS

(57) Abstract: A Radio Network Node (RNN) (102), and a method therein, for reception of data comprised in an UL transmission on a common channel. The RNN serves a primary cell (104) comprising a primary antenna (110). The RNN, the primary cell and at least one secondary antenna (112,116) are comprised in a communications system (100). Further, a user equipment (UE) (108) is located in the primary cell. The RNN adds the primary antenna (110) and the at least one secondary antenna (112,116) to a set of receiving antennas. The primary and secondary antennas received a transmission from the UE. The secondary antenna is comprised in the primary cell or in the at least one secondary cell. Further, the RNN receives the data comprised in the UL transmission from all antennas comprised in the set of receiving antennas.

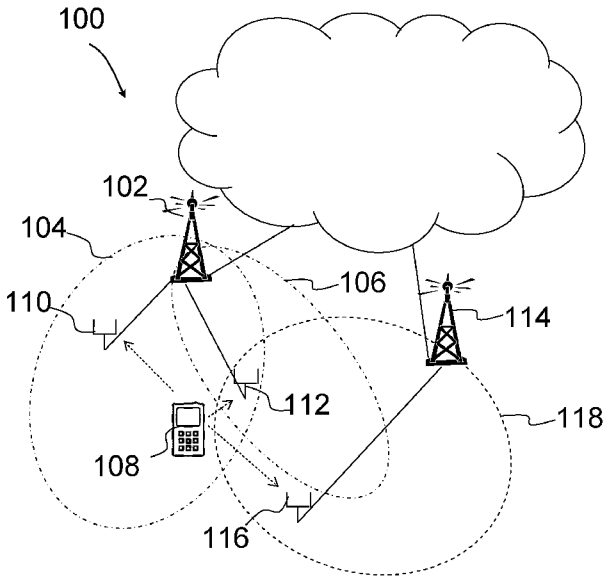

Fig. 1

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METHOD FOR SELECTING ANTENNAS TO BE INCLUDED IN A SET OF RECEIVING ANTENNAS

TECHNICAL FIELD

Embodiments herein relate to a radio network node, a method therein, and to a radio communications system comprising the radio network node. In particular, embodiments herein relate to the reception of data comprised in an uplink transmission on a common channel.

BACKGROUND

Communication devices such as User Equipments (UE) are enabled to communicate wirelessly in a radio communications system, sometimes also referred to as a radio communications network, a mobile communication system, a wireless communications network, a wireless communication system, a cellular radio system or a cellular system. The communication may be performed e.g. between two user equipments, between a user equipment and a regular telephone and/or between a user equipment and a server via a Radio Access Network (RAN) and possibly one or more core networks, comprised within the wireless communications network.

User equipments are also known as e.g. mobile terminals, wireless terminals and/or mobile stations, mobile telephones, cellular telephones, or laptops with wireless capability, just to mention some examples. The user equipments in the present context may be, for example, portable, pocket-storable, hand-held, computer-comprised, or vehicle-mounted mobile devices, enabled to communicate voice and/or data, via the RAN, with another entity.

The wireless communications network covers a geographical area which is divided into cell areas, wherein each cell area being served by a network node such as a Base Station (BS), e.g. a Radio Base Station (RBS), which sometimes may be referred to as e.g. eNB, eNodeB, NodeB, B node, or BTS (Base Transceiver Station), depending on the technology and terminology used. The base stations may be of different classes such as e.g. macro eNodeB, home eNodeB or pico base station, based on transmission power and thereby also cell size. A cell is the geographical area where radio coverage is provided by the base station at a base station site. One base station, situated on the base station site, may serve one or several cells. Further, each base station may support one or several radio access and communication technologies. The base stations communicate

over the radio interface operating on radio frequencies with the user equipments within range of the base stations.

In some RANs, several base stations may be connected, e.g. by landlines or microwave, to a radio network controller, e.g. a Radio Network Controller (RNC) in Universal Mobile Telecommunications System (UMTS), and/or to each other. The radio network controller, also sometimes termed a Base Station Controller (BSC) e.g. in GSM, may supervise and coordinate various activities of the plural base stations connected thereto. GSM is an abbreviation for Global System for Mobile Communications (originally: Groupe Spécial Mobile).

In the context of this disclosure, the expression Downlink (DL) is used for the transmission from the base station to the UE. The expression Uplink (UL) is used for the transmission in the opposite direction i.e. from the UE to the base station.

In 3rd Generation Partnership Project (3GPP) Long Term Evolution (LTE), base stations, which may be referred to as eNodeBs or even eNBs, may be directly connected to one or more core networks.

UMTS is a third generation mobile communication system, which evolved from the GSM, and is intended to provide improved mobile communication services based on Wideband Code Division Multiple Access (WCDMA) access technology. UMTS Terrestrial Radio Access Network (UTRAN) is essentially a radio access network using wideband code division multiple access for user equipments. The 3GPP has undertaken to evolve further the UTRAN and GSM based radio access network technologies.

According to 3GPP/GERAN, a user equipment has a multi-slot class, which determines the maximum transfer rate in the uplink and downlink direction. GERAN is an abbreviation for GSM EDGE Radio Access Network. EDGE is further an abbreviation for Enhanced Data rates for GSM Evolution.

As previously mentioned, a telecommunication radio access network covers large areas that are built up of smaller cells. The cell comprises common channels and user dedicated channels in both downlink and uplink. Within an area covered by several cells the common channels are unique for the cell and the radio network node serving the cell while dedicated channels are unique to the user equipment. The radio network node serving the cell broadcasts cell information to the user equipment, which cell information defines the cell. The coverage of the cell is given by the transmitted power and the design of the antennas.

