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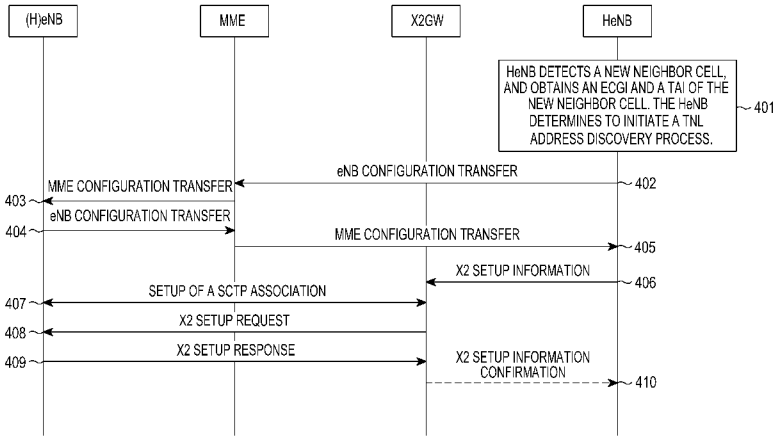
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(54) Title: A METHOD AND APPARATUS FOR SETTING UP AN X2 CONNECTION THROUGH A GATEWAY



(57) Abstract: The present invention provides a method for setting up X2 through a gateway, including: a home base station obtaining an Internet Protocol (IP) address of a neighbor base station through a Transport Network Layer (TNL) address discovery process; the home base station transmitting to an X2 gateway the obtained IP address of the neighbor base station; and the X2 gateway initiating an X2 interface setup process with the neighbor base station, or initiating an eNB configuration update process with the neighbor base station. The method can reduce impact on a macro base station, and reduce complexity of configuration of an operator, so that an X2 handover is practicable.

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Description

Title of Invention: A METHOD AND APPARATUS FOR SETTING UP AN X2 CONNECTION THROUGH A GATEWAY

Technical Field

[1] The present invention relates to mobile communication technologies, and particularly to a method and apparatus for setting up an X2 connection through a gateway.

Background Art

[2] In a current mobile communication system, in order to provide a better service to a subscriber group, generally it is required to form a plurality of radio resource management entities (i.e., a network entity which is used for managing radio resources and access of a user equipment (UE) in a radio access network, such as a base station or a cell in a variety of mobile communication systems) into a Closed Subscriber Group (CSG) for the specific subscriber group. For example, all subscribers within a company or a school are equal to a specific subscriber group, a plurality of radio resource management entities are formed into a CSG for this specific subscriber group to provide a special access service. It is widespread in a mobile communication system to form a plurality of radio resource management entities into a CSG for a specific subscriber group. In order to make this case clearer, a long term evolution (LTE) system of system architecture evolution (SAE) is taken as an example for explanation hereinafter.

[3] Figure 1 is astructureoftheLTEsystem prior art.

[4] As shown in Figure 1, in a radio access network of the LTE system, a radio resource management entity includes a macro base station (e.g., eNB:evolved NodeB, 102) and a home base station (HeNB, 103). A home base station gateway (HeNB GW, 104) is optionally included in the radio access network. The eNB(102) may be directly connected with a mobile management entity (MME, 105) in a core network. When the HeNB GW(104) is included in the radio access network, the HeNB(103) is connected with the MME(105) through the HeNB GW(104). When the HeNB GW(104) is not included in the radio access network, the HeNB(103) may be directly connected with the MME(105).

[5] For the radio resource management entity in the LTE system, in order to provide a richer access service, taking the as an example,HeNBs of various types are provided in prior art,wherein the various type sinclude an open type,a hybrid type and a CSG type. There is not a subscriber group of a specific access for an openHeNB,and any UE may access the open HeNB. ACSG HeNB is a HeNB that isused by the above described subscriber group consisting of all of the subscribers in the company or the school, the

CSG HeNB only permits the access of a UE in the specific subscriber group which the CSG HeNB serves(for convenience of description,herein after a UE in a specific subscriber group is referred to as aCSG UE). A hybrid HeNB may form a CSG together with another HeNB,and permit the access of a CSG UE which the hybrid HeNB serves, at the same time,the hybrid HeNB may also permit the access of a non-CSG UE(i.e.,a UE which does not belong to the CSG).

[6] As can be seen from the above description, in the conventional mobile communication system, a plurality of radio resource management entities may be formed into a CSG to provide a CSG radio resource management entity, e.g., a CSG HeNB, and a hybrid radio resource management entity may be further provided to provide a richer access service, e.g., a hybrid HeNB. At the same time, the macro base station (eNB) may also support a function of the CSG, or may be used as a hybrid eNB when supporting the function of the CSG.

[7] Figure 2 is a schematic diagram illustrating an X2 setup process between eNBs in prior art.

[8] In the prior art, for example, eNB1 detects a new neighbor cell, it is illustrated in Figure 2 that eNB1 triggers an X2 setup process. It is easy to understand that descriptions of some processes which are optional and are well known to the person skilled in the art are omitted hereinafter. The X2 setup process may include operations as follows.

[9] Referring to FIG. 2, in step 201, eNB1 detects a new neighbor cell.

[10] The eNB1 detects the new neighbor cell through a report of a UE, and the new neighbor cell is in eNB2.

[11] In step 202, eNB1 transmits to a MME an eNB configuration transfer message. The message contains an identifier of a source eNB, an identifier of a destination eNB, and self-optimisation networks (SON) information. The identifier of the source eNB is configured as a global eNB identifier of eNB1 and a selected tracking area identifier (TAI). The identifier of the destination eNB is configured as a global eNB identifier of eNB2 and the selected TAI. The SON information is configured as an information request which requests configuration information of an X2 Transport Network Layer.

[12] In step 203, the MME finds the destination eNB according to the identifier of the destination eNB (including the global eNB identifier and the selected TAI), and transmits to eNB2 a MME configuration transfer message.

[13] In step 204, eNB2 transmits to the MME the eNB configuration transfer message. The message contains the identifier of the source eNB, the identifier of the destination eNB, and the SON information. The identifier of the source eNB is configured as the global eNB identifier of eNB2 and the selected TAI. The identifier of the destination eNB is configured as the global eNB identifier of eNB1 and the selected TAI. The

SON(self organizing network) information includes SON information response which includes a Transport Network Layer (TNL) address of eNB2.

[14] In step 205, the MME transmits to eNB1 the MME configuration transfer message.

[15] In step 206, eNB1 transmits to eNB2 an X2 setup request message.

[16] In step 207, eNB2 transmits to eNB1 an X2 setup response message.