In a WCDMA telecommunication system the radio network node serving the cell provides an uplink Random Access procedure. When a user equipment needs to setup a connection or transmit data to the network it makes use of the random access procedure to request access to a Physical Random Access CHannel (PRACH), or to request access to an Enhanced Dedicated CHannel (E-DCH) in IDLE mode or in CELL_FACH mode (common E-DCH). The user equipment selects the best cell among the cells detected and uses the random access procedure as defined by the broadcast information received from the best cell. The best cell may be selected based on signal conditions on downlink. Based on the random access procedure parameters the user equipment randomly selects an access slot from the set of available access slots. Then, the user equipment randomly selects a signature from a set of available signatures. The signature is then transmitted, in the access slot selected, on a scrambling code reserved for the random access procedure for the selected cell. The signal that is transmitted is called a random access preamble and when a user equipment sends the random access preamble it makes a request to send data to the network via the selected cell. The radio network node serving the cell has the possibility to acknowledge (ACK) or not acknowledge (NACK) the data transmission request.

If the random access is acknowledged by the radio network node serving the cell, the user equipment transmits its data at a predefined time instant relative to the previous sent random access preamble. The ACK is by the signature selected in the preamble associated with a transmission resource, e.g. a PRACH channel code, and in case of a common Enhanced Dedicated CHannel (E-DCH) transmission required E-DCH configuration parameters such as scrambling code, Fractional Dedicated Physical CHannel (F-DPCH), and E-DCH Hybrid Automatic Repeat Query (ARQ) Indicator Channel (E-HICH).

The set of available signatures are divided into two sets. One set is to be used by user equipments for E-DCH transmission in IDLE mode or CELL_FACH mode (common E-DCH) and the other set is to be used for PRACH data burst in case of a received ACK on the AICH channel.

The user data transmitted by the user equipment is received by the network in the selected cell.

At cell borders coverage from adjacent cells within the same carrier are overlapping. The reason is to get a smooth handover between cells for connected user equipments in CELL_DCH state by establishing and deleting radio links to adjacent cells.

A user equipment in CELL_DCH state can have active radio links in several cells at the same time. The handover is triggered by cell measurements performed by the user equipment.

However, if the user equipment is in IDLE mode or CELL_FACH mode it accesses the network by using a common resource offered by the cell. The user equipment selects the best cell based on received power on the downlink common pilot channel and initiates the random access procedure by selecting and sending a preamble to the selected cell. Due to unbalanced DL/UL cell coverage, high UL interference local in cell, a poor measurement method implemented by the user equipment or due to the use of different frequencies in the downlink and uplink, it may be the case that the cell selected for transmission by the user equipment is not the best cell in an uplink reception perspective.

SUMMARY

An object of embodiments herein is to provide a way of improving the performance in a communications network.

According to a first aspect of embodiments herein, the object is achieved by a method in a radio network node for reception of data comprised in an UL transmission on a common channel. The radio network node serves a primary cell comprising a primary antenna. Further, the radio network node, the primary cell and at least one secondary antenna are comprised in a communications system. A user equipment is located in the primary cell.

The radio network node adds the primary antenna and the at least one secondary antenna to a set of receiving antennas.

The primary antenna and the at least one secondary antenna received a transmission from the user equipment. Further, the at least one secondary antenna is comprised in the primary cell or in at least one secondary cell.

Further, the radio network receives the data comprised in the UL transmission from all antennas comprised in the set of receiving antennas.

According to a second aspect of embodiments herein, the object is achieved by a radio network node for reception of data comprised in an UL transmission on a common channel. The radio network node serves a primary cell comprising a primary antenna.

Further, the radio network node, the primary cell and at least one secondary antenna are comprised in a communications system. A user equipment is located in the primary cell.

The radio network node comprises an adding circuit configured to add the primary antenna and the at least one secondary antenna to a set of receiving antennas.

The primary antenna and the at least one secondary antenna received a transmission from the user equipment. Further, the at least one secondary antenna is comprised in the primary cell or in at least one secondary cell.

The radio network node comprises further a receiving circuit configured to receive the data comprised in the UL transmission from all antennas comprised in the set of receiving antennas.

According to a third aspect of embodiments herein, the object is achieved by a radio communications system comprising the radio network node.

Since the user equipment transmission is received in all antennas comprised in the set of receiving antennas, the reception of user data is improved. This results in an improved performance in the communications network.

An advantage of embodiments herein is the possibility, due to increased diversity gain, to improve the detection performance of the data sent by the user equipment on the common channel.

A further advantage of embodiments herein is that in case of for example a common E-DCH transmission the user equipment is power controlled. Due to increased diversity gain the cell can order the user equipment to reduce its UL transmission power and the communications system will benefit from a decreased interference caused by the user equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

Examples of embodiments herein are described in more detail with reference to attached drawings in which:

Figure 1 is a schematic block diagram illustrating embodiments of a communications system;

Figure 2 is a flow chart depicting embodiments of a method in a radio network node; and

Figure 3 is a schematic block diagram illustrating embodiments of a radio network node.

DETAILED DESCRIPTION

Embodiments herein will be exemplified in the following non-limiting description.

Embodiments described herein provide for the use of several antennas to improve reception of data in an uplink transmission on a common channel. An uplink user equipment transmission, such as a random access, is performed to a specific cell. Dependent on possible overlap from adjacent cells, the user equipment transmission is received also in one or more antennas of the adjacent cells. Embodiments herein relate to the use of the antenna diversity obtained from several adjacent cells in order to improve the received user equipment transmission in a cell specific common uplink channel.