[17] In a situation that there is a home base station, in order to reduce the on the core network, it is proposed to support an X2 handover between an eNB and the home base station. Considering that there are a larger number of home base stations within the coverage of the eNB,if the eNB sets up an X2 connection with each neighbor home base station,a great burden will becaused to the eNB,especially the burden of the transport network layer.In addition,the home base stations often start up and shutdown,which also brings a negative impacton the eNB,as a result, a concept of an X2 gateway(X2 GW) is proposed.

Disclosure of Invention

Technical Problem

[18] Figure 3 is a schematic diagram illustrating a structure of a system including an X2 GW. as shown in Figure 3. The HeNB is connected with the eNB through the X2 GW.

[19] In this situation, the existing X2 setup process cannot complete an X2 setup process between the eNB and the X2 GW or an X2 setup process between the eNB and a peer HeNB through the X2 GW, and it is not resolved in the prior art how to perform the X2 setup process. One method is to complete the setup through configuration of an operator, e.g., configuration of the eNB, the HeNB, the X2 GW, but this method brings a great burden to the operator.

Solution to Problem

[20] The present invention provides a method for setting up X2 through a gateway, which can reduce impact on a macro base station, and reduce complexity of configuration of an operator, so that an X2 handover is practicable.

[21] In order to achieve the above objective, the technical solution of the present invention is implemented as follows.

[22] A method for setting up X2 through a gateway, including: a home base station obtaining an (IP) address of a neighbor base station through a Transport Network Layer(TNL) address discovery process; the home base station transmitting to an X2 gateway the obtained IP address of the neighbor base station; and the X2 gateway initiating an X2 interface setup process with the neighbor base station, or initiating an eNB configuration update process with the neighbor base station.

[23] The method further includes: the X2 gateway transmitting to the home base station X2 setup information confirmation message.

[24] It should be noted that, the X2 setup information confirmation message includes information about a serving cell.

[25] It should be noted that, the information about the serving cell includes information about a serving cell of the neighbor base station.

[26] It should be noted that, the home base station sends to the X2 gateway the obtained IP address of the neighbor base station through an X2 setup request message, or an eNB configuration update message, or a new message.

[27] It should be noted that, the X2 setup information confirmation message is an X2 setup response message, or an eNB configuration update confirmation message, or a new message.

[28] It should be noted that, the X2 gateway sends to the neighbor base station an IP address of the home base station.

[29] It should be noted that, the neighbor base station sends to the X2 gateway a failure message if the neighbor base station does not accept an X2 setup request or the eNB configuration update of the X2 gateway; wherein the failure message includes an IP address or an identifier of the home base station.

[30] A method for setting up X2 through a gateway, including: a source base station detecting a new neighbor cell; the source base station requesting a Transport Network Layer (TNL) address of a base station where the new neighbor cell locates; wherein the base station where the new neighbor cell locates is a home base station which is connected to an X2 gateway; the home base station transmitting to the source base station a TNL address of the X2 gateway to which the home base station is connected; and the source base station initiating an X2 interface setup process with the X2 gateway, or initiating an eNB configuration update process with the X2 gateway.

[31] It should be noted that, the home base station transmits to the source base station an identifier of the X2 gateway to which the home base station is connected.

[32] It should be noted that, an X2 setup request message in the X2 interface setup process includes information about a serving cell of the home base station connected to the X2 gateway.

[33] As can be seen from the above technical solution, the method for setting up X2 through a gateway provided by the present invention can reduce impact on a macro base station, and reduce complexity of configuration of an operator, so that an X2 handover is practicable.

[34] In accordance with an aspect of the present invention, a method for setting up an X2 connection through a X2 gateway by a home base station, the method comprises obtaining an (IP) address of a neighbor base station through a Transport Network Layer(TNL) address discovery process, transmitting to the X2 gateway the obtained IP address of the neighbor base station; and receiving a X2 setup information con-

firmation message, from the X2 gateway, initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station.

[35] In accordance with another aspect of the present invention, a method for setting up an X2 connection by a X2 gateway, the method comprises receiving, from a home base station an (IP) address of a neighbor base station obtained by the home base station through a Transport Network Layer (TNL) address discovery process, initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station, and transmitting a X2 setup information confirmation message to the home base station.

[36] In accordance with another aspect of the present invention, An apparatus for setting up an X2 connection through a X2 gateway, the apparatus comprising a controller for obtaining an (IP) address of a neighbor base station through a Transport Network Layer(TNL) address discovery process, a transmitter for transmitting to the X2 gateway the obtained IP address of the neighbor base station, and a receiver for receiving a X2 setup information confirmation message, from the X2 gateway initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station.

[37] In accordance with another aspect of the present invention, an apparatus for setting up an X2 connection by a X2 gateway, the apparatus comprises a receiver for receiving, from a home base station an (IP) address of a neighbor base station obtained by the home base station through a Transport Network Layer (TNL) address discovery process, a controller for initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station, and a transmitter for transmitting a X2 setup information confirmation message to the home base station.

Brief Description of Drawings

[38] Figure 1 is a schematic diagram illustrating a structure of a LTE system in prior art;

[39] Figure 2 is a schematic diagram illustrating an X2 setup process between eNBs in prior art;

[40] Figure 3 is a schematic diagram illustrating a structure of a system including an X2 GW;

[41] Figure 4 is a schematic diagram illustrating a first embodiment for setting up X2 through a gateway;

[42] Figure 5 is a schematic diagram illustrating a second embodiment for setting up X2 through a gateway;

[43] Figure 6 is a schematic diagram illustrating a third embodiment for setting up X2

through a gateway;

[44] Figure 7 illustrates a block diagram illustrating a HeNB according to an embodiment of the present invention;

[45] Figure 8 illustrates a block diagram illustrating a X2 GW according to an embodiment of the present invention.

Best Mode for Carrying out the Invention

[46] Hereinafter, the present invention is described in further detail with reference to the accompanying drawings and embodiments to make the technical solution and merits therein clearer.

[47] A first embodiment

[48] Figure 4 illustrates the first embodiment for setting up X2 through a gateway provided by the present invention. In this embodiment, a HeNB detects a new neighbor cell covered by an eNB (or a HeNB), and triggers an X2 setup process. The following is a detailed description of this embodiment. It is omitted herein that the detailed descriptions of steps which are not related to contents of the present invention.

[49] Referring to FIG.4, in step 401, the HeNB detects a new neighbor cell.

[50] The HeNB detects a new neighbor cell through a report of a UE. The HeNB obtains an evolved cell global identifier and a TAI(Tracking Area Identifier of the neighbor cell through the report of the UE. A global eNB identifier may be obtained according to an Evolved Cell Global Identifier (ECGI). The HeNB determines to initiate a TNL(Transport Layer Address) address discovery process.

[51] In step 402, the HeNB transmits to a MME an eNB configuration transfer message, wherein the message contains an identifier of a source eNB, an identifier of a destination eNB, and SON information. The identifier of the source eNB is set as a global eNB identifier of the HeNB and the selected TAI. The identifier of the destination eNB is set as a global eNB identifier of the eNB (or the HeNB) where the new neighbor cell locates and the selected TAI. The SON information is configured as an information request which requests configuration information of an X2 TNL.

[52] In a situation that there is a HeNB GW deployed, the eNB configuration transfer message is transmitted to the MME through the HeNB GW.

[53] In step 403, the MME finds the destination eNB (or the HeNB) according to the identifier of the destination eNB (including the global eNB identifier and the selected TAI), and transmits to the destination eNB (or the HeNB) a MME configuration transfer message.

[54] In step 404, the eNB (or the HeNB) transmits to the MME an eNB configuration transfer message. The message contains the identifier of the source eNB, the identifier of the destination eNB, and the SON information. The identifier of the source eNB is

set as the global eNB identifier of the eNB (or the HeNB) and the selected TAI. The identifier of the destination eNB is set as the global eNB identifier of the HeNB and the selected TAI. The SON information includes SON information response which includes a TNL address of the eNB(or the HeNB).

[55] In step 405, the MME transmits to the HeNB a MME configuration transfer message.

[56] In the situation that there is the HeNB GW deployed, the MME configuration transfer message is transmitted to the HeNB through the HeNB GW.

[57] In step 406, the HeNB transmits X2 setup information to an X2 GW. In this case, the X2 setup information may be a conventional X2 setup request message, or an eNB configuration update message, or a new message.

[58] The HeNB knows an Internet Protocol (IP) address of the X2 GW to which the HeNB is connected through pre-configuration or other methods. The message is the X2 setup request message or the new message if a SCTP(Stream Control Transmission Protocol) association has not been set up between the HeNB and the X2GW, and the HeNB is required to set up a SCTP association before sending the X2 setup information. The message is the X2 setup request message or the new message if an X2 connection is not set up between the HeNB and the X2GW, and an X2 interface between the HeNB and the X2GW is set up through the step 406. The message in the present step may be the X2 setup request message, or the eNB configuration update message, or the new message if the X2 connection has been set up between the HeNB and the X2GW.It should be noted that the X2 interface has been set up may means that the X2 setup procedure is performed between two nodes.

[59] The X2 setup information includes a TNL address of the eNB (or the HeNB) where the neighbor cell locates, i.e., an IP address. The X2 setup information message may include information about a serving cell of the HeNB, or may include information about a neighbor cell of the serving cell of the HeNB. The information about a cell includes a Physical-layer Cell Identifier (PCI) of the cell, an identifier of the cell, a tracking area code (TAC), and frequency information.

[60] In step 407, the X2 GW sets up a SCTP association with the eNB (or the HeNB). The present step is not performed if the SCTP association has been already set up between the eNB (or the HeNB) and the X2 GW. The X2 GW knows the eNB (or the HeNB) according to the eNB IP received from HeNB in step 406.

[61] In step 408, the X2 GW transmits to the eNB (or the HeNB) an X2 setup request message. The message contains the information about the serving cell. The information about the serving cell includes information about a cell of the HeNB which is connected to the X2 GW. The information about the cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information. The X2GW may send the eNB configuration update message to the eNB (or the HeNB) in this step if

the X2 connection has been already set up between the eNB (or the HeNB) and the X2GW. The X2GW sends to the eNB (or the HeNB) the X2 setup request message or the eNB configuration update message according to the IP address of the eNB (or the HeNB) received from the HeNB.

[62] The X2 setup request message or the eNB configuration update message may include the IP address of the HeNB.

[63] In step 409, the eNB (or the HeNB) transmits to the X2 GW an X2 setup response message or an eNB configuration update confirmation message. The message contains the information about the serving cell. The information about the cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information. The eNB (or the HeNB) sends the X2 setup response message if the eNB (or the HeNB) receives the X2 setup request message. The eNB (or the HeNB) sends the eNB configuration update confirmation message if the eNB (or the HeNB) receives the eNB configuration update message.

[64] The X2 setup response message or the eNB configuration update confirmation message may include the identifier or the IP address of the peer HeNB.

[65] The eNB (or the HeNB) may send to the X2GW an X2 setup failure message or an eNB configuration update confirmation failure message if the eNB (or the HeNB) cannot accept the setup of X2 or cannot accept the eNB configuration update. The message may include the identifier or the IP address of the peer HeNB. In this way, the X2GW can send the failure message to a corresponding HeNB or eNB when the X2GW receives a plurality of X2 setup request messages or eNB configuration update messages sent from multiple HeNBs or eNBs.

[66] In step 410, the X2 GW transmits to the HeNB a X2 setup information confirmation message. The X2 setup information confirmation message may be the X2 setup response message, or the eNB configuration update confirmation message, or a new message. The X2GW sends the X2 setup response message if the X2GW receives from the HeNB the X2 setup request message. The X2GW sends the eNB configuration update confirmation message if the X2GW receives from the HeNB the eNB configuration update message. The X2GW sends a new response message if the X2GW receives from HeNB a new message.

[67] The X2GW sends the message to the corresponding HeNB according to the neighbor cell information included in the message received from the eNB (or the HeNB), or according to the neighbor cell information included in the message received from the eNB (or the HeNB) and the information stored in the X2GW (e.g., the ID or the IP address of the HeNB), or according to the identifier or the IP address of the peer HeNB included in the message received from the eNB (or the HeNB). The message contains information about a serving cell of the eNB or theHeNB. The information about the

serving cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information. This step may be a response message of step 406, or may be a separate indication message. This step is an optional step, i.e., the method that the X2 GW obtains the IP address of the neighbor eNB and sets up X2 includes a technical solution in which this step is included and another technical solution in which this step is not included.

[68] A second embodiment

[69] Figure 5 illustrates the second embodiment for setting up X2 through a gateway provided by the present invention. In this embodiment, a HeNB detects a new neighbor cell covered by an eNB (or a HeNB), and triggers an X2 setup process. The following is a detailed description of this embodiment. It is omitted herein that the detailed descriptions of steps which are not related to contents of the present invention.

[70] Referring to FIG.5, in step 501, the HeNB detects the new neighbor cell.

[71] The HeNB detects the new neighbor cell through a report of a UE. The HeNB obtains an ECGE and a TAI of the neighbor cell through the report of the UE. A global eNB identifier may be obtained according to an ECGI. The HeNB determines to initiate a TNL address discovery process.