Figure 1 schematically illustrates embodiments of **a radio communications system 100**. The radio communication system 100 may be a 3GPP communications system or a non-3GPP communications system. The radio communications system 100 may comprises one or more of radio communications networks (not shown). Each radio communications network may be configured to support one or more Radio Access Technologies (RATs). Further, the one or more radio communications networks may be configured to support different RATs. Some examples of RATs are GSM, WCDMA, and LTE.

The radio communications system 100 comprises **a radio network node 102,** herein sometimes also referred to as **a first radio network node 102**. The radio network node 102 may be a base station such as an eNB, an eNodeB, Node B or a Home Node B, a Home eNode B, a radio network controller, a base station controller, an access point, a relay node (which may be fixed or movable), a donor node serving a relay, a GSM/EDGE radio base station, a Multi-Standard Radio (MSR) base station or any other network unit capable to serve a user equipment in the cellular communications system 100.

Further, the radio network node 102 provides radio coverage over **at least one cell 104, 106**. In Figure 1, the radio network node 102 is illustrated to provide radio coverage over **a primary cell 104**, and over **at least one first secondary cell 106**. In

some embodiments, a user equipment may select the cell with best received downlink signal power for random access in uplink. In this description, the primary cell 104 of the radio network node 102 is considered to be the cell selected by the user equipment. Consequently, the at least one first secondary cell 106 is at least one cell in which the user equipment transmission may be received but it is not selected by the user equipment for transmission.

The radio communications system 100 comprises further **a user equipment 108**.The user equipment 108 transmits data over a radio interface to the radio network node 102 in an uplink (UL) transmission and the radio network node 102 transmits data to the user equipment 108 in a downlink (DL) transmission. A number of other user equipments, not shown, may also be located within the geographic area 104.

The first user equipment 108 may be e.g. a mobile terminal or a wireless terminal, a mobile phone, a computer such as e.g. a laptop, a tablet pc such as e.g. an iPad™, a Personal Digital Assistant (PDA), or any other radio network unit capable to communicate over a radio link in a cellular communications network. The first user equipment 108 may further be configured for use in both a 3GPP network and in a non-3GPP network.

Further, the communications system comprises **a primary antenna 110**. The primary antenna 110 is comprised in the primary cell 104 and arranged in communication with the radio network node 102. The primary antenna 110 is configured to receive a transmission from the user equipment 108.

The user equipment 108 transmission may be or comprise an access request and/or a signal transmitted on an Enhanced Dedicated Physical Data Channel (E-DPDCH) and/or an Enhanced Dedicated Physical Control Channel (E-DPCCH), or the user equipment 108 transmission may be or comprise an access request and/or a signal transmitted on a Physical Random Access Channel (PRACH).

At least one secondary antenna 112, 116 is comprised in the communications system 100.

At least one first secondary antenna 112 is comprised in the primary cell 104 or in the at least one first secondary cell 106. The at least one first secondary antenna 112 is arranged in communication with the first radio network node 104.

Further, at least one second secondary antenna 116 is comprised in **at least one second secondary cell 118**. The at least one second secondary antenna 112 is arranged in communication with **a second radio network node 114**. The second radio network node 114 and the at least one second secondary cell 118 are comprised in the communications system 100. Further, the at least one second secondary cell 118 is

served by the second radio network node 114. Furthermore, the at least one second secondary cell 118 is at least one cell in which the user equipment transmission may be received but it is not selected by the user equipment for transmission.

The second radio network node 114 may be a base station such as an eNB, an eNodeB, Node B or a Home Node B, a Home eNode B, a radio network controller, a base station controller, an access point, a relay node (which may be fixed or movable), a donor node serving a relay, a GSM/EDGE radio base station, a Multi-Standard Radio (MSR) base station or any other network unit capable to serve a user equipment in the cellular communications system 100. Further, the second radio network node 114 provides radio coverage over the at least one second secondary cell 118.

A method in a radio network node 102 for reception of data comprised in an UL transmission on a common channel will now be described with reference to **Figure 2**. As previously mentioned, the radio network node 102 serves a primary cell 104, which primary cell 104 comprises a primary antenna 110.The radio network node 102, the primary cell 104 and at least one secondary antenna 112,116 are comprised in the communications system 100. Further, a user equipment 108 is located in the primary cell 104. Further, as previously mentioned, the at least one first secondary antenna 112 is comprised in the primary cell 104 or in the at least one first secondary cell 106. Furthermore, the at least one first secondary cell 106 is served by the radio network node 102 and is a neighbour cell to the primary cell 104.

By the term “neighbour cell” when used herein is meant a cell wherein the transmission from the user equipment 108 is possible to be received.

The actions do not have to be performed in the order stated below, but may be taken in any suitable order. Further, actions may be combined. Optional actions are indicated by dashed boxes.

Action 201

When a transmission from the user equipment 108 is received in the primary antenna 110 and in order to find at least one more antenna that may be used for reception of user data, the radio network node 102 may search for the user equipment 108 transmission being received in the at least one first secondary antenna 112. In other words, when a transmission from the user equipment 108 is received in the primary antenna 110, the radio network node 102 may search for the user equipment 108

transmission being received in at least one more antenna which is located within a cell that is served by the radio network node 102.

Action 202

When the user equipment 108 transmission is received in the primary antenna 110 and in order to find at least one more antenna that may be used for reception of user data, the first radio network node 102 may request the second radio network node 114 to search for the user equipment 108 transmission being received in the at least one second secondary antenna 116 of the at least one secondary cell 118. The at least one secondary cell 118 is served by a second radio network node 114 and is a neighbour cell to the primary cell 104. In other words, when a transmission from the user equipment 108 is received in the primary antenna 110, the first radio network node 102 may request the second radio network node 114 to search for the user equipment 108 transmission being received in at least one antenna which is located within a cell that is served by the second radio network node 108.

Action 203

When then the user equipment 108 transmission is received in the second secondary antenna 116 comprised in the at least one second secondary cell 118 served by the second radio network node 114, the first radio network node 102 may receive information about the at least one second secondary antenna 116 from the second radio network node 114. Thus, the second radio network node 108 will provide the first radio network node 102 with information about the at least one second secondary antenna 116 that may be used for reception of user data in order to improve the user data reception.

Action 204

In order to know which antennas to use for user data reception, the radio network node 102 adds the primary antenna 110 and the at least one secondary antenna 112,116 to a set of receiving antennas. This may also be expressed as the radio network node 102 expands the set of receiving antennas. Information relating to the identity of the primary and secondary antennas 110,112,116, signal strength, and/or signal quality may be added to the set of receiving antennas. The signal strength and the signal quality may be estimated signal strength and estimated signal quality, respectively.

The primary antenna 110 and the at least one secondary antenna 112,116 have received a transmission from the user equipment 108. As previously mentioned, the

primary antenna 110 is comprised in the primary cell 104, and the at least one secondary antenna 112,116 is comprised in the primary cell 104 or in the at least one secondary cell 106,118.

In some embodiments, the common channel is a common Enhanced Dedicated Channel (E-DCH). In such embodiments, the radio network node 102 adds the information about the secondary antenna 112,116 to the set of receiving antennas when a signal strength of the received user equipment 108 transmission is above a threshold value. The signal strength may be based on the received user equipment 108 transmission, such as a received access request and/or a received signal transmitted on,a Dedicated Physical Control Channel (DPCCH), and/or Enhanced Dedicated Physical Control Channel (E-DPCCH) and/or on an Enhanced Dedicated Physical Data Channel (E-DPDCH).

In some embodiments, the common channel is a Random Access Channel (RACH). In such embodiments, the radio network node 102 adds the information about the secondary antenna 112,116 to the set of receiving antennas when a signal strength of the received user equipment 108 transmission is above a threshold value. The signal strength may be based on the received user equipment 108 transmission, such as a received access request and/or a received signal transmitted on a Physical Random Access Channel (PRACH).

Action 205

The radio network node 102 receives the data comprised in the UL transmission from all antennas 110,112,116 comprised in the set of receiving antennas. Thereby, the user data reception is improved.

The UL transmission received on each antenna 110,112,116 in the set of receiving antennas may be channel compensated combined and decoded before the data comprised in the UL transmission is received in the radio network node 102.

To perform the method actions in radio network node 102 described above in relation to Figure 2 for reception of data comprised in an UL transmission on a common channel, the radio network node 102 comprises the following arrangement depicted in **Figure 3.**

As previously mentioned, the radio network node 102 serves a primary cell 104 which comprises a primary antenna 110. The radio network node 102, the primary cell

104 and at least one secondary antenna 110,112 are comprised in the communications system 100. Further, a user equipment 108 is located in the primary cell 104.

The radio network node 102 comprises **an input and output port 301** configured to function as an interface for communication in the communication system 100. The communication may for example be communication with the first and/or second radio network node 102,114 and/or communication with one or more second user equipments (not shown).

The radio network node 102 may further comprise **a searching circuit 302**. The searching circuit 302 is configured to search for the user equipment 108 transmission being received in the at least one first secondary antenna 112. The at least one first secondary antenna 112 is comprised in the primary cell 104 or in the at least one first secondary cell 106, which at least one first secondary cell 106 is a neighbour cell the primary cell 104.

In some embodiments, when the at least one first secondary cell 106 is served by the radio network node 102, and when the user equipment 108 transmission is received in the primary antenna 110, the searching circuit 302 is configured to search for the user equipment 108 transmission being received in the at least one first secondary antenna 112.

The radio network node 102 may further comprise **a requesting circuit 303**. The requesting circuit 303 may be configured to request the second radio network node 114 to search for the user equipment 108 transmission being received in at least one second secondary antenna 116 of the at least one second secondary cell 118. The at least one second secondary cell 118 is a neighbour cell to the primary cell 104.

In some embodiments, when the at least one second secondary cell 118 is served by a second radio network node 114, and when the user equipment 108 transmission is received in the primary antenna 110, the radio network node 102 is configured to request the second radio network node 114 to search for the user equipment 108 transmission being received in the at least one second secondary antenna 116.

Further, the radio network node 102 comprises **an adding circuit 304**. The adding circuit 304 is configured to add information about the primary antenna 110 and information about the at least one secondary antenna 112,116 to a set of receiving antennas. This

may also be expressed as the adding circuit 304 is configured to expand the set of receiving antennas.

The primary antenna 110 and the at least one secondary antenna 112,116 are antennas that received a transmission from the user equipment 108. Further, the primary antenna 110 is comprised in the primary cell 104 and the at least one secondary antenna 112,116 is comprised in the primary cell 104 or in the at least one secondary cell 106,118.

In some embodiments, the common channel is a common Enhanced Dedicated Channel (E-DCH). In such embodiments, the adding circuit 304 may further be configured to add the information about the at least one secondary antenna 112,116 to the set of receiving antennas when a signal strength of the received user equipment 108 transmission is above a threshold value. The signal strength may be based on the received user equipment 108 transmission, such as a received access request and/or a received signal transmitted on a Dedicated Physical Control Channel (DPCCH),and/or Enhanced Dedicated Physical Control Channel (E-DPCCH) and/or on an Enhanced Dedicated Physical Data Channel (E-DPDCH).