[72] In step 502, the HeNB transmits to a MME an eNB configuration transfer message, wherein the message contains an identifier of a source eNB, an identifier of a destination eNB, and SON information. The identifier of the source eNB is configured as the selected TAI and a global eNB identifier of the HeNB or an X2 GW. The identifier of the destination eNB is configured as a global eNB identifier of the eNB (or the HeNB) where the new neighbor cell locates and the selected TAI. The SON information is configured as an information request which requests configuration information of an X2 TNL. The message contains the configuration information of the X2 TNL of the source base station. The configuration information of the X2 TNL includes a TNL address of the X2 GW to which the HeNB is connected. If the identifier of the source eNB is configured as the identifier of the HeNB, as another embodiment of the present invention, the message may contain an identifier of the X2 GW to which the HeNB is connected.

[73] The TNL address of the X2 GW may be a new information element, or may be an X2 TNL address of the source eNB in an existing eNB configuration transfer message. If using the existing X2 TNL address of the source eNB in the existing eNB configuration transfer message to transfer the TNL address of the X2 GW, the eNB configuration transfer message may contain a new information element, i.e., an indication of the TNL address of the X2 GW. If the message contains the identifier of the X2 GW, the indication of the TNL address of the X2 GW may not be contained.

[74] The HeNB knows the TNL address of the X2 GW to which the HeNB is connected

and/or the identifier of the X2 GW through pre-configuration or other methods.

[75] In a situation that there is a HeNB GW deployed, the eNB configuration transfer message is transmitted to the MME through the HeNB GW.

[76] In step 503, the MME finds the destination eNB (or the HeNB) according to the identifier of the destination eNB (including the global eNB identifier and the selected TAI), and transmits to the destination eNB (or the HeNB) a MME configuration transfer message.

[77] In step 504, the eNB (or the HeNB) transmits to the MME an eNB configuration transfer message. The message contains the identifier of the source eNB, the identifier of the destination eNB, and the SON information. The identifier of the source eNB is set as the global eNB identifier of the eNB (or the HeNB) and the selected TAI. The identifier of the destination eNB is set as the global eNB identifier of the source eNB received in step 503 and the selected TAI. The SON information includes SON information response which includes a TNL address of the eNB (or the HeNB).

[78] In step 505, the MME transmits to the HeNB a MME configuration transfer message.

[79] In the situation that there is the HeNB GW deployed, the MME configuration transfer message is transmitted to the HeNB through the HeNB GW.

[80] In step 506, the eNB (or the HeNB) knows that the destination HeNB is connected to the X2 GW according to the new information element contained in the message in step 503, i.e., the TNL address of the X2 GW, or the indication of the TNL address of the X2 GW, or the identifier of the X2 GW. The eNB (or the HeNB) initiates a SCTP association process with an entity indicated by the TNL address contained in the message in step 503, i.e., the X2 GW. The present step is not performed if the SCTP association has been already set up between the eNB (or the HeNB) and the X2GW.

[81] In step 507, the eNB (or the HeNB) transmits to the X2 GW an X2 setup request message.

[82] The message may contain information about a serving cell of the eNB (or the HeNB), or may contain information about a neighbor cell of the serving cell of the eNB (or the HeNB). The information about the cell includes a PCI of the cell, an identifier of the cell, a TAC, and frequency information.

[83] The message may further include the identifier or the IP address of the HeNB.

[84] In step 508, the X2 GW transmits to the eNB (or the HeNB) an X2 setup response message. The message contains the information about the serving cell. The information about the serving cell includes information about a cell of the HeNB which is connected to the X2 GW. The information about the cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information.

[85] In step 509, the X2GW transmits to the HeNB an X2 setup information indication message. The X2GW may initiate the X2 setup process between the X2GW and the

HeNB. The X2 setup information indication message may be the eNB configuration update message if the X2 connection between the X2GW and the HeNB has been already set up. The X2GW sends the message to the corresponding HeNB according to the neighbor cell information included in the message received from the eNB (or the HeNB), or according to the neighbor cell information included in the message received from the eNB (or the HeNB) and the information stored in the X2GW (e.g., the ID or the IP address of the HeNB), or according to the identifier or the IP address of the peer HeNB included in the message received from the eNB (or the HeNB).

[86] The message contains information about the serving cell of the eNB (or the HeNB). The information about the cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information. This step is an optional step, i.e., the method for setting up X2 includes a technical solution in which this step is included and another technical solution in which this step is not included.

[87] It should be noted that there is no absolute sequence between step 508 and step 509.

[88] A third embodiment

[89] Figure 6 illustrates the third embodiment for setting up X2 connection through a X2 gateway provided by the present invention. In this embodiment, an eNB (or a HeNB) detects a new neighbor cell covered by a HeNB, and triggers an X2 setup process. The following is a detailed description of this embodiment. It is omitted herein that the detailed descriptions of steps which are not related to contents of the present invention.

[90] Referring to FIG. 6, in step 601, the eNB (or the HeNB) detects the new neighbor cell.

[91] The eNB (or the HeNB) detects a new neighbor cell through a report of a UE. The eNB (or the HeNB) obtains an ECGI and a TAI of the neighbor cell through the report of the UE. A global eNB identifier may be obtained according to an ECGI. The eNB (or the HeNB) determines to request a TNL address of the base station where the new neighbor cell locates.

[92] In step 602, the eNB (or the HeNB) transmits to a MME an eNB configuration transfer message.

[93] The message contains an identifier of a source eNB, an identifier of a destination eNB, and SON information. The identifier of the source eNB is set as a global eNB identifier of the eNB (or the HeNB) and the selected TAI. The identifier of the destination eNB is set as a global eNB identifier of the HeNB where the new neighbor cell locates and the selected TAI. The SON information is configured as an information request which requests configuration information of an X2 TNL.

[94] In step 603, the MME transmits to the HeNB a MME configuration transfer message. The configuration of an information element in the message is the same as that in step 602.

[95] In a situation that there is a HeNB GW deployed, the MME configuration transfer message is transmitted to the HeNB through the HeNB GW.

[96] In step 604, the HeNB transmits to the MME an eNB configuration transfer message.

[97] The message contains the identifier of the source eNB, the identifier of the destination eNB, and the SON information. The identifier of the source eNB is set as the selected TAI and the global eNB identifier of the HeNB or an identifier of an X2 GW. The identifier of the destination eNB is set as the global eNB identifier of the eNB (or the HeNB) and the selected TAI. The SON information includes SON information response which includes a TNL address of the X2 GW to which the HeNB is connected. The message may contain the identifier of the X2 GW to which the HeNB is connected. The SON information response may further include the IP address of the HeNB.

[98] The HeNB detects an IP address of the X2 GW to which the HeNB is connected and/or the identifier of the X2 GW through pre-configuration or other methods. The HeNB may not set up the SCTP association with the X2GW, or may not set up the X2 interface. Alternatively, the HeNB may have already set up an SCTP association with the X2 GW. Or an X2 interface may have already been set up between the HeNB and the X2 GW. The embodiment of the present disclosure does not limit herein.