In some embodiments, the common channel is a Random Access Channel (RACH). In such embodiments, the adding circuit 304 may further be configured to add the information about the at least one secondary antenna 112,116 to the set of receiving antennas when a signal strength of the received user equipment 108 transmission is above a threshold value. The signal strength may be based on the received user equipment 108 transmission, such as a received access request and/or a received signal transmitted on a Physical Random Access Channel (PRACH).

The radio network node 102 comprises further **a receiving circuit 305** configured to receive the data comprised in the UL transmission from all antennas 110,112,116 comprised in the set of receiving antennas.

In some embodiments, when the user equipment 108 transmission is received in the at least one secondary antenna 112,116, the receiving circuit 305 is further configured to receive information about the at least one secondary antenna 112,116 from the second radio network node 114.

Embodiments herein for reception of data comprised in an UL transmission on a common channel may be implemented through one or more processors, such as **a processing circuit 306** depicted in Fig. 3, together with computer program code for performing the functions and/or method actions of embodiments herein.

It should be understood that one or more of the circuits comprised in the radio network node 102 described above may be integrated with each other to form an integrated circuit.

The radio network node 102 may further comprise **a memory 307**. The memory may comprise one or more memory units and may be used to store for example data such as thresholds, predefined or pre-set information, etc.

Embodiments herein do also relate to a radio communications system 100 comprising the radio network node 102.

Example

In some embodiments, the user equipment 108 may select the cell with best received downlink signal power for random access in uplink. In this description, the primary cell 104 of the radio network node 102 is considered to be the cell with the best received downlink signal power. To request a random access resource, the user equipment 108 may transmit an access request in uplink to the first radio network node 102. The access request may be transmitted as a preamble in uplink. Further, the access request may be for user data transmission on either a RACH or a common E-DCH channel. The preamble may be detected by an antenna, i.e. the primary antenna 110, in the selected cell, i.e. the primary cell 104, by for example UL Preamble Detection. If the access is granted an ACK is sent to the user equipment 108 from the radio network node 102. The UE 108 then transmits the user data in the selected cell. To improve the reception of user data embodiments herein provides for searching for and including signals received in adjacent antennas, i.e. in secondary antennas 112,116.

For detected preambles and ACKed preambles, the radio network node 102 searches for the access request being received in one or more secondary antennas 112,116 being comprised in the primary cell 104 or in secondary cells 106,118. The secondary cells 106,118 are neighbour cells to the primary cell 104. The first radio node 102 may also request a second radio network node 114 to search for the preamble being received in one or more secondary antennas 116 comprised in one or more secondary cells 118 served by the second radio network node 114. If the preamble is detected in one or more of the secondary antennas 112,116, the first radio network node 102 adds the one or more secondary antenna 112,116, as possible receiving antennas. Thereby, the receiving antenna area is increased.

Then the radio network node 102 uses all added antennas for uplink reception of user data in the subsequent RACH message or common E-DCH channel. Thereby, the reception of the subsequent user data transmission is improved.

It should be understood that the detection criterion for adding the antennas of a cell for possible reception does not necessarily have to be the same as the preamble detection criterion. In addition to using the RACH preamble other measurement methods may be used, e.g. received PRACH, DPCCH and/or E-DPCCH and/or E-DPDCH signal strength, in order to finally decide if a neighbour cell shall be added for uplink reception or not.

Although the description above contains many specifics, they should not be construed as limiting but as merely providing illustrations of some presently preferred embodiments. The technology fully encompasses other embodiments which may become apparent to those skilled in the art. Reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural and functional equivalents to the elements of the above-described embodiments that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed hereby. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the described technology for it to be encompassed hereby.

When using the word “comprise” or “comprising” it shall be interpreted as non-limiting, in the meaning of consist at least of.

When using the word action/actions it shall be interpreted broadly and not to imply that the actions have to be carried out in the order mentioned. Instead, the actions may be carried out in any suitable order other than the order mentioned. Further, some action/actions may be optional.

Further, the dotted boxes and dotted arrows in the drawings schematically illustrate optional features and actions of embodiments herein.

The embodiments herein are not limited to the above described examples. Various alternatives, modifications and equivalents may be used. Therefore, the above examples should not be taken as limiting the scope of the invention, which is defined by the appending claims.

CLAIMS

1. A method in a radio network node (102) for reception of data comprised in an UL transmission on a common channel, which radio network node (102) serves a primary cell (104) comprising a primary antenna (110), wherein the radio network node (102), the primary cell (104) and at least one secondary antenna (112,116) are comprised in a communications system (100), and wherein a user equipment (108) is located in the primary cell (104), the method comprises:

   - *adding (204)* the primary antenna (110) and the at least one secondary antenna (112,116) to a set of receiving antennas, wherein the primary antenna (110) and the at least one secondary antenna (112,116) received a transmission from the user equipment (108), and wherein the at least one secondary antenna (112,116) is comprised in the primary cell (104) or in at least one secondary cell (106,118) of the communications system (100); and

   - *receiving (205)* the data comprised in the UL transmission from all antennas (110,112,116) comprised in the set of receiving antennas.

2. The method of claim 1, wherein the method further comprises:

   - when the user equipment (108) transmission is received in the primary antenna (110), *searching (201)* for the user equipment (108) transmission being received in the at least one secondary antenna (112), wherein the at least one secondary antenna (112) is comprised in the primary cell (104) or in the at least one secondary cell (106), which at least one secondary cell (106) is served by the radio network node (102) and is a neighbour cell to the primary cell (104).