[99] In the situation that there is the HeNB GW deployed, the eNB configuration transfer message is transmitted to the MME through the HeNB GW.

[100] In step 605, the MME transmits to the eNB (or the HeNB) a MME configuration transfer message. The configuration of the information element in the message is the same as that in step 604.

[101] In step 606, the eNB (or the HeNB) sets up a SCTP association with the X2 GW. The eNB (or the HeNB) sets up the SCTP association with a corresponding entity according to the TNL address of the X2GW received in step 605. The eNB (or the HeNB) may not know whether the opposite peer is the HeNB, or the eNB, or the HeNB which is connected to the X2 GW. The present step is not performed if the SCTP association between the eNB (or the HeNB) and the X2 GW has been already set up.

[102] In step 607, the eNB (or the HeNB) transmits to the X2 GW an X2 setup request message. The eNB (or the HeNB) sets up X2 with the corresponding entity according to the TNL address received in step 605. The eNB (or the HeNB) may not know whether the opposite peer is the HeNB, or the eNB, or the HeNB which is connected to the X2 GW.

[103] The message may contain information about a serving cell. The information about the serving cell includes information about a serving cell of the eNB (or the HeNB). The information about the cell includes a PCI of the cell, an identifier of the cell, a

TAC, and frequency information.

[104] The message may further include the identifier or the IP address of the peer HeNB.

[105] In step 608, the X2 GW transmits to the eNB (or the HeNB) an X2 setup response message. The message contains the information about a serving cell. The information about the serving cell includes information about a cell of the HeNB which is connected to the X2 GW. The information about the cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information.

[106] In step 609, the X2 GW transmits to the HeNB an X2 setup information indication message. The X2GW may initiate the X2 setup process between the X2GW and the HeNB. In this case, the X2 setup information indication message may be the X2 setup request message. The X2 setup information indication message may be the eNB configuration update message if the X2 interface between the X2GW and the HeNB has been already set up. The X2GW sends the message to the corresponding HeNB according to the the neighbor cell information included in the message received from the eNB (or the HeNB), or according to the neighbor cell information included in the message received from the eNB (or the HeNB) and the information stored in the X2GW (e.g., the ID or the IP address of the HeNB), or according to the identifier or the IP address of the peer HeNB included in the message received from the eNB (or the HeNB).

[107] The message contains information about the serving cell of the eNB or the HeNB (or the HeNB). The information about the serving cell includes the PCI of the cell, the identifier of the cell, the TAC, and the frequency information.

[108] It should be noted that there is no absolute sequence between step 608 and step 609.

[109] This step is an optional step, i.e., the method that the eNB (or the HeNB) obtains the IP address of the opposite peer and sets up X2 includes a technical solution in which this step is included and another technical solution in which this step is not included.

[110] Figure 7 illustrates a block diagram illustrating a HeNB according to an embodiment of the present invention.

[111] Referring to FIG. 7, the HeNB(700) includes a receiver(702), a controller(704) an a transmitter(706).

[112] The controller(704) obtaines an IP address of a neighbor base station through a TNL address discovery process, a transmitter(706) transmits to the X2 GW the obtained IP address of the neighbor base station(e.g., eNB (or the HeNB)), the receiver(702) receives a X2 setup information confirmation message, from the X2 GW initiating an X2 interface setup process with the neighbor base station, or an eNB configuration update process with the neighbor base station. the X2 setup information confirmation message comprises information about a serving cell of the neighbor base station. the obtained IP address is transmitted through one of an X2 setup request message, an eNB

configuration update message, a new message. the X2 setup information confirmation message is one of an X2 setup response message, an eNB configuration update confirmation message, a new message.

[113] The receiver receives from the X2 GW a failure message received from the neighbor base station if the neighbor base station does not accept an X2 setup request or the eNB configuration update of the X2 GW, the failure message comprises an IP address or an identifier of the home base station.

[114] Figure 8 illustrates a block diagram illustrating a X2 GW according to an embodiment of the present invention.

[115] Referring to FIG. 8, the HeNB(800) includes a receiver(802), a controller(804) an a transmitter(806).

[116] The receiver(802) receives from a home base station an IP address of a neighbor base station obtained by the home base station through a TNL address discovery process, the controller(804) initiates an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station, and a transmitter transmits a X2 setup information confirmation message to the home base station. the X2 setup information confirmation message comprises information about a serving cell of the neighbor base station. an X2 setup request message in the X2 interface setup process comprises information about a serving cell of the home base station connected to the X2 GW. the obtained IP address is recevied through one of an X2 setup request message, an eNB configuration update message, a new message. the X2 setup information confirmation message is one of an X2 setup response message, an eNB configuration update confirmation message, a new message.

[117] The receiver(804) receives a failure message received from the neighbor base station if the neighbor base station does not accept an X2 setup request or the eNB configuration update of the X2 GW, the failure message comprises an IP address or an identifier of the home base station.

[118] As can be seen from the above description, the method for setting up X2 through a gateway provided by the present invention can reduce the impact on the macro base station, and reduce complexity of the configuration of the operator, so that an X2 handover is practicable.

[119] The above are preferable embodiments of the present invention, and are not used for limiting the present invention. Any modifications, equivalents, improvements, etc., made under the spirit and principle of the present invention should be included in the protection scope of the present invention.

Claims

[Claim 1] A method for setting up an X2 connection through a X2 gateway by a home base station, the method comprising:
obtaining an Internet Protocol (IP) address of a neighbor base station through a Transport Network Layer (TNL) address discovery process;
transmitting to the X2 gateway the obtained IP address of the neighbor base station; and
receiving a X2 setup information confirmation message, from the X2 gateway, initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station.

[Claim 2] The method of claim 1, wherein the X2 setup information confirmation message comprises information about a serving cell of the neighbor base station.

[Claim 3] The method of claim 1, wherein the obtained IP address is transmitted through one of an X2 setup request message, an eNB configuration update message, a new message.

[Claim 4] The method of claim 1, wherein the X2 setup information confirmation message is one of an X2 setup response message, an eNB configuration update confirmation message, a new message.

[Claim 5] The method of claim 1, further comprising:
receiving from the X2 gateway a failure message received from the neighbor base station if the neighbor base station does not accept an X2 setup request or the eNB configuration update of the X2 gateway,
wherein the failure message comprises an IP address or an identifier of the home base station.

[Claim 6] A method for setting up an X2 connection by a X2 gateway, the method comprising:
receiving, from a home base station an Internet Protocol (IP) address of a neighbor base station obtained by the home base station through a Transport Network Layer (TNL) address discovery process;
initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station; and
transmitting a X2 setup information confirmation message to the home base station.

[Claim 7] The method of claim 6, wherein the X2 setup information confirmation

message comprises information about a serving cell of the neighbor base station.

[Claim 8] The method of claim 6, wherein an X2 setup request message in the X2 interface setup process comprises information about a serving cell of the home base station connected to the X2 gateway.

[Claim 9] The method of claim 6, wherein the obtained IP address is recevied through one of an X2 setup request message, an eNB configuration update message, a new message.

[Claim 10] The method of claim 6, wherein the X2 setup information confirmation message is one of an X2 setup response message, an eNB configuration update confirmation message, a new message.

[Claim 11] The method of claim 6, further comprising:
receiving a failure message received from the neighbor base station if the neighbor base station does not accept an X2 setup request or the eNB configuration update of the X2 gateway,
wherein the failure message comprises an IP address or an identifier of the home base station.

[Claim 12] An apparatus for setting up an X2 connection through a X2 gateway, the apparatus comprising:
a controller for obtaining an Internet Protocol (IP) address of a neighbor base station through a Transport Network Layer (TNL) address discovery process;
a transmitter for transmitting to the X2 gateway the obtained IP address of the neighbor base station; and
a receiver for receiving a X2 setup information confirmation message, from the X2 gateway initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update process with the neighbor base station.

[Claim 13] The appartus as claimed in claim 12, implemented according to one of claims 2 to 5.

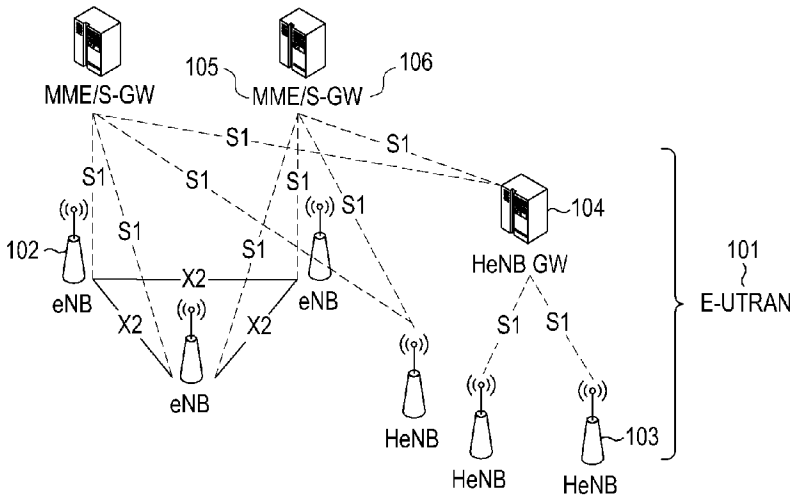
[Claim 14] An apparatus for setting up an X2 connection by a X2 gateway, the apparatus comprising:
a receiver for receiving, from a home base station an Internet Protocol (IP) address of a neighbor base station obtained by the home base station through a Transport Network Layer (TNL) address discovery process;
a controller for initiating an X2 interface setup process with the neighbor base station, or an eNB(evolved NodeB) configuration update

process with the neighbor base station; and

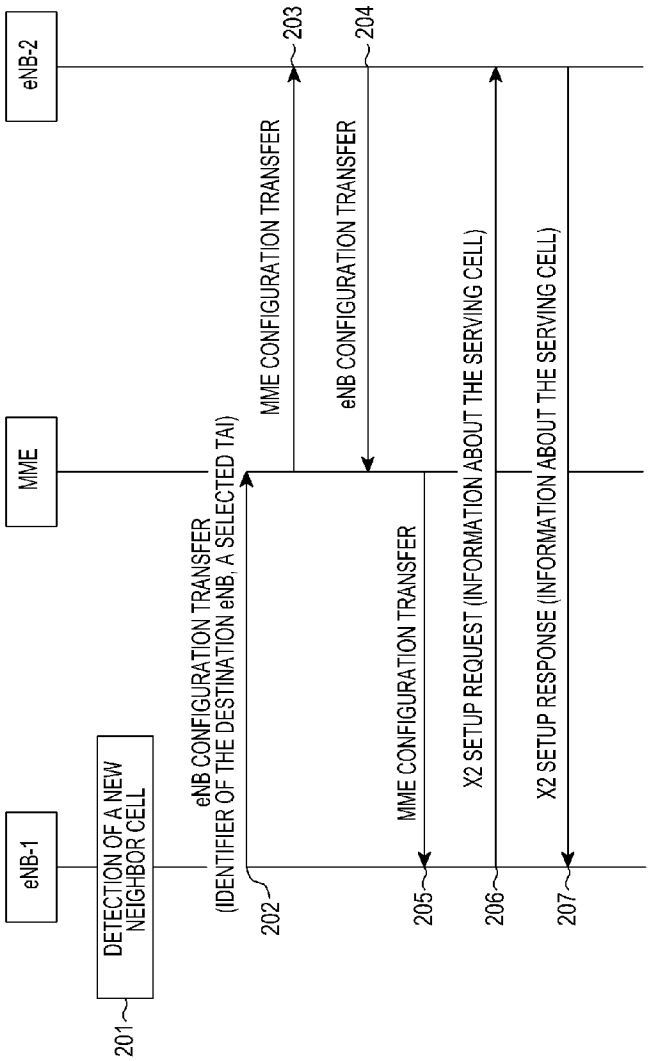
a transmitter for transmitting a X2 setup information confirmation message to the home base station.

[Claim 15] The appartus as claimed in claim 14, implemented according to one of claims 7 to 11.

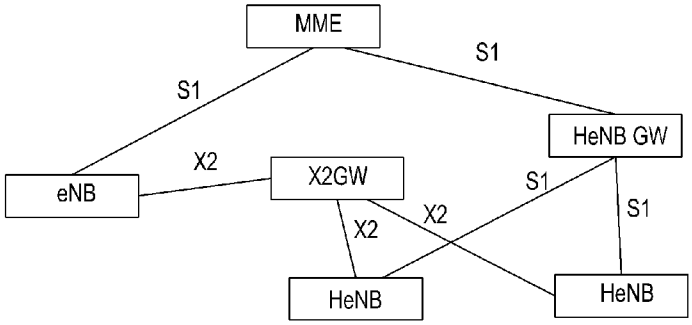
[Fig. 1]


MME/S-GW
105
MME/S-GW
106
S1
S1
S1
S1
S1
S1
S1
S1
S1
S1
102
104
HeNB GW
101
E-UTRAN
X2
X2
X2
eNB
eNB
eNB
HeNB
HeNB
HeNB
103