3. The method of claim 1, wherein the radio network node (102) is a first radio network node (102), wherein the at least one secondary cell (118) is served by a second radio network node (114) comprised in the communications system (100), and wherein the method further comprises:

   - when the user equipment (108) transmission is received in the primary antenna (110), *requesting (202)* the second radio network node (114) to search for the user equipment (108) transmission being received in the at least one secondary antenna (116) of the at least one secondary cell (118), which at least one secondary cell (118) is a neighbour cell to the primary cell (104), and

   - when the user equipment (108) transmission is received in the secondary

antenna (116), *receiving (203)* information about the secondary antenna (116) from the second radio network node (114).

4. The method of any one of claim 1-3, wherein the common channel is a common Enhanced Dedicated Channel (E-DCH).

5. The method of claim 4, wherein the *adding (202)* of information about the secondary antenna (112,116) to the set of receiving antennas further comprises:

- adding the secondary antenna (112,116) when a signal strength of the received user equipment (108) transmission is above a threshold value.

6. The method of claim 5, wherein the signal strength is based on the received user equipment (108) transmission, such as a received access request and/or a received signal transmitted on a Dedicated Physical Control Channel (DPCCH), an Enhanced Dedicated Physical Control Channel (E-DPCCH) and/or on an Enhanced Dedicated Physical Data Channel (E-DPDCH).

7. The method of any one of claim 1-3, wherein the common channel is a Random Access Channel (RACH).

8. The method of claim 7, wherein the *adding (202)* of information about the secondary antenna (112,116) to the set of receiving antennas further comprises:

- adding the secondary antenna (112,116) when a signal strength of the received user equipment (108) transmission is above a threshold value.

9. The method of claim 8, wherein the signal strength is based on the received user equipment (108) transmission, such as a received access request and/or a received signal transmitted on a Physical Random Access Channel (PRACH).

10. A radio network node (102) for reception of data comprised in an UL transmission on a common channel, which radio network node (102) serves a primary cell (104) comprising a primary antenna (110), wherein the radio network node (102), the primary cell (104) and at least one secondary antenna (112,116) are comprised in a communications system (100), and wherein a user equipment (108) is located in the primary cell (104), the radio network node (102) comprises:

- an adding circuit (304) configured to add the primary antenna (110) and the at least one secondary antenna (112,116) to a set of receiving antennas, wherein the primary antenna (110) and the at least one secondary antenna (112,116) received a transmission from the user equipment (108), and wherein the at least one secondary antenna (112,116) is comprised in the primary cell (104) or in at least one secondary cell (106,118) of the communications system (100); and

- a receiving circuit (305) configured to receive the data comprised in the UL transmission from all antennas (110,112,116) comprised in the set of receiving antennas.

11. The radio network node (102) of claim 10, wherein the radio network node (102) further comprises:

- a searching circuit (302) configured to, when the user equipment (108) transmission is received in the primary antenna (110), search for the user equipment (108) transmission being received in the at least one secondary antenna (112), wherein the at least one secondary antenna (112) is comprised in the primary cell (104) or in the at least one secondary cell (106), which at least one secondary cell (106) is served by the radio network node (102) and is a neighbour cell to the first cell (104).

12. The radio network node (102) of claim 10, wherein the radio network node (102) is a first radio network node (102), wherein the at least one secondary cell (118) is served by a second radio network node (114), and wherein the first radio network node (102) further comprises:

- a requesting circuit (303) configured to, when the user equipment (108) transmission is received in the primary antenna (110), request the second radio network node (114) to search for the user equipment (108) transmission being received in the at least one secondary antenna (116) of the at least one secondary cell (118) being a neighbour cell the primary cell (104); and wherein

- the receiving circuit (305) further is configured to receive information about the at least one secondary antenna (116) from the second radio network node (102) when the user equipment (108) transmission is received in the at least one secondary antenna (116).

13. The radio network node (102) of any one of claim 10-12, wherein the common channel is a common Enhanced Dedicated Channel (E-DCH).

14. The radio network node (102) of claim 13, wherein the adding circuit (304) further is configured to add the at least one secondary antenna (112,116) to the set of receiving antennas when a signal strength of the received user equipment (108) transmission is above a threshold value.

15. The radio network node (102) of claim 14, wherein the signal strength is based on the received user equipment (108) transmission, such as a received access request and/or a received signal transmitted on a Dedicated Physical Control Channel (DPCCH), an Enhanced Dedicated Physical Control Channel (E-DPCCH) and/or on an Enhanced Dedicated Physical Data Channel (E-DPDCH).

16. The radio network node (102) of any one of claim 10-12, wherein the common channel is a Random Access Channel (RACH).

17. The radio network node (102) of claim 16, wherein the adding circuit (304) further is configured to add the at least one secondary antenna (112,116) to the set of receiving antennas when a signal strength of the received user equipment (108) transmission is above a threshold value.

18. The radio network node (102) of claim 17, wherein the signal strength is based on the received user equipment (108) transmission, such as a received access request and/or a received signal transmitted on a Physical Random Access Channel (PRACH).