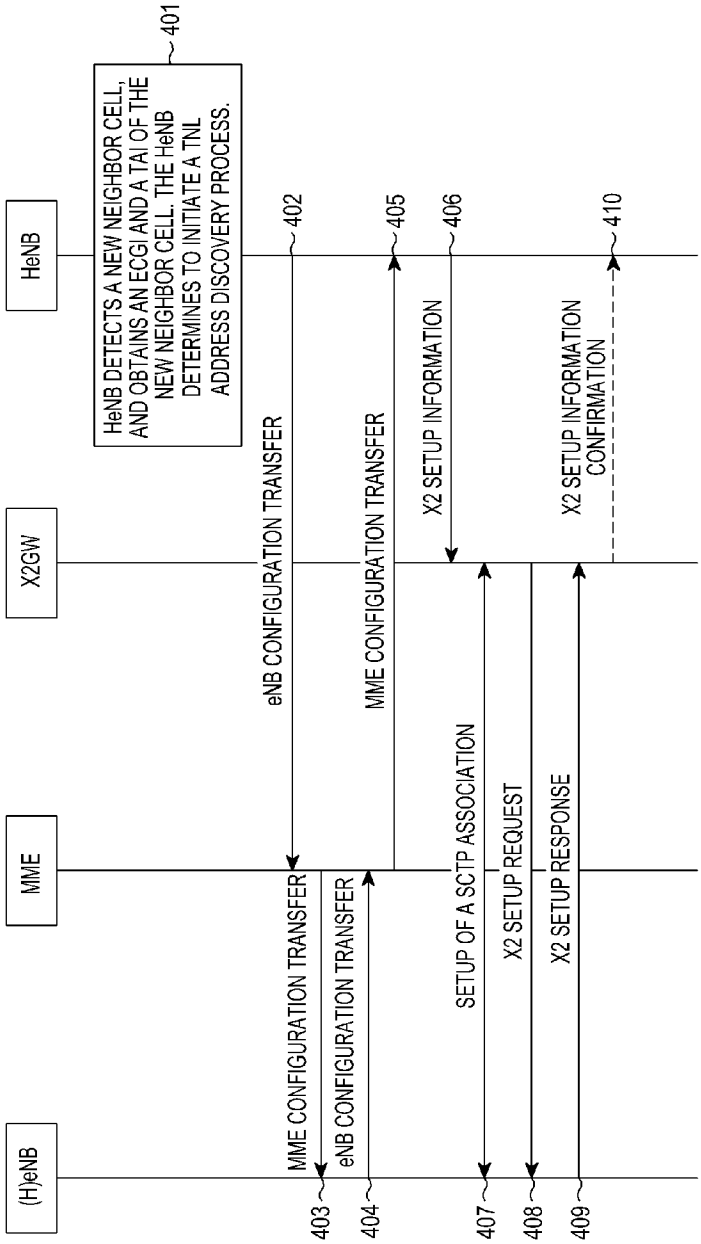
[Fig. 2]


eNB-2
MME
eNB-1
203
204
MME CONFIGURATION TRANSFER
eNB CONFIGURATION TRANSFER
eNB CONFIGURATION TRANSFER
(IDENTIFIER OF THE DESTINATION eNB, A SELECTED TAI)
MME CONFIGURATION TRANSFER
X2 SETUP REQUEST (INFORMATION ABOUT THE SERVING CELL)
X2 SETUP RESPONSE (INFORMATION ABOUT THE SERVING CELL)
DETECTION OF A NEW NEIGHBOR CELL
201
202
205
206
207

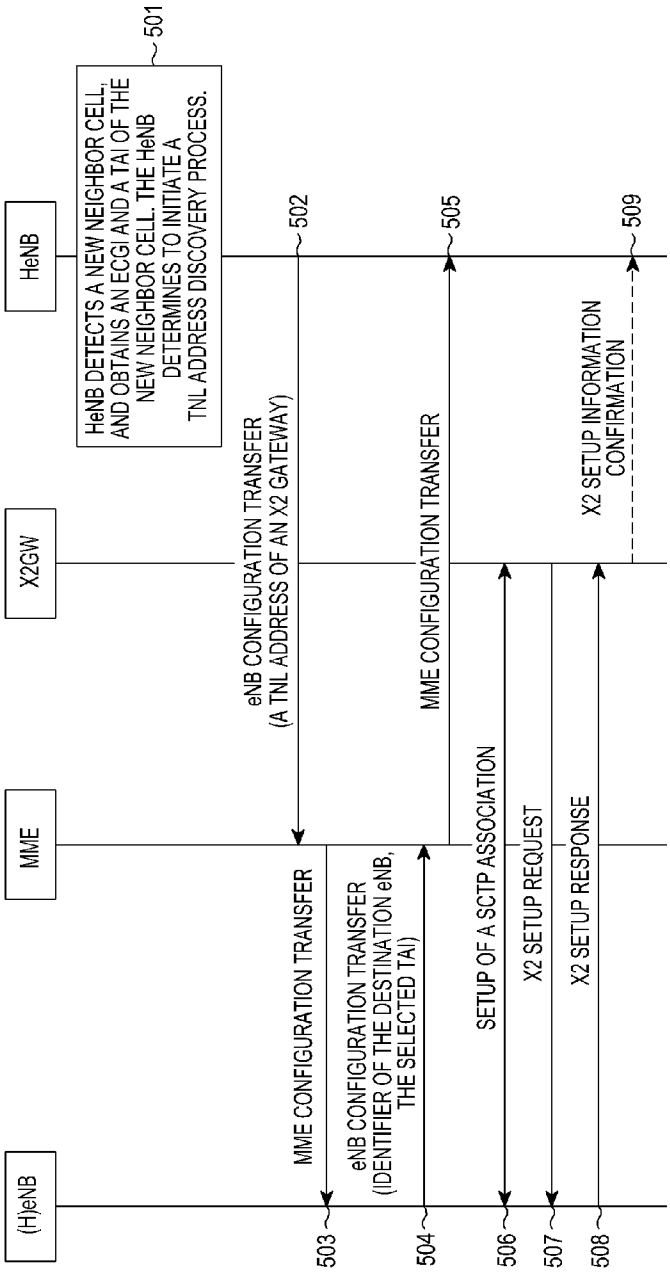
[Fig. 3]