19. A radio communications system (100) comprising the radio network node (102) of any one of claim 10-18.

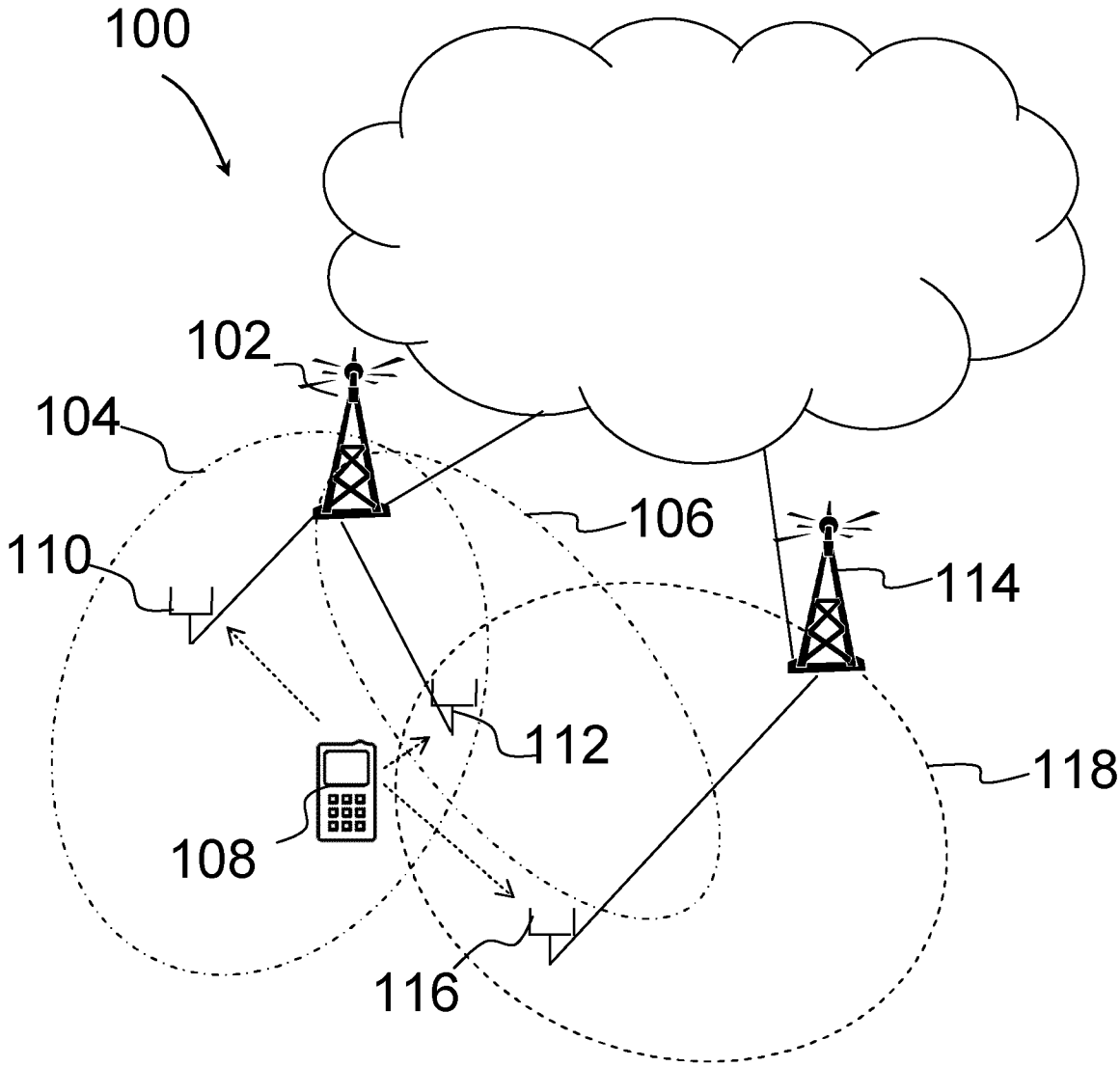

Fig. 1

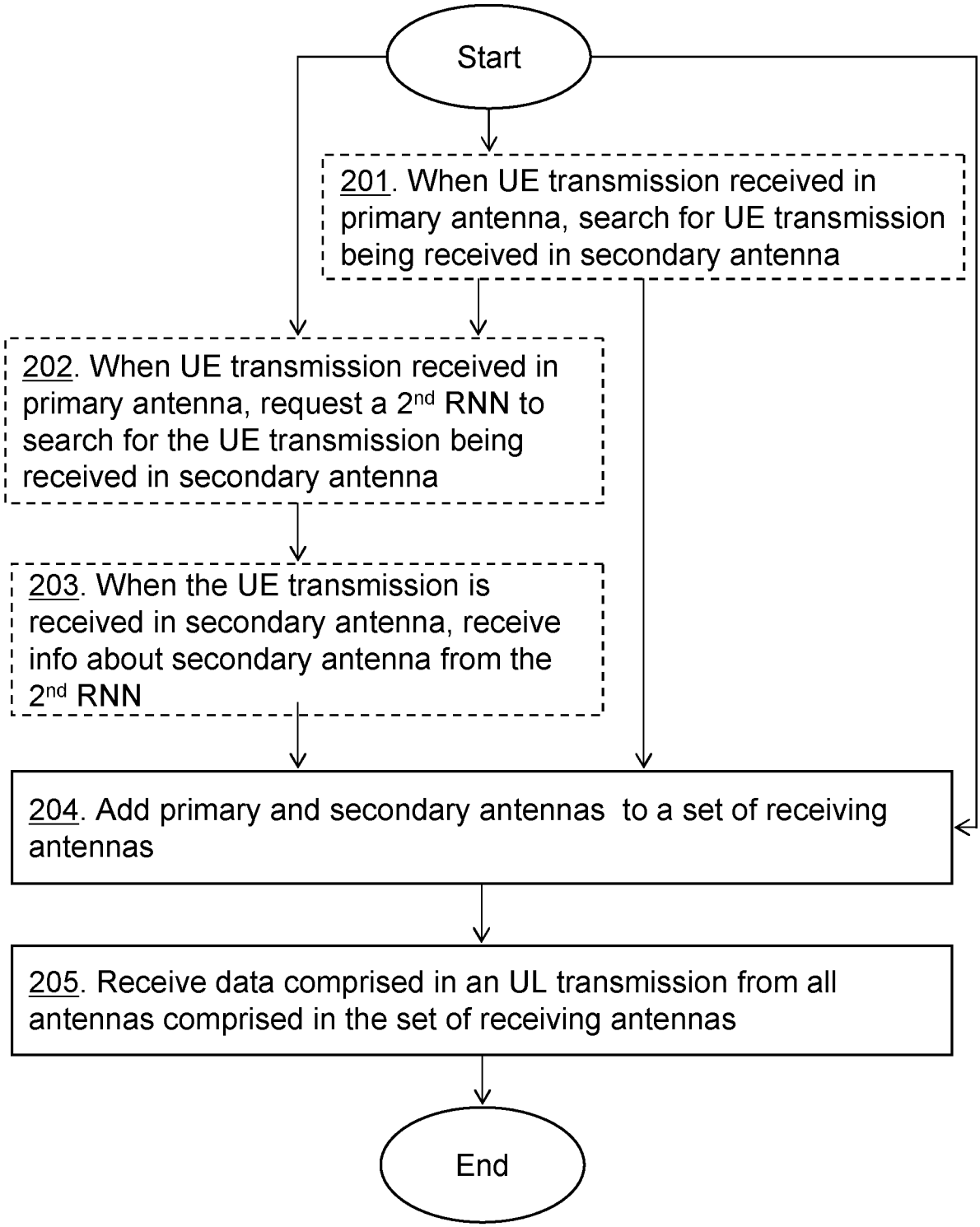
Start
201. When UE transmission received in primary antenna, search for UE transmission being received in secondary antenna
202. When UE transmission received in primary antenna, request a 2nd RNN to search for the UE transmission being received in secondary antenna
203. When the UE transmission is received in secondary antenna, receive info about secondary antenna from the 2nd RNN
204. Add primary and secondary antennas to a set of receiving antennas
205. Receive data comprised in an UL transmission from all antennas comprised in the set of receiving antennas
End

Fig. 2

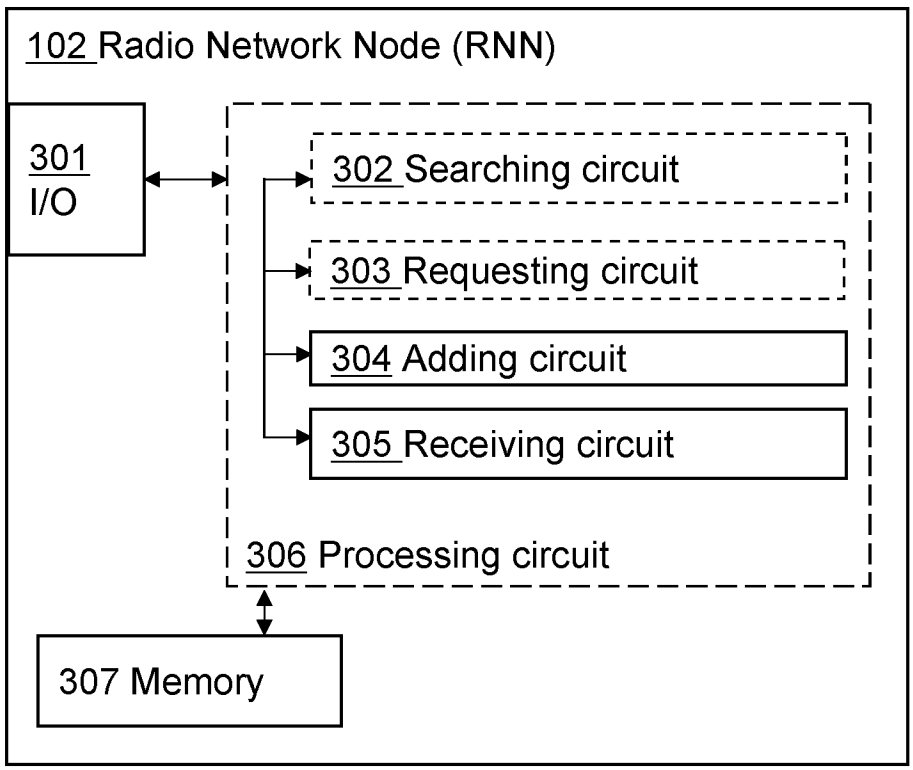
102 Radio Network Node (RNN)
301
I/O
302 Searching circuit
303 Requesting circuit
304 Adding circuit
305 Receiving circuit
306 Processing circuit
307 Memory

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050603

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: H04B, 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, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20110080879 A1 (GRANT STEPHEN), 7 April 2011 (2011-04-07); abstract; paragraphs [0003]-[0007] --	1-19
A	EP 2264960 A1 (ALCATEL LUCENT), 22 December 2010 (2010-12-22); abstract --	1-19
A	"Opportunistic coordinated multi-point reception for multi-codeword uplink transmission", 3GPP Draft; R1-112455, Publication date: 2011-08-16.; whole document -- --------	1-19

☐ 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
14-06-2013	17-06-2013
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Ralf Boström Telephone No. + 46 8 782 25 00

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Continuation of: second sheet

International Patent Classification (IPC)

H04W 76/02 (2009.01)
H04B 7/08 (2006.01)
H04W 24/02 (2009.01)

US	20110080879	A1	07/04/2011	AR	078545	A1 16/11/2011
				CA	2773517	A1 14/04/2011
				CN	102696185	A 26/09/2012
				EP	2486674	A2 15/08/2012
				JP	2013507816	A 04/03/2013
				KR	20120086304	A 02/08/2012
				TW	201136219	A 16/10/2011
				US	8224314	B2 17/07/2012
				WO	2011042864	A2 14/04/2011
EP	2264960	A1	22/12/2010	CN	102439927	A 02/05/2012
				US	20120163484	A1 28/06/2012
				WO	2010145873	A1 23/12/2010