MME
S1
S1
HeNB GW
X2
X2GW
eNB
S1
X2
X2
S1
HeNB
HeNB

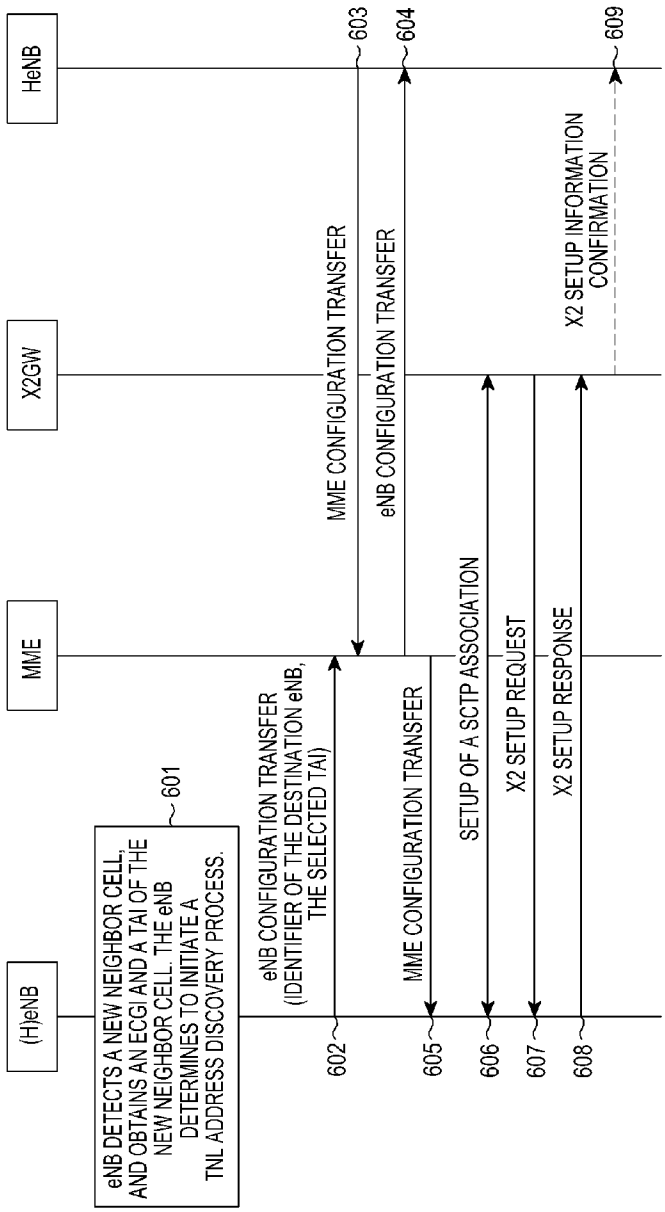
[Fig. 4]


401
HeNB DETECTS A NEW NEIGHBOR CELL, AND OBTAINS AN ECGI AND A TAI OF THE NEW NEIGHBOR CELL. THE HeNB DETERMINES TO INITIATE A TNL ADDRESS DISCOVERY PROCESS.
HeNB
X2GW
MME
(H)eNB
402
405
406
410
eNB CONFIGURATION TRANSFER
MME CONFIGURATION TRANSFER
X2 SETUP INFORMATION
X2 SETUP INFORMATION CONFIRMATION
MME CONFIGURATION TRANSFER
eNB CONFIGURATION TRANSFER
SETUP OF A SCTP ASSOCIATION
X2 SETUP REQUEST
X2 SETUP RESPONSE
403
404
407
408
409

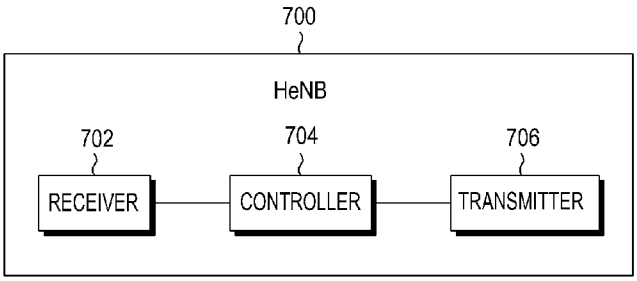
[Fig. 5]


HeNB
X2GW
MME
(H)eNB
501
HeNB DETECTS A NEW NEIGHBOR CELL, AND OBTAINS AN ECGI AND A TAI OF THE NEW NEIGHBOR CELL. THE HeNB DETERMINES TO INITIATE A TNL ADDRESS DISCOVERY PROCESS.
502
eNB CONFIGURATION TRANSFER (A TNL ADDRESS OF AN X2 GATEWAY)
505
MME CONFIGURATION TRANSFER
509
X2 SETUP INFORMATION CONFIRMATION
503
MME CONFIGURATION TRANSFER
504
eNB CONFIGURATION TRANSFER (IDENTIFIER OF THE DESTINATION eNB, THE SELECTED TAI)
506
SETUP OF A SCTP ASSOCIATION
507
X2 SETUP REQUEST
508
X2 SETUP RESPONSE

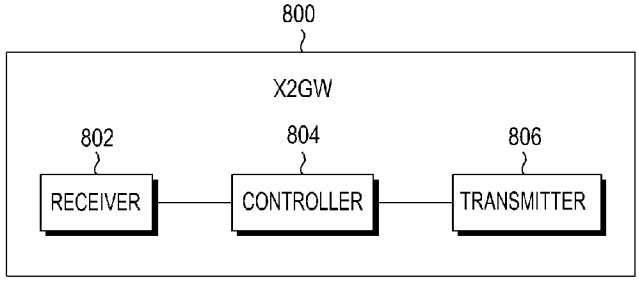
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/008731

A. CLASSIFICATION OF SUBJECT MATTER

H04W 48/16(2009.01)i, H04W 76/02(2009.01)i

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)
H04W 48/16; H04W 76/02; H04W 36/38; H04W 92/20; H04W 16/00; H04W 40/00; H04W 92/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: X2 interface, gateway, neighbor, HeNB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011-0310791 A1 (PRAKASH RAJAT et al.) 22 December 2011 See paragraphs [0175]-[0193]; figs 9, 10.	1-15
A	KR 10-2011-0123681 A (SAMSUNG ELECTRONICS CO., LTD.) 15 November 2011 See paragraphs [0061]-[0101]; claims 1-8 and figure 4.	1-15
A	KR 10-2011-0120225 A (SAMSUNG ELECTRONICS CO., LTD., et al.) 03 November 2011 See abstract.	1-15
PA	WO 2012-148217 A2 (LG ELECTRONICS INC. et al.) 01 November 2012 See figure 9.	1-15

☐ 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
30 December 2013 (30.12.2013)	**30 December 2013 (30.12.2013)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

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Telephone No. +82-42-481-5772

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/008731

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 13, 15
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2013/008731

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011-0310791 A1	22/12/2011	CN 102948195 A	27/02/2013
		EP 2586233 A2	01/05/2013
		JP 2013-533694A	22/08/2013
		KR 10-2013-0059383 A	05/06/2013
		KR 20130059383A	05/06/2013
		WO 2011-163403 A2	29/12/2011
		WO 2011-163403 A3	19/04/2012
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		WO 2011-139112 A3	19/04/2012
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		CN 102238669 A	09/11/2011
		EP 2564633 A2	06/03/2013
		JP 2013-526209A	20/06/2013
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		WO 2011-136534 A2	03/11/2011
		WO 2011-136534 A3	01/03/2012
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